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COVER FEATURE

Rail Rover

Making Do

Simple Wagons

Solenoid Engine

MODEL ENGINEER

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EDITORIAL
Editor: Martin R. Evans
Deputy editor: Diane Carney
Designer: Yvette Green
Club News: Geoff Theasby
Illustrator: Grahame Chambers
Retouching manager: Brian Vickers
Publisher: Steve O'Hara

CUSTOMER SERVICES
General Queries and Back Issues
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Archive enquiries: Jane Skayman
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ADVERTISING
Group advertising manager: Sue Keily
Advertising: Angela Price
aprice@mortons.co.uk Tel: 01507 529537
By post: Model Engineer advertising, Mortons Media Group, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR

PUBLISHING
Sales and distribution manager: Carl Smith
Marketing manager: Charlotte Park
Commercial director: Nigel Hole
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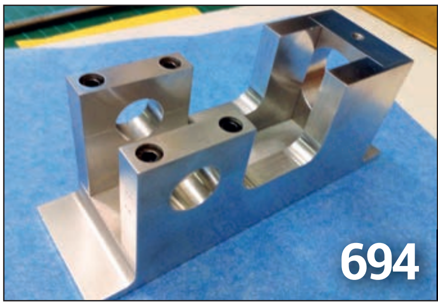


IN THIS ISSUE

Vol. 228 No. 4691 20 May - 2 June 2022

ON THE COVER...

Is this a 'Rail Rover'? Ken Toone tries out his converted Land Rover on the track (photo: Ken Toone).

This issue was published on May 20, 2022.
The next will be on sale on June 3, 2022.

SMOKE RINGS

MARTIN EVANS
Editor

DIANE CARNEY
Assistant Editor

YVETTE GREEN
Designer

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

New NW Wales Club

Regular readers may remember Nick Canfield's letter a few issues ago (Postbag, M.E.4681, 31st December 2021) in which he announced the formation of a new model engineering club in North West Wales. The club now has a name and is to be called 'Modelywr Gwynedd a Mon Modellers', covering all model engineering and technical interests in North West Wales, Gwynedd and Anglesey.

A founders' meeting held on 2nd April was attended by ten interested individuals. The new club has gone from zero to eleven members in three months and more members, whatever their interest or skill level, will get a warm, friendly welcome. If anyone would like to know more they could email churchview@onnentree.co.uk.

The wide-ranging interests of those present include boats, including radio control yachts and steam, launches, traction engines, stationary steam engines, boilers and of course railways, from 16mm narrow gauge through 2½, 3½, 5 and 7¼ inch gauge, and a Terrier tank engine currently under construction in 10¼ inch gauge. That, I imagine, would certainly be something to see. What is a thing of beauty in 5 inch gauge must be twice as lovely in 10¼ inch gauge!

Unique Nameplate?

Mike Joseph wonders whether the nameplate on his locomotive (**photo 1**) is unique in the model engineering world (**photo 2**). Is it the only Arabic nameplate in the UK? Transliterated, it is *Zahia*, Mike's partner's name.

Event Alert!

A couple of events are now approaching and I shall certainly be doing my best not to miss them.

The Melton Mowbray and District Model Engineering Society holds its annual Steam Weekend at the **Whissendine** sports ground on the 18th and 19th of June. The newly renovated track (7¼ and 5 inch gauge) will be open and refreshments will be available all day. The highlight of the day is the lunchtime run for road locomotives down to the village pub – not to be missed! More information is available at **mmdmes.wixsite.com/home** or contact **jacced@hotmail.co.uk**.

If small locomotives are your thing then this year's LittleLEC takes place at Reading Society of Model Engineer's track at Prospect Park, Reading. This also takes place on the weekend of the 18th and 19th of June. More information is available from **littlelec@gmes.org.uk**.

Also, on the same weekend, is the Welsh Rally at Cardiff Model Engineering Society's track at Heath Park, Cardiff. There are trains, trams and a hog roast on the Saturday evening, for which you will need to book in advance. For more information about how to get there see **www.cardiffmes.co.uk** and for more details on the event itself (and to reserve your hog) contact secretary@cardiffmes.co.uk.

If you are into 7¼ inch gauge railways then the Parklands Railway Week at **Hemsby** near Great Yarmouth must go into your diary. It takes place from the 31st of May until the 4th of June at the Parklands Holiday Centre. The *Café de Parklands* will be offering a full service and I can recommend both the bacon rolls and the lemon cake – I certainly intend to be there and sample them again. The railway, established forty years ago by the late Don Witheridge, extends for ⅝ mile and has a new semaphore signalling system. The railway week is always very well attended and plays host to a wide variety of 7¼ inch gauge locomotives as well as other steam machinery. You can find out more on the 7¼ Inch Gauge Society website (**www.sevenandaquarter.org/events**).

Eric Upchurch's Crewe Works shunter at Hemsby (photo: Brian Baker).

Simple 7¼ Inch Gauge Wagons

Kevin Baldwin reaches for his angle grinder and gets down to business.

The maxim 'keep things simple' is often worth listening to. When I decided to have a go at making a standard gauge four-wheel wagon in 7¼ inch gauge I felt it was important to keep construction simple in order to make the build easy and quick. The tools needed were a vice, a drill, a welder and a handful of angle grinders. Access to, and use of, a lathe and milling machine is helpful but not essential.

When I made my first wagons several years ago I made my own wheels from sawn blanks. The faces were machined in the chuck and the tread was carved with the wheel mounted on a mandrel. Wheel profiles are important; the angle on the tread, the profile of the flange and the root radius ensure that the wheels run well on the railhead. The 7¼ Inch Gauge Society have guidance on this subject on their website (**ref 1**). Subsequent wagons have used commercially available wheels and axles which are of excellent quality and also serve to simplify the building process even further. They are worth the money and save you the time and effort of machining your own wheels, and from filling your bin up with large quantities of swarf!

As I mentioned above, my wagons are simple. They are built to be used as driving and riding trucks but must also look attractive and be authentic representations of the full-size article. This latter is very important, as I'm sure we've all seen people spend many years, lots of money and many hours of effort making a beautiful locomotive, only to then build a basic, unpleasant 'chipboard box on wheels' from which to drive it. This is a great shame, as it doesn't take much effort to make a nice wagon, to be used as the driving truck, that actually complements the locomotive. Make your train set something to be proud of! Books and internet photos will yield more than enough information to allow you to make an authentic, attractive wagon.

The frame of the wagon uses 25mm box section and 40 x 10 x 310mm long for the buffer beams, although you could use any similar sections that are appropriate to the scale of your wagon (**photo 1**). Standard gauge in 7¼ inch gauge scales roughly to about 1½ inch to the foot, so bear this in mind when you make yours.

The buffer beams are worked on first. Buffer stocks are fabricated using squares of 40 x 3mm flat which are drilled in the centre to take the thick wall 25mm diameter tube stock body, and are drilled in each corner to take four ⅛ inch diameter snap head rivets. These holes are then countersunk on the back. The tube for the stock body is welded from the back, with the weld penetrating the weld prep countersink. The ⅛ inch rivets which are simply there to look pretty are cut to length, put through the holes in each corner and peined in. These welds and any protruding rivet peinings on the back are then ground flat with an angle grinder. The stocks are then welded to the buffer beams at the buffer centres of your choice. Again, the 7¼ Inch Gauge Society have information on their website regarding buffer centres and height from the railhead (ref 1). A 9mm hole drilled in the beams centrally to the stocks will allow the tails of the buffer shanks to poke though and have a retaining pin applied to keep the shanks in place. The shanks and heads use 19/20mm diameter steel bar with a thin 'penny washer' of about 40mm diameter welded on the end. Again, prep deeply for the weld as it allows you to grind the face of the head off and clean up with a bit of scotchbrite without fear of the head falling off. The other end of the shank has a short length of 8mm diameter steel welded on which pokes through the 9mm hole in the buffer beam. A small hole drilled in the tail allows a pin or piece of wire to be put through to retain the thing. A little coil spring inserted on assembly results in attractive, fully sprung buffers without lots of machining or large section materials. Cheap and quick! The centre of the buffer beams can be drilled for whatever coupling you wish to fit. I use couplings suitable for either three-link chains or solid bars and pins.

Next the 25mm box section can be cut to length. Unsurprisingly the length you cut the box section depends on the length of wagon you want to make. For a 'standard' four-wheel mineral wagon these rails are cut 610mm long or thereabouts. These are then welded to the buffer beams, taking care to just weld the top, inside and bottom of the rails and not to weld on the outside face. This keeps it neat and hides all the welds.

The springs, axleboxes and 'W' irons are all fake and are only there to make the thing look pretty, and we'll come to these later. The bearings that do take the weight of the wagon are ¾ inch pillow block bearings (**photo 2**). They are simple, robust and readily available. Turn your wheels and axles, or buy them; it's your choice. As I said, I buy mine as I'm inherently lazy! The bearings are slipped onto the axle and the wheels are applied after. The wheels can be pressed on, Loctited, or welded on. I like to either press the wheels on or weld them on. The thinking being, if (and I emphasise '*if*', as the bearings are good quality and can be strangers to failure) the bearings wear out, the wheels can be pressed off fairly easily (or bashed off with a beefy hammer!), or the welds can be ground off and the wheel removed that way. If Loctite is used it is likely that a large amount of heat will be required to shift the wheel, heat that is likely to be beyond the scope of most model engineers.

You now have your wheelsets and bearings ready for the bearing mounts.

The bearing mounts are four short lengths of 25/30 x 10mm steel cut to the length of the bearing foot. These are drilled 12.5mm diameter at the ends at the largest centres the slots in the bearings allow. With reference to the required buffer centre height from the railhead, a short length of 25mm box section about 27mm long is then welded centrally to each bearing mount. Please study the photographs carefully as they probably explain all this better than I can! The mounts are welded to 25mm stretchers that run transversely between the 25mm box section chassis rails. These stretchers are then welded to the chassis rails at whichever wheel centres your particular wagon requires. The wheel centres on the four-wheel mineral wagon are 380mm.

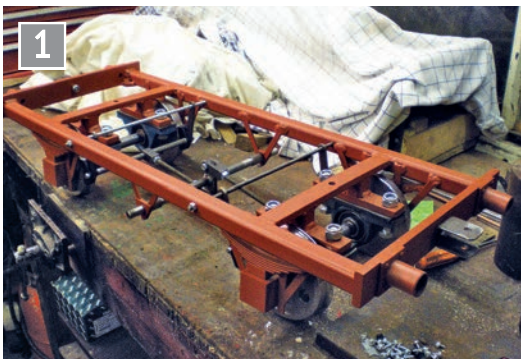
Next come the appliqué axlebox assemblies. These are there to look pretty and don't play a structural role on the wagon. I have made the 'W' irons from 10 x 3mm flat in the past, but I now use laser cut components to my own design to speed up construction. The axleboxes I make use 40mm box section cut 20mm thick with a plate welded in the end then ground flush and smooth. A small lump of 12mm square is then welded on the top from the back. The spring is made from 10 x 3mm flat, rolled to the required radius in long lengths and then cut to size and deburred. These are then gathered into their bundles ensuring the leaves are flat and even, then welded on the back to make one solid bunch of leaves. I then made a little jig to assemble all these components to make the whole axlebox assembly, but you can do it nearly as quickly one piece at a time. Make make sure the axlebox itself is in the right place so that its centre is in line with the centre of the axle.

You can now take these assemblies and weld them to the chassis to your corresponding wheel centres. Weld from the back to keep things tidy. Clean all the welds and spatter off and then paint it. When the paint has dried, take your wheelsets and fix on to the bearing mounts using M12 bolts and Nylocs, sandwiching a strip of thin, dense foam or rubber between the bearing and the mount. This allows for a little comfort and softens the *'donks'* of joints in the track.

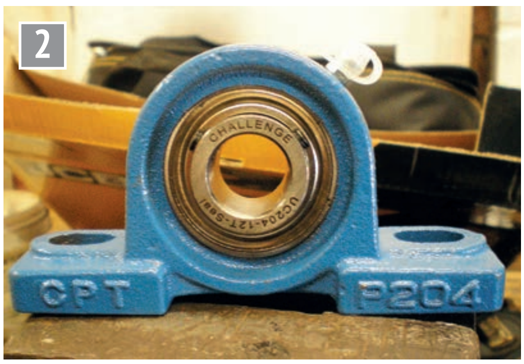
Regarding the M12 bolts and Nylocs, DO NOT DO THESE UP TIGHT! I know this may sound strange, but don't do it. The hole centres you drilled in the mounts will not allow the bearings to slide backwards, forwards or sideways, so don't worry about that. By not tightening the nuts up it allows the axle and wheel to fall into dips in the track and allows the whole wagon to ride cross levels. The Nylocs will not loosen themselves and fall of, and will stay where you put them. You only need about a 3mm gap between the nut and the bearing foot to allow enough movement. If you find it's not enough, then slacken the nuts. Conversely if it's too slack, then tighten them up a bit. It's a very tune-able design! I have used this method with all my wagons and they ride even the roughest of tracks with ease.

If you are planning to add brakes to your wagon you'll need to make a pair of 'Vee' hangers that are then welded centrally on the chassis rails. These take the brake shaft. I won't go into details here as the photos should give you the idea. My brake gear is a simplified version of the full size article and uses commercially available 'plastic' brake blocks. Feel free to use whatever gear you see fit. A removable brake handle fitted to the brake shaft completes the gear (**photo 3**).

Foot pegs are accommodated in a piece of 30 x 10mm flat that is bent down on the ends and drilled M12 to take the pegs (**photo 4**). The bar itself is bolted to two M10 nuts that are welded into the front



A simple welded chassis.



Use pillow blocks for bearings.

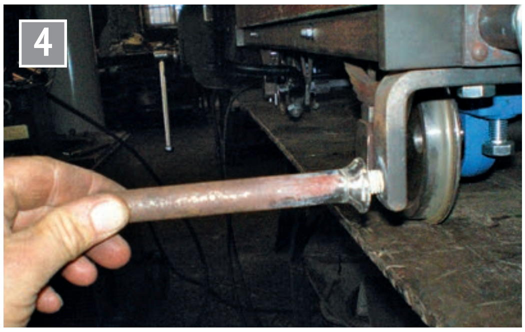
inside corner of the chassis flush with the underneath. Very simple and very low profile. For the obligatory 'scale' photograph these pegs are simply unscrewed from the bar. This feature also allows the wagon to be packed into the car or trailer without taking up too much room.

Apply the buffers with their springs and place the little pin or wire through on the back and you now have a painted, attractive, nicely detailed chassis that is ready for whatever body you choose to build for it.

A mineral or coal wagon body (**photo 5**) can be made from 12mm MDF and 25mm square timber. Cut your pieces of MDF to suit your chosen wagon, and if you've chosen a wagon that used planks in its construction, you can rout these in to simulate the planks. I use a centre drill in the mill and a 'fence' mounted on the table as a makeshift router, but you can use any method you see fit. Sand off any burrs and assemble. Give it a good coat of primer, and enough coats of paint to achieve a good seal and finish.

We are now at a stage when you can really go to town and do a bit of signwriting to personalise and enhance your wagon. I use a combination of painting the big letters on and using little white sticky letters for the more fiddly writing. First choose what you want to write on your wagon. It could be your name, or you may want to replicate the livery of a particular wagon that tickles your fancy. For the large letters I choose a font from those on offer on the computer, get the size sorted, then print each letter out. With the wagon body laid on its side or supported on the end of a plank clamped to the bench, these letters are cut out and arranged on the wagon side. A chinagraph or standard pencil run around the edge of these letters will give you a line to work to with your paint brush. Now for the steady bit! With your wagon body lying on its side on a low bench, find a suitable chair and sit on it.

You can add breaks if you like.



Adding footrests is very simple.

A coal wagon with convincing plank pattern.

Lettering and strapping add verisimilitude.

Most workshops I know have a chair in it, for those times when you want to scratch your head about a project in comfort! Now that you are sitting comfortably, take your brush and chosen colour of paint and start to fill in your letters. Keep a rag handy to adjust any mistakes, and relax into applying the finishing touches that will change your wagon from a simple functional vehicle into a work of art. Do both sides and allow to dry. Then apply the shading to the letters. For simplicity I use a black permanent marker for this job. With any luck you'll have complete success (**photo 6**), but if you're not happy with the results, rub it back a little with sandpaper, apply another topcoat, and have another go later. Nothing ventured, nothing gained! The little sticky letters and numbers are applied where necessary and shaded with the permanent marker.

Simple steel strapwork can also be made and applied. I use 10 x 3mm flat and, as a complete cheat, 25 x 1mm bent angle steel that is available from DIY stores. These items are cut to suit the wagon, with another handful of fake ⅛ inch rivets applied to most of the holes, with round head screws put through the remaining holes to fix it to the body.

A simple padded seat can be made that sits on top of the wagon body, so that with the foot pegs screwed in, the wagon can now carry a driver or lucky passenger (**photos 7** and **8**). You now have a functional, authentic and attractive wagon that is capable of carrying a person. I hope you agree that it is a quick and simple design and so much better than that 'chipboard box on wheels' we sometimes see. They are also fun to make; I'm at twenty-five wagons and counting! Get building!

ME

Padded seats add comfort.

We think they look the part!

Making Do!

Gordon Gurney undertakes an exercise in improvisation.

The Victorian skeleton clock to John Wilding's design.

Over the last 30 years or so I have made five clocks, two of which I still have. One of these, a Victorian Skeleton Clock to John Wilding's design completed in 1995 (**photo 1**), has never looked 'quite right'. After much rumination I concluded that what it lacked was a brass surround to the chapter ring to finish it off.

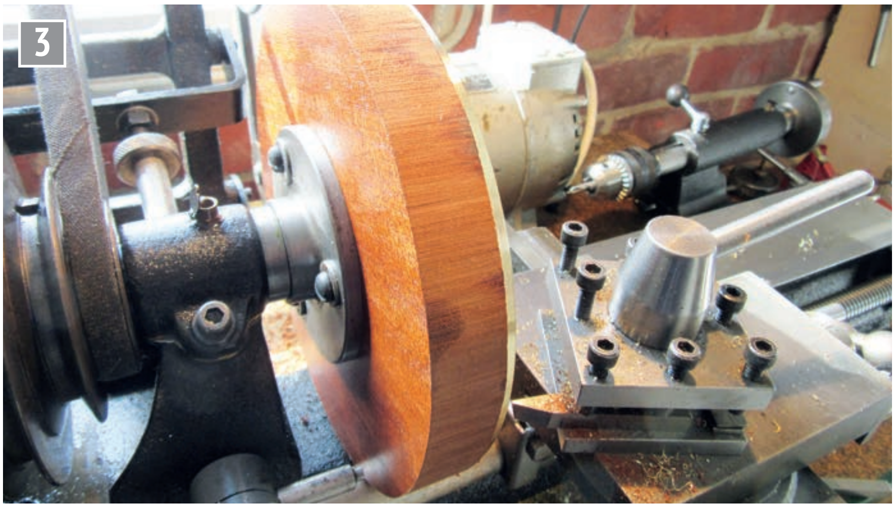
Not having a suitable piece of brass 'in stock' meant that the project remained at the 'wouldn't it be nice stage' but on a visit to Bath to see my daughter I remembered there used to be a material stockist in the city. Avery Knight & Bowlers were – and, as it turned out, still are – near the old S&D Green Park Station. (The station canopy was restored by Sainsburys when they built their supermarket.) It is 20 years since I moved from Bath to Norfolk but when I walked through A. K. & B.'s door it was as if it were yesterday, apart, that is, from the computer on the counter! Five minutes after walking through the door I left with a piece of 3mm brass, 6½ inches sqare. Now that's what I call good service.

Back home in Sheringham I began to have doubts about whether I would be able to complete the project. My workshop facilities are now very limited. Some five years ago, due to a radical change in personal circumstances, I decided to part with my Myford Speed 10 (owned for 32 years) and my Dore Westbury mill. It didn't take me long, however, to realise that being without a lathe of some sort was not an option but any replacement would need to be small and portable. I started looking at small Chinese lathes and although they seemed good value, I just couldn't bring myself to buy one having been used to Myford quality.

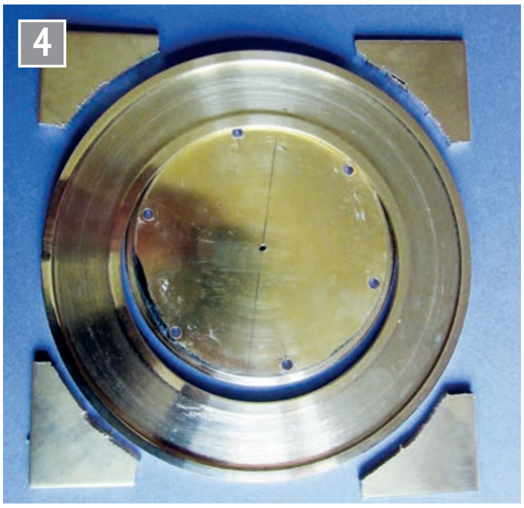
Sadly, at about this time, a friend and fellow member of the North Norfolk M.E.C. passed away and I was very fortunate to acquire his 2½ inch centre height lathe. Over the years I had visited Alan's workshop many times and always admired the little E.W. lathe sitting quietly in the corner, resplendent in its black crackle finish (**photo 2**). It is a lovely little tool and, like everything of Alan's, had been well cared for. The E.W. was first introduced in 1947 and during the fifties, when money was tight, could be purchased in very basic form and upgraded as funds became available. Mine is the 'posh' top of the range model priced at £18 and, fortunately, it was ordered with a gap bed (for an extra 7s 6d!). For further information on this, or any other lathe, it's worth looking at **www.lathes.co.uk**

The gap enabled me to swing - just - the 6w½ inches needed but I was unsure whether such a small machine would be capable of turning something in brass of that diameter. In Alan's workshop the E.W. was permanently mounted and driven by a very old and heavy quarter horse motor, almost bigger than the lathe! I wanted the lathe to be portable so that I could carry the whole thing on its base on my own. I had an unused 1/8 HP Parvalux

The E.W. lathe.



Makeshift faceplate.



A successful result.

motor on the shelf, acquired from a M.E. show for £12, and I decided to try it out as it is very light and compact. I was a bit doubtful that it would cope as a ¼ horsepower was recommended but the Parvalux has not so far been beaten!

My first problem was the lack of a faceplate. It would appear that a previous owner had modified the faceplate to use as a chuck backplate so I removed the chuck from its backplate and substituted it with a piece of ¾ inch hardwood, carefully cut to size on the bandsaw, and fixed with three 'fat' wood screws. That done, I took a skim across the face to make sure all was true. I pop marked the square brass sheet at its centre and scribed the inner and outer circles. I then carefully removed the surplus brass outside the outer circle by hand, to keep the swing required to a minimum. A fixed centre in the tailstock, located in the centre pop, held the brass in position while it was attached to the makeshift faceplate by woodscrews through predrilled holes (**photo 3**).

Now for the moment of truth, would my little lathe cope? Using the lowest speed and back gear engaged I was able to machine the recess to accommodate the chapter ring, leaving a decorative circle of brass inside and outside (**photo 4**). It was a slow process but all went well. I was pleasantly surprised that everything ran true and I was able to achieve a snug, sliding fit with the chapter ring in its recess. The chapter ring had to be removable should I need to resilver it at a future date and is 'nipped' in place with a 12BA countersunk screw.

Of course, it was helpful that the material being machined was relatively soft but it is an example of what can be achieved with limited resources using a bit of ingenuity and patience. It served to remind me of the model engineers of times past who made marvellous models on treadle lathes, replacing the sophisticated powered machinery of today with hand and eye skill and that all important word – patience.

The clock that I started 30 years ago is now finally finished, thanks to my little E.W. (**photo 5**)!

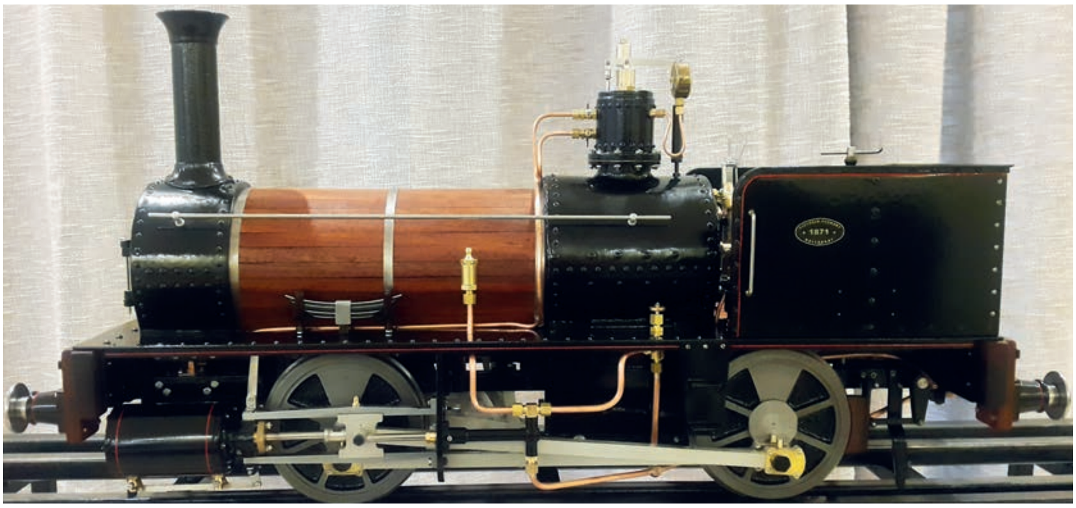
More on the E.W. lathe

The lathe was designed by a Mr. Stringer and a company was set up to manufacture it; J. F. Stringer & Co. Initially space was rented from an established engineering company based in the 'Express Works', Islington, London - hence the name! I believe it continued in production until the early 1960s surviving various reincarnations and difficulties along the way. My E.W. is remarkably complete and original but lacks its face plate, change wheels and vertical slide for milling operations. The makers did list a guard to cover the mandrel and belt but apparently no one has ever seen one! Can you imagine that in today's world of safety guards and isolating switches?

The present day's imported machine tools are made in their thousands, all, I suspect, from the same factory but with different paint jobs and names, each purporting to be better than the rest. In contrast, the E.W. was made by just a few skilled people on basic manual machinery and they obviously took pride in their work. When I use the E.W. I often think of the people who made it and hope that they are not sitting, heads in hands, groaning at my feeble efforts. ME

The clock with its new surround.

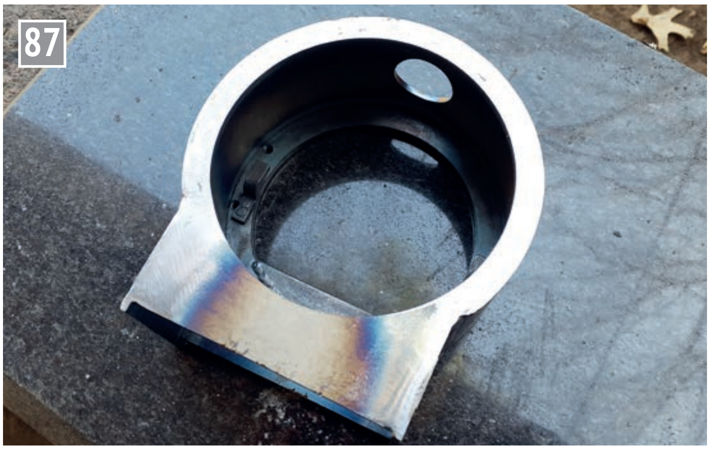
***Luker* describes a simple but authentic small locomotive.**



Continued from p.567
M.E. 4689, 22 April 2022

Ballaarat PART 12

A 5 Inch Gauge 0-4-0 Aussie Locomotive



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Smokebox fabrication.

The smokebox

The smokebox for this little locomotive is tight to say the least (**fig 23**). To help with assembly, especially with rather large fingers like mine, the snifting valve is fitted outside the smokebox and no superheaters are included. When testing my locomotive on our club track I couldn't get it to prime with the boiler water level within the sight glass range, so the lack of superheaters didn't adversely affect the steaming.

The smokebox for my little locomotive was a seam welded assembly (**photo 87**), but using a rivet construction or rounded screws will work just as well. All the platework was laser cut and rolled by my laser cutting suppliers, making construction a simple and quick fabrication.

The hand railing holes can be marked out from the top of the smoke box centreline with a little masking tape to get the correct position (**photo 88**). The dimensions given in the drawings are to suit this method.

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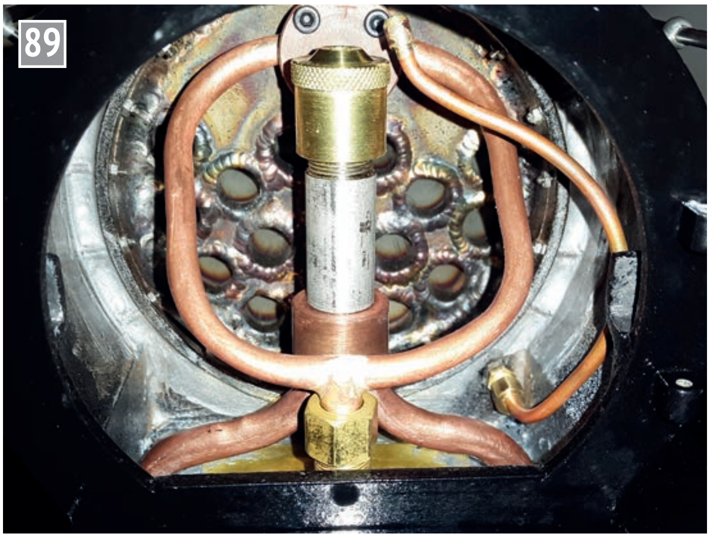
Marking out the handrailing holes.



89

Completed smokebox piping including blower.

Blower and coupling

The blower coupling position is to the bottom of the smokebox with the blower line following a similar routing to the prototype (**photo 89**). This position, and the final routing of the blower line inside the smokebox, leave enough space for the tubes to be swept without negotiation around small piping. The blower coupling will be soldered to the blower line but the coupling can be made in the meantime and temporarily fixed to the smokebox. The coupling is held in place, and

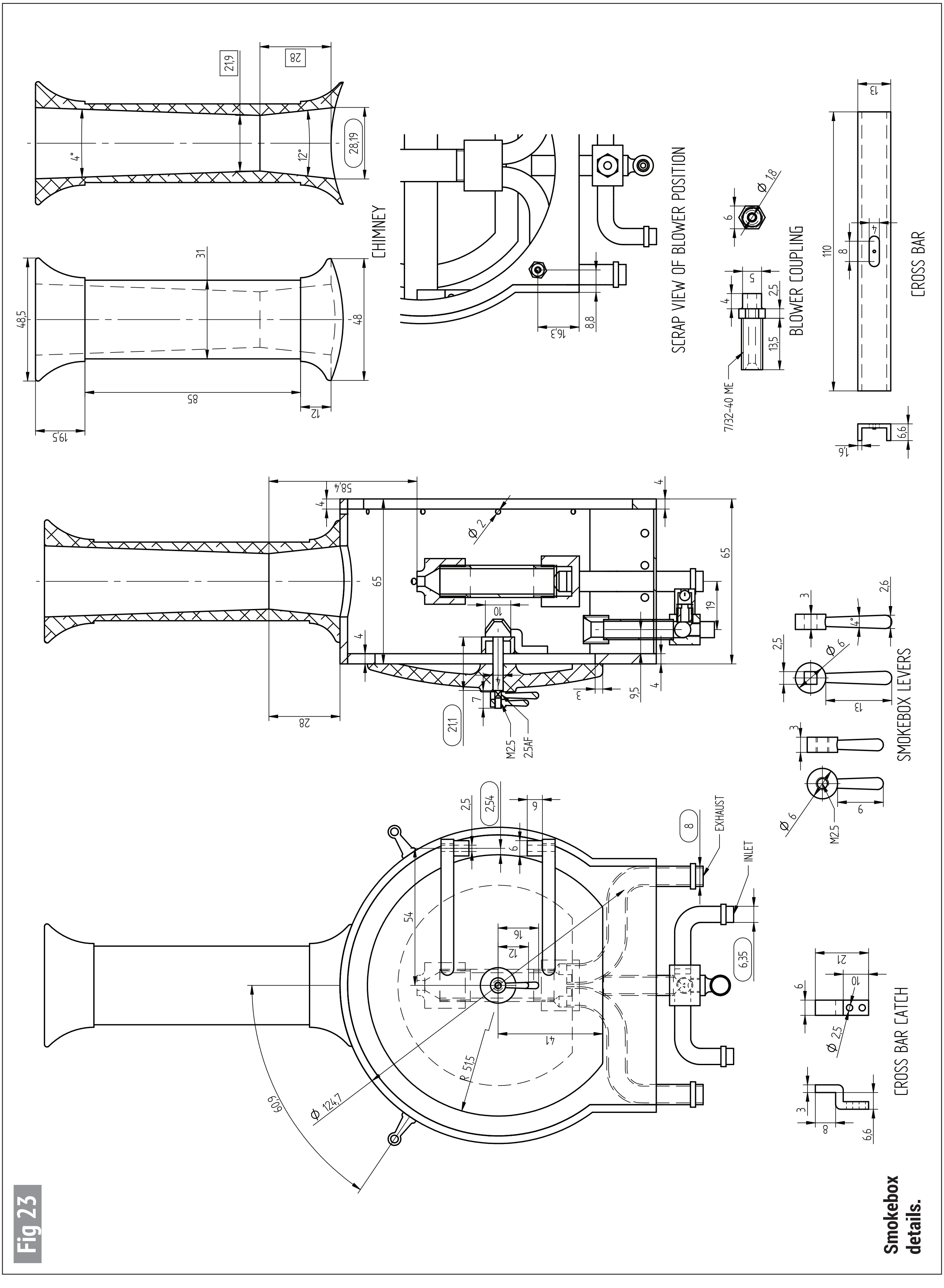


Fig 23

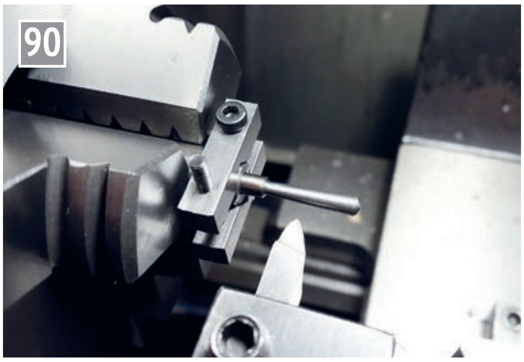
Smokebox details.

sealed, using a 7⁄32 inch nut with a standard coupling and line to the blower jet. The blower jet is a simple end piece soldered to a piece of ⅛ inch copper line with a 1mm hole. The hole size is for slightly poorer fuel and might need to be opened up slightly if the safety valves can't keep to design pressure plus 10%.

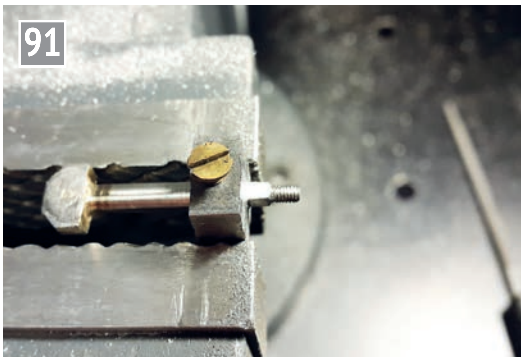
The smoke box door, dart and crossbar assembly

The smokebox door is one of the quickest components to machine. It was so quick I was done before I had a chance to take any pictures. That's one of the benefits of 3D printing the patterns to suit home workshop manufacturing. The bottom of the smoke box door is 'cut-off' which is very different to most of the doors I've seen. The sealing surface is simply skimmed in the lathe using the cast-on spigot for holding, and the hole drilled to full depth for the dart. The spigot is sawn off and the door reversed in the lathe to clean up the hacksaw marks. The hinges were part of the pattern and drilled out for the hinge bar. The hinge lugs are screwed to the smokebox from the inside using countersunk screws. The lugs are a drilling and filing operation with the only trick aligning the lot up for the door to swing open properly. But before that we need the cross bar to position the door.

The cross bar is made by cutting any 12mm square tube section open and clamping a piece of 5mm thick scrap plate to the inside and angle grinding the sides to the guide piece. The corners are then rounded and the edges cleaned with a file. The catches can be made by bending 3mm angles to shape in the vice and drilling the holes to drawing. The cross bar, door and catches are best fitted before the smokebox is welded closed. The cross bar is centred on the smokebox front plate and fixed in place with a bolt and a clamping plate on the other side. The catches can then be easily positioned and the holes drilled for riveting.



Machining tapered handles.



Making the square for the dart.

With the cross bar fitted the door can be aligned and the fixed hinges marked out and fitted to the front plate. I suggest screwing the fixed hinges from the inside of the smokebox but only screwing them home after painting the smokebox. The paint build-up on the front of the smokebox (and door) might cause problems for correct door sealing.

The smokebox levers can be left till last but sometimes it's nice to do something fiddly in-between the bigger jobs. I make my levers in two parts - the centre part which is drilled and tapped, or drilled and made square with a suitably sized drift (normally the back of a broken tap ground flat), and the handle part which is soldered to this centre. The handle looks much better with a slight taper and the end rounded with a forming tool or file on the lathe (**photo 90**).

The dart itself requires a little machining for the threaded end, and the dart side soldered to a piece of suitably sized stainless steel round bar. I generally check the length on the job with the door fitted to make sure any build tolerance is taken up on this component. The rest of the job is finished off by a little hand filing. I have a trusty square filing jig with a brass clamping screw that I use as a filing guide when making any squares at the end of shafts; works like a charm (**photo 91**).

The chimney

I've included some updates to my design methodology based on the flow dynamics through the grate, tubes and smokebox. On first steaming, the results were incredible with a very enjoyable first day of steaming. The fire was bright and lively but easy to manage by opening the door a little if the safety valve was about to blow off. This was all achieved by proportioning the various components properly; with the chimney internal draft angles, choke position and some of the areas optimised.

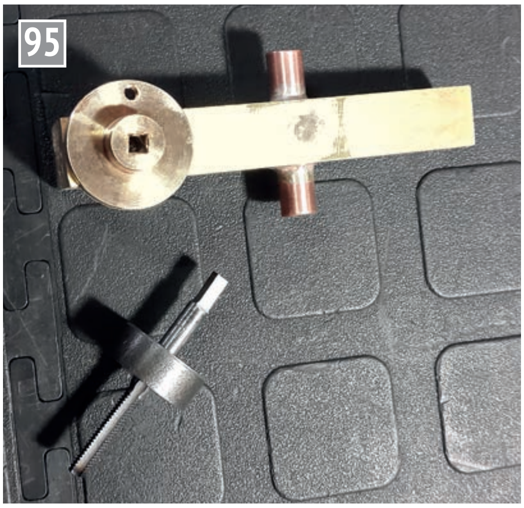
Machining the chimney.

I cast the chimney from aluminium to bring the centre of gravity between the wheels; it also machines a little easier (**photo 92**). The outside casting required a going over with some emery paper and the inner bore was machined with a stout boring bar. I generally braze a used carbide insert to the end of a bar and dress it with a green stone on the bench grinder; works like a charm and stays sharp for ages. The spigot used for holding the chimney in the lathe is best sawn off by hand, with the top of the chimney neatly machined with a left-hand tool by pushing it onto a tapered mandrel. When the machining forces are against the taper, as in this case, a draw bar and securing bolt should be used to keep the chimney on the mandrel.

A good seal is necessary between the chimney and smokebox to prevent air short-circuiting the firebox. A little mechanic's blue to show the high spots when fitted to the smokebox and a lot of patient filing will get the job done. When drilling the holes to mount the chimney make absolutely sure the chimney is straight; there is nothing worse

Aligning the chimney to the front buffer beam.

The completed front end of Ballaarat.



Bottom regulator and tooling.

Dimpling the pin of the regulator disk.

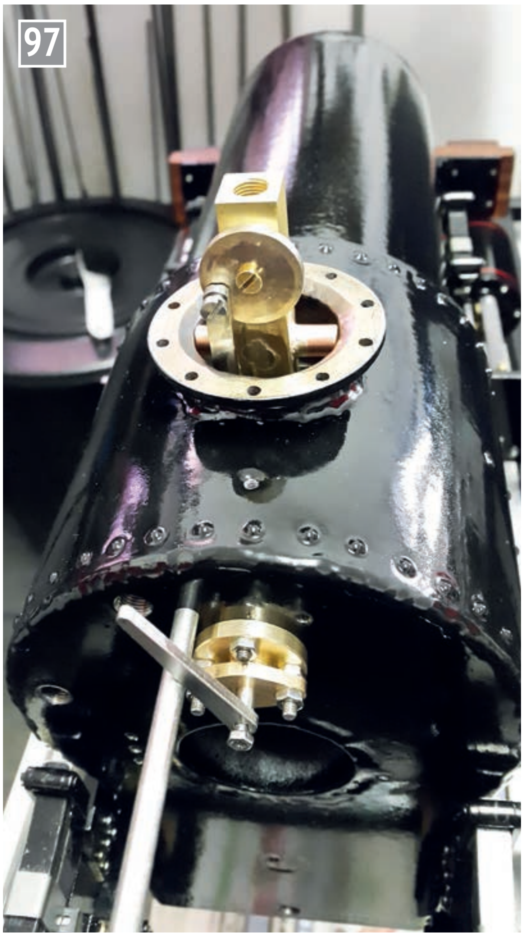
than a skew chimney (**photos 93** and **94**).

The main steam regulator

The steam regulator (**fig 24**) is the standard Stroudley disk type regulator. Provided there are no manufacturing burrs and the faces are properly lapped this valve seals very well under steam. The main body is a two-stage soldering operation. First, the lateral support needs to be soldered in place. A soldering filling hole midway will make sure there is full penetration of the solder. After cleaning, the through steam hole is drilled in the four-jaw chuck and the supports machined to size to fit neatly inside the boiler regulator flange. Finally, the bottom extension and pivot can be soldered. Apply the soldering flame selectively so that you don't undo the solder for the supports.

The square for the regulator spindle in the bottom disk is made using a simple drift made from a broken tap (**photo 95**). The disk needs to rotate freely on the bottom pivot, with no wobble or the top sealing disk will lift off the seat.

The lever to the top disk requires little description and to make life easier only one side is needed. This negates any filing to miss the top screw and bottom pivot point. The pins for the two disks can be screwed tight and the back end knocked with a punch. The pins are then backed off a little to get free movement of



Marking out the steam ports.

Packing the wet header gland with graphite packing.

the link. The tightening of the pin makes sure the pins don't bend when dimpling the back (**photo 96**).

All the other bits and pieces are simple turning operations, with the last hurdle the fitment of the regulator. The two steam holes will only be drilled right at the end to make sure the full open position lines up with the regulator lever position. For fitment, the regulator body and main steam pipe are installed from the respective positions meeting under the stiffening plate of the crown stay. The threads should engage easily. If they don't, do not force it; it is incredibly easy to strip 40TPI at this diameter. With the main steam line screwed in a couple of turns the handle spindle can be fed through the regulator bush and the whole lot tightened up.

The two steam holes can be marked on the assembly with the regulator lever in the full open position (**photo 97**). Finally, the assembly is stripped and the holes are drilled through the disk and body as an assembly. The disk and body are lapped using fine water paper (600 grit) on a flat surface. On my regulator I also chamfered the top pivot screw thread in the main body; »

this is the most likely failure point with an assembly burr lifting the disk off the seat causing leakage. If you shine a light from behind the joint you shouldn't see any light between the body and disk, then you should be okay for a good seal.

On final assembly the graphite yarn used for the piston rings is un-ravelled and packed in the recess of the boiler side of the wet header (**photo 98**). The graphite is compressed on assembly making a very durable, steam tight seal. When assembling the wet header bush high tensile cap screws are preferred over stainless to prevent cold welding. Even so, a little copper slip on the threads will do no harm.

I've left the description of the regulator spindle bush out because I decided to let the young lad have a bash and see how he goes. My one tip for the compression gland body is radius guides… (**photo 99**)

Simple radius guides for shaping the regulator gland flange.

Checking alignment of exhaust.

Fitting the boiler

The boiler for *Ballaarat* was pitched incredibly low in the frames. When I assembled my locomotive it looked like the boiler had fallen through the floorboards, but on running the locomotive on our track I realised that, with the boiler pitched so low, the locomotive was incredibly stable. There was no hunting typically associated with the 0-4-0 configuration, especially with the cylinders in front of the leading wheels.

The boiler and smokebox can be fitted as an assembly; this is how I did mine. With the boiler un-cladded, 12mm round bars were rested on the two stretchers at four points and the boiler and smokebox fitted to rest on these bars. The expansion angle on the boiler was marked and fitted, and the holes for the smokebox drilled. Finally, the smokebox was fixed to the boiler with a number of screws with the nuts on the inside of the smokebox. Rounding the screws to look like rivets adds a neat touch to the whole assembly.

Fitting the boiler cladding.

The smokebox needs to be properly sealed and I have found high temperature RTV silicone is the way to go. Just make sure any paraffin used for cleaning is kept out of the smokebox. Shoulders were welded to the front and back of the smokebox bottom as a rest for the thin sealing plates. The thin plate was silicone'd in place, and the areas around the steam pipes sealed with a bead of silicon.

With the blast nozzle removed, a 10mm rod slipped inside the exhaust tube makes a decent lever to carefully caress the exhaust to line up perfectly with the centre of the chimney (**photo100**). All of this is of course done after the cladding has been fitted and the locomotive has been painted.

Cladding the boiler

For the boiler cladding I cut strips of wood from an old teak rail sleeper using my trusty, cheap-Chinese-light-duty table saw. As much as I look after my lathe and milling machine I have no great love for woodworking so the tools work a little harder than they should, but I get the job done. I cut 4mm strips roughly 10mm wide and these were fitted between the smokebox and front lip of the boiler. The strips were held in place (just for assembly) with a little super glue and elastic bands (**photo 101**). The wood cladding is fixed using three thin bands with angles riveted to the ends. A little trick to making this look a little neater is to rivet an oversized angle. After drilling the clamping holes file the angle flush with the bands. A 6mm band looks the part with the angle on the boiler side of the band so that it reacts with the band when tightening and not on the rivets.

●To be continued.

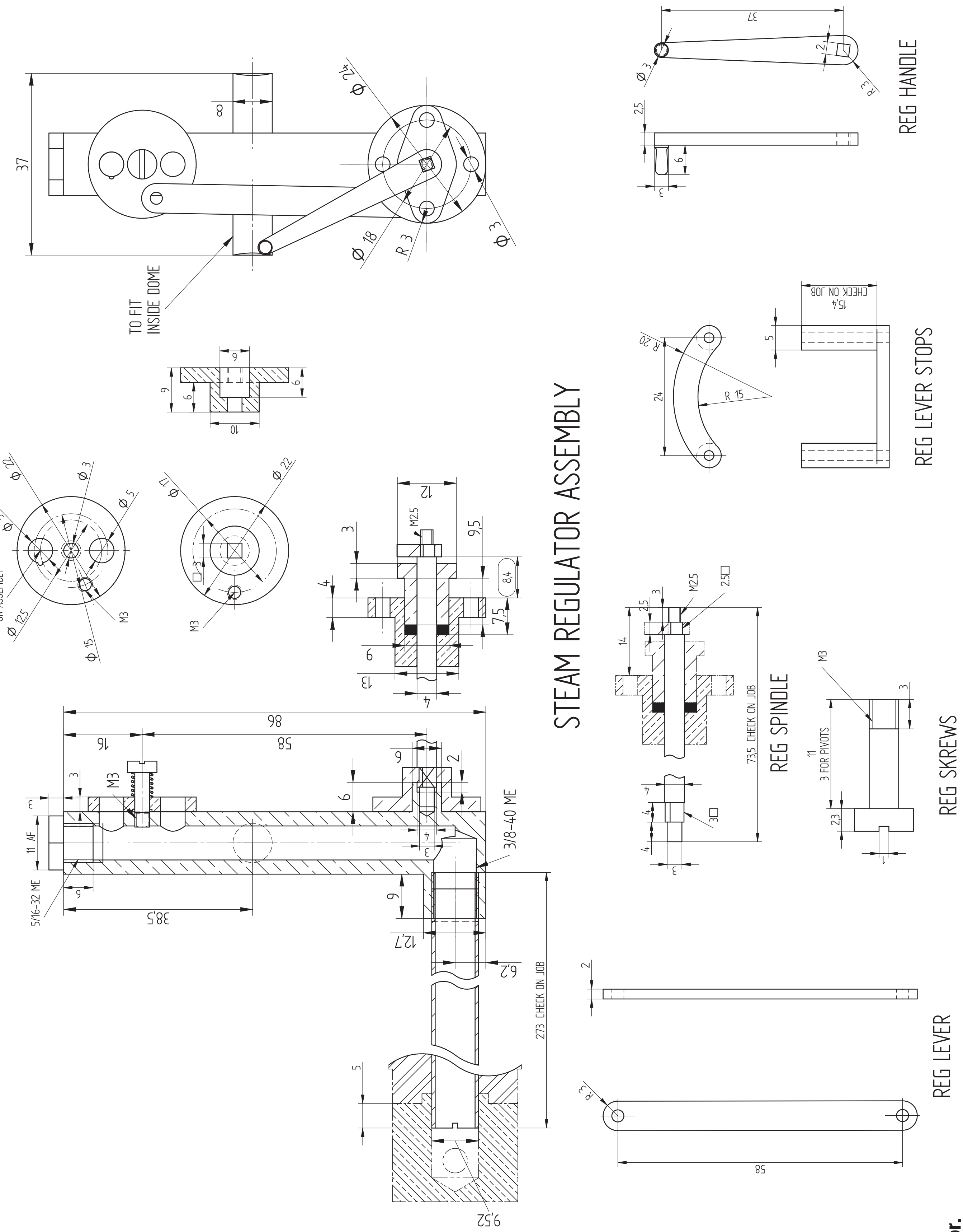


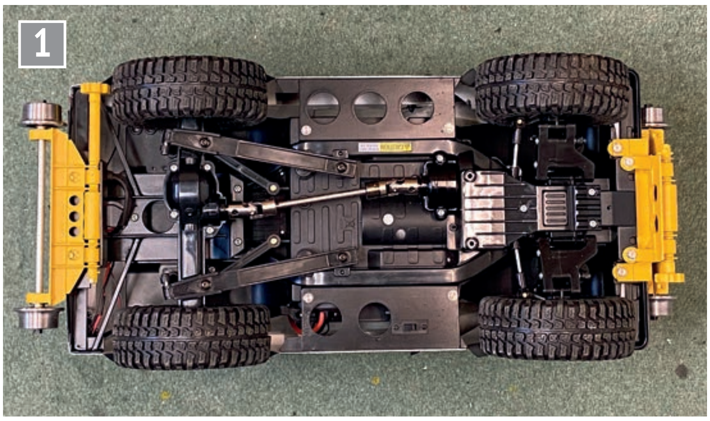
Fig 24

Main steam regulator.

Ken Toone extends the versatility of his Land Rover even further.

Conversion of a Tamiya 1/10 Scale Land Rover to Road/Rail Operation

Regular readers may recall that I tend to build models somewhat different from those normally seen on our miniature railways, e.g. Class 86 Electric, Class 323 EMU, Class 47 Diesel/Electric and of course the Cowans/Sheldon 75t Breakdown Crane. With the onset of Covid 19 and the need to lockdown I found myself looking around for something to do.



Underside showing the fabricated extensions.

Some months previously I had been very much taken, by a Radio Controlled Tamiya HGV that one of our members had built and thought that I would like to do something similar. On looking through the Tamiya catalogue it soon became obvious, with my JLR connections, the Land Rover 4 x 4 was the vehicle to go for.

This is a 1/10 scale replica of the Land Rover Defender 90 and comes with a precision moulded body, working four-wheel drive and differentials. Also included in the kit is a 540 drive motor and an electronic speed control. Additional parts required are paint, battery and radio control unit.

Construction of the basic kit was no problem but most of the plastic bearings supplied were replaced by ball races. It soon became obvious, however, that a number of small modifications were desirable to improve the vehicle overall.

The bodywork was only located on the chassis by four pegs with circlips and much relative movement was observed between the body and the chassis. This was improved by fabricating extensions to the chassis on the front and rear and also the sides to support the body (**photo 1**). The rear fabrication also allowed for a tow bar to fitted.

On test runs it seemed that the speed was far too fast for off-road use so the drive motor was changed to a slower running equivalent which has made control far more manageable. Additional circuits were provided to radio control the lighting and also ensure that the reversing light operates correctly.

Initially the vehicle was finished in Royal Mail colours, depicting the post delivery vehicle as used in the Scottish Highands. However, taking into account my railway interests, I subsequently purchased a second body kit which was finished in Network Rail colours (**photos 2, 3, 4** and **5**).

Now, it is known that Network Rail have a number of commercial vehicles, which they have converted, with the help of specific contract companies, to run on standard gauge railway track. This allows for men and materials to reach locations far from the nearest road.

Generally the conversion takes the form of additional fabrications front and rear, which support railway guide wheels, to keep the vehicle on the track, with the tyres providing the adhesion as normal.

It occurred to me, therefore, why not convert the model to road/rail operation, such that it would run on our Birmingham SME club's 5 inch gauge railway track? After checking the basic measurements and accounting for the fact that 5 inch gauge is near enough 1/12 scale, I discovered that the wheel track was somewhat wider than the railway track and the tyres only just contacted the rail.

It's surprising what you can find on eBay and I found a number of suppliers offering tyres of various sizes, which would still fit on the standard wheel rims supplied. The tyres selected were 100 x 38mm, some 6mm wider than the supplied tyre; they were also 10mm larger in diameter but still cleared the bodywork after adjustments to the suspension height. This change allowed the tyres to fully contact the rails.

The road/rail conversion assemblies are brass fabrications soft soldered together and bolted to the front and rear extension fabrications as previously described. They can be manually clamped in the up or down positions to enable running in both scenarios. The rail wheels are steel, mounted on ball bearings to ensure smooth running and are there simply to guide the vehicle on the track.

Prior to the lockdown I was able to test run the vehicle on our track but found that there was not enough load on the guide wheels and the vehicle would occasionally jump off the track. This was solved by adjustments to the suspension height to increase the load on the guide wheels and at the expense of some loss of adhesion.

Following completion of the model, I have now made up a light-weight four-wheel driving truck – well, more of skateboard really - just a sheet of plywood with four wheels attached, running on ball races for minimum friction. No springs, but with a piece of sorbo rubber added, for a modicum of comfort.

Recent running trials have shown that the change of motor was not a good choice, as it struggled to pull just me, so I have replaced the original 540 motor and can now confirm that it will, at least, pull me but it's most doubtful whether it will pull any passengers!

I have also just completed a section of ballasted track on which to display the vehicle in its railway format, in the hope that we may, one day, get back to a normal life and possibly see it at some future M.E. Exhibition, who knows …?

ME

Side view.

Right-hand view.

Left-hand view.

Rear view.

A Lockdown Project

John Arrowsmith discovers how one reader survived the dark days of covid lockdown.

This is a short article describing one man's solution to a very depressing series of events. The gentleman in question is a lifelong railway enthusiast with particular interest in the old GWR. He has written a number of books and completed lots of detailed research into different railway subjects. However, at the start of the Covid lockdown period he was also diagnosed with a terminal cancer but, undeterred, he decided that he needed a suitable project to give himself something to do. His solution was to turn the double garage of his house into a railway layout room to occupy his time building a Gauge 1 layout. This is the story of that endeavour.

He chose to design a simple end to end layout that would be fully scenic and convey the atmosphere of a small GWR country station with a connection to a main line. This sort of scenario enables a wide variety of locomotives to be seen on the layout without actually having to do any work. The imagination of the railway modeller knows no bounds when it comes to creating a certain image to match their thoughts.

The first problem was deciding the type of baseboard to use and the size of the layout. It is a strange thing to say but the pandemic and lockdown provided a novel solution to the railway base. With timber supplies being both difficult to get and quite expensive as a result of the lockdown, it was decided that the base structure would be

Excellent storage space provided by the kitchen units.

Roof detail on the station.

Rhywle Station building based on an original at Presteigne.

Fine detail on the goods shed.

The coal and coke merchant.

a series of matching kitchen units on which to fit the base board. This not only provided a set of bases of identical height but also a very useful selection of storage space underneath for all the material needed for the railway (**photo 1**). They were also cheaper than buying the equivalent timber.

The next job was to make the garage warm, comfortable and secure for the new railway and this was quite easily completed with help from his club friends. Having established the basic 'L' shaped layout, which was his wife's idea, and with all the supports in place, the base was fitted quite easily and proprietary track laying began. In between all this basic work he used his Welsh heritage to come up with a name for the layout which is shown on the front when the main garage door is opened - Rhywle Am Rhywbeth-yn-Mynd, which roughly translated stands for Rhywle for Somewhere. I think at this point I should say that the buildings and structures on the layout have all been meticulously hand built. The station is an exact model of the now demolished structure at Presteigne on the Herefordshire/Powys border. The builder had previously accurately measured and photographed the structure before demolition and this fine model is the result (**photos 2** and **3**). The goods shed (**photo 4**) is also a fully detailed model from the original at Risca in South Wales. All the other buildings are scratch built and are built to suit the available space (**photo 5**).

Locomotives and rolling stock are typical of a small GWR branch line with panniers and 0-4-2 tank engines handling the traffic (**photos 6** and **7**). All the locomotives are battery powered and are controlled via radio control. Occasional special excursion trains visit and this gives scope for a larger locomotive to be seen on the railway from time to time. Not surprisingly, with the full-size name and number plate adorning the

1447 has been busy judging by the ash on the engine.

1420 and auto coach waiting to depart.

>>

18+

WHAT IS AVAXHOME?

The excursion locomotive waiting in the loading bay.

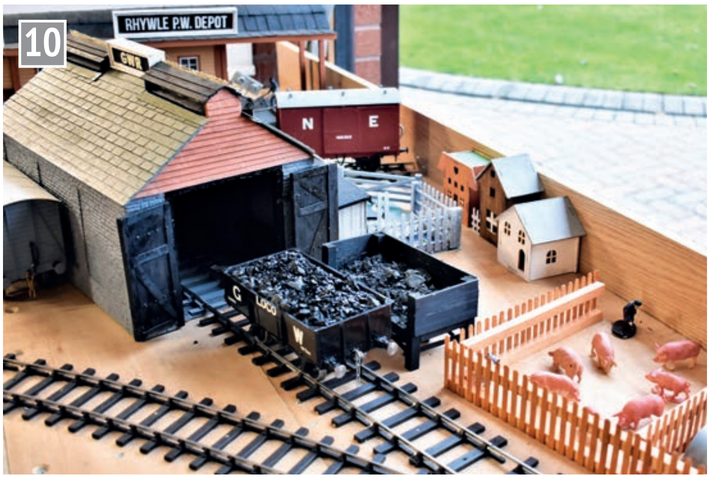
garage walls, the visiting engine just had to be 5967 *Bickmarsh Hall* which had brought in an excursion train and was being serviced on the loading bay (**photo 8**).

The buildings show a wide variety of designs and construction but each has been carefully positioned on the layout to create the right sort of atmosphere. The PW depot is a typical GWR structure as is the main water tank and small engine shed (**photos 9** and **10**). The signal box is another unusual structure located opposite the main platform (**photo 11**). There must be some interesting characters in the locality judging by the coal merchant - Ivor Waylight, seems an appropriate name for this type of delivery work. All that fencing has taken hours of patience and close work (**photo 12**). I hope the photographs convey the detail of the layout which has been very well made and finished - just the ballast is needed now to give it the right feel.

This little project has helped the builder to cope with his illness and the boredom of the pandemic whilst creating a very nice fictional GWR railway scene which has provided hours of pleasurable work.

ME

An impressive water tank.



Plenty of coal at the engine shed.

The signal box and main platform.

Fencing around the cattle pens.

Richard Gibbon restores a pannier's 'get up and go'.

Speedy arrives in the workshop.

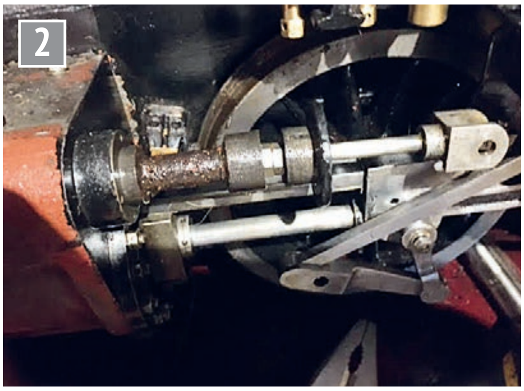
Recovering LBSC's *Speedy's* Performance Through Overhaul of the Piston Valve Assembly

For some time throughout the Covid epidemic I had been aware through conversations with York Society of Model Engineers Member Charlie Bauckham and his dad Phil that there was a developing problem with their LBSC designed *Speedy* which is one of the ubiquitous 5 inch gauge locomotive designs by Curly Lawrence from the 1970s that were serialised in *Model Engineer*. As a young man interested in model engineering I was aware of at the time of the serialisation in the journal. The locomotive is based on the GWR 1500 outside cylindered pannier tank engines and was heavily criticised at the time of publication for having badly proportioned outside Walschaerts motion driving the basic piston valves. None of that stopped Charlie's locomotive performing spectacularly on our track before lockdown but performance dropped off in the last year.

None of my fourteen locomotives has been equipped with piston valves but when we concluded together that the piston valves were passing steam and needed overhaul I decided that I could probably carry this out in my workshop and make and fit new piston valves, which was beyond the skills of the owner.

Speedy's cylinder blocks are cast iron and the piston valve bore is nominally 5⁄8 inch diameter but, unlike many piston valve model designs, this assembly is very unsophisticated and there are not even oil grooves on the piston valve bobbins.

Charlie had attempted himself to do what he could to get the locomotive up to scratch but clearly what was needed was a more radical approach. A rebore of the piston valve bores and remanufacture of the piston valve bobbins in cast iron was, as I saw it, the only option and I offered to carry out the work on the locomotive for Charlie even though this meant stopping work on my present Corpet Louvet model locomotive project.



Withdrawing the old piston valve.

The old piston valve.

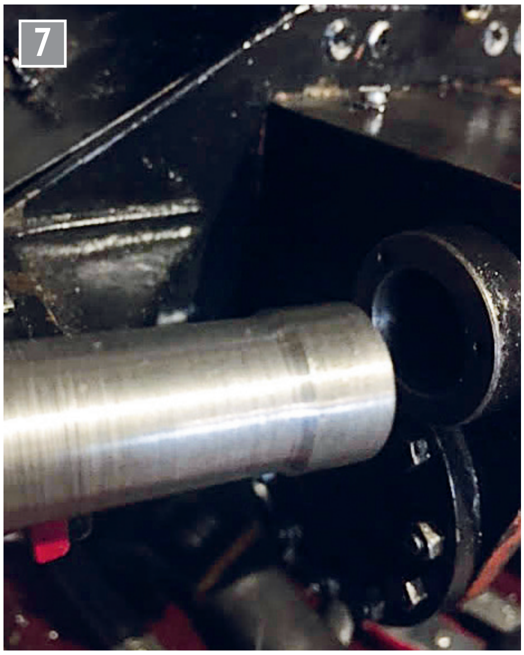
The locomotive arrived in my workshop (**photo 1**) and I had already purchased a brand new expanding ⅝ inch nominal diameter adjustable reamer. I started by stripping out the piston valves (**photos 2**, **3** and **4**), carefully observing where the valve was slack in the bore and that there was definite play in the centre section.

I attempted to use the reamer (**photo 5**) under slow speed power from a pistol drill to clean up the blackened bore but it was far from ideal and the reamer kept locking and jamming. Had it been a spiral reamer (no such thing adjustable!) I'm sure it would have done a lot better. So, I then changed tack and made a lap out of 15mm copper central heating pipe with the end slit across the diameter with a hacksaw ready to accept a short length of medium grade emery cloth. I tried that under slow speed power (**photo 6**). That was a much better proposition and after changing the emery cloth about twelve times I soon had a shiny clean bore and I checked with a mild steel plug gauge how parallel the bore was (**photos 7** and **8**). I had managed to remove about 0.003" from the bore.

The old piston valve bore.

Using the expanding reamer.

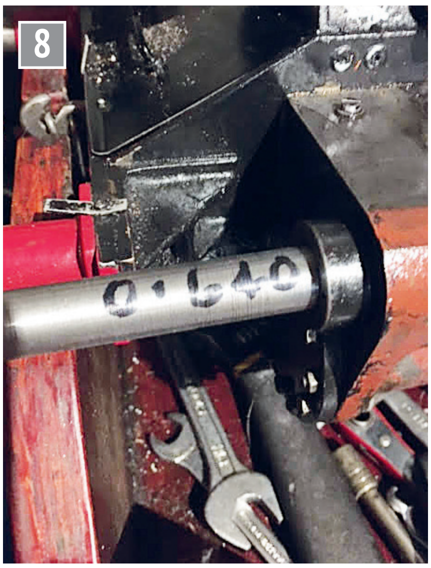
Using the copper and emery lap.



A measuring plug to size the bore.

I had some cast iron bar in stock and turned up a new bobbin to exactly the same proportions as the old valve bobbin but 0.003" larger and polished it until it was a nice sliding fit (**photo 9**). I cleaned the bores of debris and reassembled the piston valve first side and hoped that everything would be okay!

It was at this point as I started to set up to do the second side that I had a memory flashback and I remembered that there was a model engineering writer called Don Young in the 1970s who ran his own series of model engineering magazines called *Locomotives large and Small* - I was a great admirer of his work .



Sizing the bore.

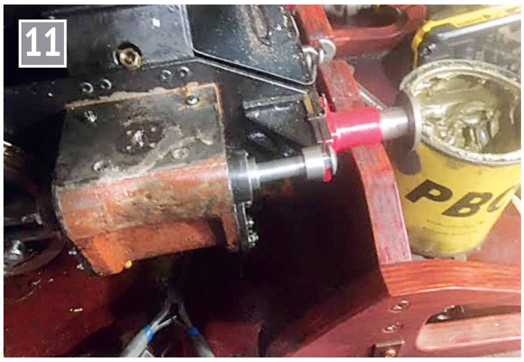
Old and new piston valves and sizing tool.

Don advocated a novel technique for bedding in newly made piston valves. He suggested making the new piston valve size and size with the bore and then by liberally coating the valve and the bore with Rocol Anti-Scuffing paste and, using 6mm steel screwed rod and nuts, forcibly dragging the valve through the newly prepared bore many, many times back and forth until it was a perfect lapped fit and could be pushed with your finger pressure (**photos 10** and **11**)! I remember thinking at the time it was a brilliant idea but, unfortunately, I had forgotten about it in the meantime! That is one of the advantages and disadvantages of being very old! You have experienced a lot but cannot remember it when you should!

So, sadly, one side of Charlie's locomotive has had this monkey gland treatment and the other side hasn't... and I watched with great interest what happened when it was steamed (**photo 12**)! I am pleased to report that the owner was delighted with the much improved performance!

ME

The burnished outer face of the pulled through piston valve.



Trying the new piston valve in the bore.

Speedy *back on the track.*

POSTBAG

Lubrication

Dear Martin,
Here is a bit more information on the topic of optical alignment mentioned in Rhys Owen's article in ME4689 (22nd April).

I mentioned this system briefly in ME 4677 (5th November 2021) in relation to machining Bulleid Pacific hornguides to achieve the best possible alignment of cylinders and axles. The subject is covered in great detail in a paper presented to the Institution of Locomotive Engineers by Mr K.J. Cook in September 1955. This can be viewed online courtesy of the Kent and East Sussex Railway web site by searching for 'The Steam Locomotive: A Machine of Precision'. This explains in detail how the system was used generally and specifically at Swindon. A lot of work was carried out on 34105 *Swanage* at the Ropley workshops on the Mid Hants Railway to produce all the necessary jigs and fixtures for mounting the telescopes, mirrors and prisms. The result was very accurate alignment of all three-cylinder bores with the hornguides and axles. If it ever runs again it should be one of the most precisely overhauled locomotives in preservation but unfortunately there are currently no plans to complete it. Swindon used to boast that engines overhauled by other British railways works were little better than worn engines going in to Swindon works!

Another paper worth reading that can also be found on the internet is 'Recent Developments in Cylinder Lubrication', presented to the GWR Swindon Engineering Society by Mr W.H. Pearce in October 1931. The chairman of the meeting was a certain Mr William Stanier. There was discussion on these pages some months ago regarding definitions of displacement and hydrostatic lubricators. Page 10 of the paper goes into the shortcomings of the simple hydrostatic lubricator such as we would use on a model. The 4 or 5 foot head of the condenser coil above the lubricator is mentioned, contributing less than half of one pound per square inch to the boiler pressure of possibly 180 pounds (about average for 1931). It goes on to say that if the oil feed rate is set for low boiler pressures then more oil will be delivered at high pressures and less at very low pressures, which is what I have said in the past. As Mr Stanier did not disagree with this statement, I feel he probably agreed! This was clearly unsatisfactory and the paper goes on to detail various devices that had to be used to ensure a consistent supply of lubrication. These would have required maintenance in service so this added cost and complication and encouraged the trend to positive displacement mechanical lubrication for cylinders and valves which became the BR standard later on. I am happy to call my non-mechanical lubricators with floor level condensers 'displacement' rather than 'hydrostatic' in future, I don't think the absent 0.03 of a psi (in 3½ inch gauge) will worry them.

Best regards, Nick Feast (Southampton)

3D CAD

Dear Martin,
At the time of writing this - at the end of March 2022 – ME No. 4684 (11th February) had just arrived in the mailbox. On skimming through I noticed in Postbag the letter from John Hannum from the US suggesting an article/articles on 3D CAD.

I'm not sure what John wants to achieve by such an article as there is a plethora of 3D programs available, each with its own idiosyncrasies and with a cost range of thousands to purchase either outright, or a licence and/or a subscription to annually renew, to the free ones found on the internet.

I've been using AutoCAD since the mid 1980's and Autodesk Inventor for the last 10 years professionally. One would expect with that sort of experience that I could be classed as an expert - far from it. I only use a small amount of the potential of both programs to achieve the results I want. I'm definitely not the one to write such an article, as I just don't know enough about it.

For instance, when AutoCAD first came out, one drew in what was called 'Model Space' on the screen. It was/is easy to use in navigating around the drawing in the application of detail such as sections and dimensioning, it was basically an electronic version of drawing on the board. Later versions came with a production increase in the form of - I believe at the time they called - 'Paper Space' (now it's called 'Layout'). I found this cumbersome, couldn't really get to grips with it, so stayed with the original 'Model Space', which I still use to this day. Some users like 'Paper Space' as that was what they were trained to use - I on the other hand cut my teeth on 'Model Space' and found it hard to change.

3D renderings of an item in a magazine looks fine and impressive. In *Model Engineer* there is an increasing use of such renderings appearing with articles. At least – usually – one 3D view will reveal more detail than at least two to three views of a 2D drawing. With an article on 3D renderings, what would be the ultimate aim for such an article? Would it be for the 'artwork' just to be looked at like a piece of… art? Or would the aim be to produce 2D drawings, or for 3D machining and printing?

Two of the major programs I'm aware of – Autodesk Inventor and SolidWorks – are both able to produce 2D drawings straight from the 3D model – well, within reason. You still have to decide when in the 2D mode which views you wish to show - any sections and enlarged detail. This 2D drawing still needs you to do the editing such as the application of centrelines, the dimensions required and where to place them and any

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Martin R. Evans, The Editor, Model Engineer, Mortons Media Group Ltd, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR
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Responses to published letters are forwarded as appropriate.

notes. The computer or the programs are not that smart, yet! Don't forget, at the 3D stage, rubbish in and you get rubbish out in your 2D drawing. One plus - if a change is made on the model the 2D drawing is automatically updated. This includes any dimensions etc.

AutoCAD can produce 3D renderings. This not easy to do, especially if not experienced in using AutoCAD. I once had to produce a 3D drawing of a large compaction roller (my first foray into 3D) for a finite element analysis (FEA). For this project, I was just drawing in 2D and the consultant wanted it in 3D (I didn't have Inventor then). It was cheaper to have me do the 3D than the consultant. It was an exercise I would not want to repeat with 3D in AutoCAD.

I found – like 'Paper Space' - the 2D drawing component in Inventor slow, cumbersome and frustrating and inflexible to my way of working, especially when wanting to produce drawings strictly to the code. However, for CAD dinosaurs like me, Inventor has the ability to save an Inventor drawing as an AutoCAD .dwg drawing and away I go, in my favourite 'Model Space'. I still go to the Inventor 2D drawing format, place the views, sections and any enlarge detail that I require, go to Save As and save as an AutoCAD .dwg drawing. I then load this saved drawing into AutoCAD to do all the editing such as centrelines, dimensions etc, insert the title block – which I've had for years with various attributes attached - and fill out the title block attributes - job done. I've produced hundreds of drawings this away and in my working life my production rate would be up there, if not better, than other operators who don't go through the rigmarole I go through.

Inventor 2D drawings are not readable by AutoCAD (I don't know about SolidWorks) – unless as I've outlined above - and this is another problem with portability of files of 3D or 2D. Inventor will not save down to a previous version – so that a lower version can read a higher version - but a higher version will read a lower version. AutoCAD on the other hand can save to a lower version, I have set my 2021 version of AutoCAD to automatically save drawings to AutoCAD version 2010.

Therefore, there is a problem with, say Inventor 3D models transferring to other users with the Inventor format. A work around for this is to save the Inventor file in some other format such as IGES, SAT etc. This is quite often done by manufacturers of equipment such as rolling element bearings, transmission reducers and other items. For instance, you can go to a bearing manufacturer and download the bearing you require as, say, a SAT file and load it into your 3D model. Not many model engineers will have access to Inventor or SolidWorks or be able to afford them but will rely on other products - that don't cost an arm and two legs - such as the free ones found on the internet.

Again, similar questions arise. Can one produce 2D drawings and what is the file format? And what about file portability?

One may ask why is he harping on about this? As sophistication has over the years crept into model engineering – just look at the increase of milling machines into the workshop of model engineers over the years, it's now basically a given – so the lending/swapping of electronic 3D and 2D drawing files between model engineers needs to be considered, especially when some form of 3D machining or printing is involved. An instance may be that someone has produced a 3D model of locomotive cylinders or wheels and, someone else wishes to use the same 3D models for their locomotive. Having access to this information saves time etc. Why reinvent the wheel when someone else has already done so?

Someone may extol the virtues of some free 3D modelling program and think it's the best thing since sliced bread and then someone else will think that same program is as useless as a two-bob watch! If 3D printing or even 3D machining is the requirement, how many of these free programmes are able to produce the required file format for either of these?

Any article, I feel, should look at all these factors – 2D drawings, 3D formats for 3D printing and machining and file portability. Such an article may eliminate a lot of the freebies and arrive at a list of either outright purchase or licence to use (you don't get to own) programs that may be beyond some model engineers.

The Autodesk programs (AutoCAD, Inventor) and SolidWorks are not for model engineers due to cost and sophistication. There is a Lite version of Inventor but you can only produce individual parts. You cannot assemble these parts into an assembly (general arrangement), so I believe it is of not much use. My level of Inventor will do not only parts and assemblies, but a range of other sophisticated tasks but not FEA. That version of the Inventor licence is several thousands more.

It may be a tall order to find some expert that is on top of all of this but in our readership you just never know and by the time the editor gets this missive from me he may already have something in the pipeline.

Regards, Tony Reeve (Tasmania)

Insurance

Dear Martin,

Brandon & District Society of Model Engineers have just renewed their Public Liability Insurance. Walker Midgley our agent has sent us no fewer than 117 pages of written do's and don'ts – 'We will pay this, we will NOT pay that'.

One set of papers, of 51 pages, includes a paragraph on page 12 on personal injury when on club business (for instance, being assaulted while banking the club's 'takings') which says 'This extension only applies to a person between the ages of 16 and 70 years at the start of the period of Insurance and to physical injury events occurring within the territorial limits'. It continues for the rest of the page.

I have spoken to Walker Midgley and was told there could be 'NO CHANGE'.

In our club B&DSME our top three officers are all very much over 70 years old, in fact six of the eight committee members are all over 70 years. Why can there not be a change because I think that in every model engineering club the treasurer may will be over 70 years old.

I think this means that they will pay for the loss of the money resulting from a robbery, but NOT for the injury that was inflicted on the person the money was stolen from.

I would imagine that 90% of model engineering clubs have officers over 70 years old and would ask ME clubs, 'WHAT DO YOU THINK ABOUT THIS?' and see if we could get it changed.

Regards, Dave Moore, Chairman

Jodrell Bank

Dear Martin,

I'm afraid Doug Hewson's comment about the rollers in the telescope bogies may not be correct. They are certainly ex-BR wheels but not from BR Standard tenders which were all in service when the telescope was erected. I think you will find they are ex GWR 'Castle' class bogie wheels with inside bearings. I recall seeing a photograph taken at the time and which I think was published in *Model Engineer* but I cannot trace my copy.

Best wishes, Mike Johns (Taunton)

Book Review

Mustang in My Workshop

David Glen

A second major publication from David Glen, this is a remarkable book, complementing, as it does, his 2015 title *Spitfire In My Workshop*.

Since its unveiling in 2014, tens of thousands of visitors to the Royal Air Force Museum at Cosford in the West Midlands have marvelled at David Glen's magnificent 1:5 scale P-51D Mustang. Set off to perfection in its giant purpose-built display case, the model bears its builder's own heartfelt dedication *'to all US aircrew who gave their lives in support of their British and European allies through the course of two world wars'*.

Divided into thirteen chapters, the text of this recently released book initially covers David's research, planning and preparation - the key, he says, to a successful model. Subsequent chapters focus on, in turn (and to mention only a few): the wooden fuselage core; several more sub-assemblies in wood; metallic structure, cockpit and instrumentation detail; wheels and their operation; fuselage construction (with those now famous offset litho printing plates!), rivet making and fitting and compound curves in abundance; fabrics and tapes; landing gear; paint and polish and a fair analysis of the trials and tribulations (and some heart-ache!) of achieving his goals. This list is very far from exhaustive but I hope it serves to show that David keeps nothing from the reader. His genuine hope that any model maker who ever attempts anything - or who hopes to - will take away masses of tips and tricks and a huge amount of inspiration from this book resonates loud and clear. He selflessly aims to empower us all.

The book is lavishly illustrated with 600 colour photographs of exceptional quality. It is a veritable tome, containing 288 large-format pages (325 x 254mm) case-bound and weighs 2.3kg. It is a 'must-read' for beginners as well as seasoned modellers and everyone with an interest in the legendary 'Cadillac of the Sky'.

David Glen has balanced a career in publishing and journalism with a passion for aircraft and all things aeronautical. In his spare time, he indulged his fascination for aviation as a volunteer restorer of veteran warbirds, as a private pilot and, above all, as a model maker. Following his retirement in 2010, David now devotes his time to building exhibition quality model aircraft and to his writing, which includes numerous articles for the modelling press. He lives with his wife Eva in the tiny South Cambridgeshire village of Whaddon.

Diane Carney

This book is ONLY available to buy at www.warbirdsinmyworkshop.net
Retail price: £54.99. (Signed For courier delivery is £4.95 within the UK but it is available for worldwide delivery via tracked package.)
Publishers: Brown & Brown - www.brownandbrown.co.uk

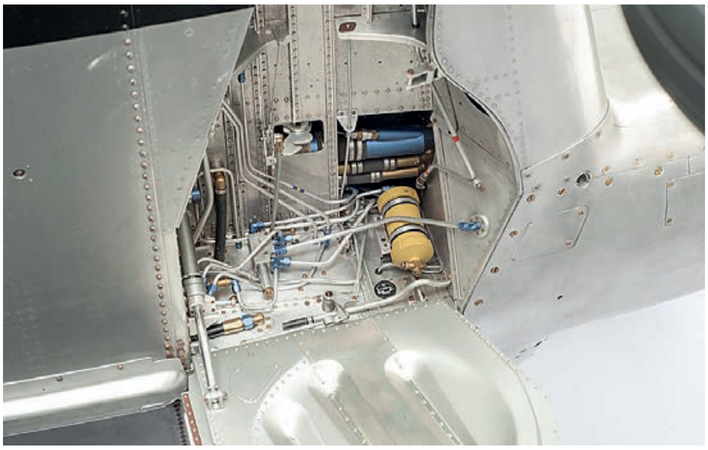
Model Engineering or Sleight of Hand?

Thoughts, by David Glen

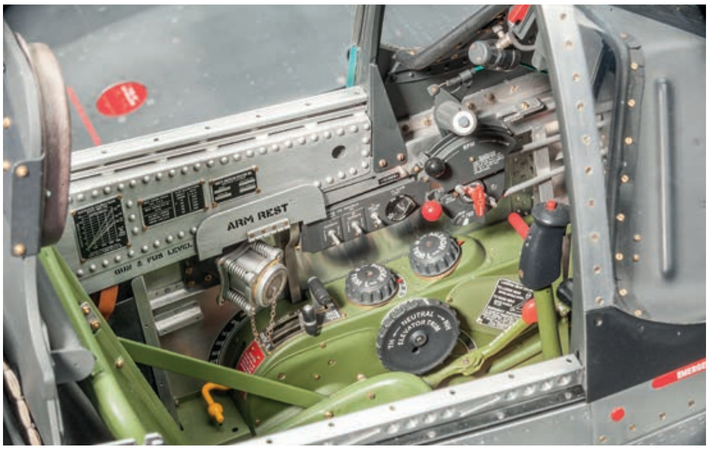
It would be disingenuous to downplay the thrill that I experienced when my large-scale aircraft models began to attract the notice of the model engineering press. Who would not take pride at seeing their work arrayed in print alongside living, breathing, precision engineered masterpieces faithful not just to the form but the function of the original? Yet it was hard not to feel like an interloper, for while what I do is unquestionably model making, is it model engineering?

Major components of my models are most certainly 'engineered' in the sense that the techniques used are those of the builders of, say, live-steam models, albeit executed to a lesser degree of tolerance, accuracy and mechanical integrity. In my workshop metals of various kinds are turned, milled, drilled, ground, etc.

A classic view of this 'warbird' serves to demonstrate the model maker's perfect eye for proportion. INSET: Another classic view, this time from the rear.



Wheel bay detail.



Breathtaking! Cockpit detail.

and held together either with solders and brazes or with traditional mechanical fastenings that are the stuff of the engineer. However, I also rely on the ways of the aero modeller, using ply, balsa wood, plastics and whatever adhesives are appropriate. I make significant use of two-part casting resin and modern composite materials such as foam board and high-density model board, and I have greatly benefited from the ability to produce vac-formed parts from sheet styrene. And in the final analysis, my work owes much to skills and techniques garnered from many years of making and modifying plastic model kits. In short, I choose whichever methods and materials that make the task at hand as easy and as practicable as possible, with the condition that they must be stable, durable and appropriate to achieving the result that I seek. The ultimate requirement is that my work looks 'engineered', that what the eye sees is a faithful replica of the original, down to the feel and even patina of the finished construction.

My models are unashamedly part engineered, part sleight of hand - an amalgam of methods and materials. Under their aluminium skins is a wooden heart. As important to their structural integrity as the numberless nuts, bolts, screws and rivets that hold them together are modern adhesives, particularly cyanoacrylate and epoxy glues. Yet so long as the outcome is robust, enduring, accurate and – above all – convincing, then I am content, for hopefully I have captured in miniature, if not the function, then certainly the form and perhaps even something of the soul of these magnificent aircraft. Should that qualify me for 'honorary membership' of that exclusive, yet sadly dwindling fellowship of 'model engineers', then I am honoured and proud to accept. **ME**

Cockpit showing a lot of 'finishing' detail. (David also explains how to make transfers.)

The *Little Demon* Supercharged V8 PART 5

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

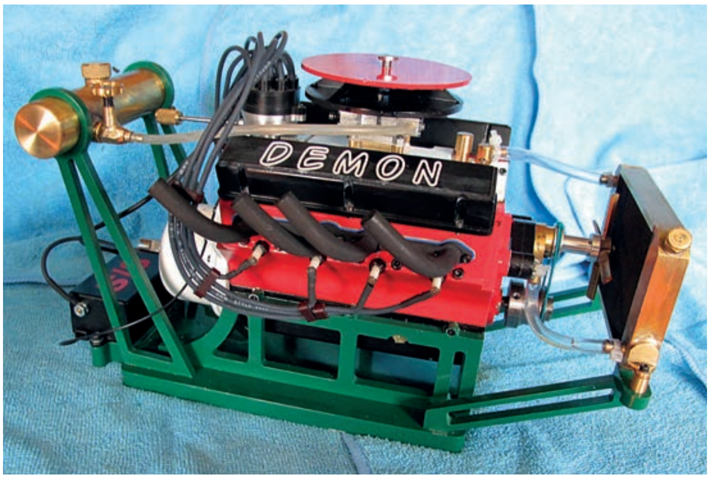
Continued from p.636
M.E. 4690, 6 May 2022

Camshaft

As I was saying a bit back, I have machined a sixteen-lobe camshaft from solid silver steel before, only on that occasion it was produced using a milling fixture which was rotated by hand to generate the cam profile, I certainly had my moments during that particular process rotating each cam lobe against a rotating milling cutter. However, the suggested method of manufacture for this camshaft is by using an offset turning fixture. I must confess it took me a while to get my head around the process being described. This is by no means a criticism, as I wouldn't have the first idea of how to set about designing a multi lobe cam shaft, but the designer uses, as an example, the production of an eight-lobe camshaft, rather than the sixteen lobe cam required.

The idea is to set the angular position of each individual cam using a 360 degree disc attached to the turning fixture, then move the fixture through 56 five degree increments taking a passing cut at each angular setting until a complete lobe has been generated. This is repeated sixteen times. Apart from the sheer amount of time the process would take to actually make and use the fixture, setting and using a fairly large (in comparison) offset turning fixture on a Myford isn't the best of ideas.

I have produced an eight position multi lobe bonded camshaft before and the process is quite straight forward using a dividing head



or a vertically mounted rotary table. All you need to know is the angular position of each cam relative to the number one lobe, when its position is taken as zero degrees, and of course a little CNC mill on which to produce the cam blanks. Of course, not everyone has such a facility in their workshops, so I would suggest a couple of options. If the hobby workshop has limited capacity it's probably worth any potential builder approaching a sub contract machine shop in their local area to see if a batch of cam lobes could be produced. Once programmed, it would only take at most a couple of hours work to produce a batch of sixteen plus a few spares, as unlike other camshafts I've produced the exhaust and inlet cam lift profiles for this engine are identical.

The actual cams are very small so as long as the base radius and lift is machined correctly and the overall height is also correct I can see no reason why the lobes couldn't be generated using a small rotary table, and a simple locating and holding fixture similar to the one I used on the CNC mill, where the cam is secured by its central bore. This option would of course require three separate operations. There is of course a third option for those with good hand to eye skills - it's an old toolmaker's trick of producing the complete cam profile from a piece of gauge plate, which is heat treated and used as a filing guide, clamping the cam and guide together with a suitable nut and bolt through the central hole.

I mentioned in the introduction that during the course of the build I contacted Steve Huck, the designer of the engine. I was probably being particularly thick at the time but I couldn't work out what was being described to me regarding the angular positions of individual cam lobes and the purpose of the cam chart, but when explained it's quite straightforward. I did think about reproducing the cam chart for clarity, that's until I noticed the copyright logo at the bottom of that particular page was highlighted in red and so thought better of it!

The camshaft for the single carburettor version has a rotation duration of 280 degrees, while (as I found out with my other question to Steve) the supercharged version has a duration of 300 degrees - the 300 degree chart comes with the additional supercharger plans. I don't intend making a second camshaft at this stage, so the supercharger may just be for display for the time being.

When you look at the cam chart there are sixteen columns which are listed at the side of the page. Looking at the first column of the chart the first cam, which is exhaust #1, is set at zero degrees. The positions of all the subsequent cams are shown as the first entry in the relevant column. The next cam is exhaust #2 and the first entry appears as 315 degrees, so this cam position is 315 degrees past zero. The angular position of all the subsequent lobes are determined by taking the angle opposite the first entry in all the other columns. This is also the process that any engineer producing the camshaft from solid using the turning fixture would need to follow. Each five degree increment represents one indexing move of the fixture and one passing cut.

To produce the cams, I used a strip of gauge plate the finished thickness of the cam which was located in a slot machined in a suitable piece of aluminium. A position towards the end of the slot was taken as absolute zero and a M6 hole drilled and tapped at that position for securing the lobe while the profile is generated. With the strip of gauge plate held by a suitable clamp a 6mm bore was generated (**photo 28**). The radial scallop shown in the photograph is from the generation of the previous cam's top radius. Using a suitable fixing to secure the strip the cam profile was generated, while the strip was secured with a clamp (**photo 29**).

To assemble the camshaft individual cams are bonded onto a rod of 6mm silver steel which is held and centrally positioned in the dividing head, or vertically positioned rotary table. The first cam is bonded at 12 o'clock and this position is set to zero degrees on the dividing head. This position is also zeroed on the X axis, either on the DRO or the machine dials, depending on the workshop's equipment level. To ensure each cam is accurately positioned a locating finger was produced and set in the spindle.

The profile of the locating finger was produced to snugly locate around the top radius of the cam, while the width of the finger is identical to the width of the cam, so a simple thumb nail test to either side will ensure the cam is in the correct position once the table is positioned at the correct X axis coordinate while the bonding cures.

I fully appreciate that the prospect of positioning and bonding the sixteen cams can seem a bit daunting especially the orientation of the actual indexing moves. A quick double check is to use the 360 degree printed protractor that is intended to be used as part of the cam turning fixture. Assuming that the dividing head is positioned to the left of the machine table, place the protractor at the back of the dividing head with zero at 12 o'clock. The graduations start at 0 and run clockwise to 360 and so that is the direction of rotation for each indexing move of the dividing head.

When the first cam (exhaust #1) has successfully cured enough to allow the next cam to be located, the dividing head is rotated clockwise through 315 degrees to the position of exhaust #2, a second cam is loaded and the machine table advanced to about a cam's width away from its final position. A little loctite 648 is applied around the shaft and the table advanced to the cam's final position, which is a reading of 0.2085 inch on the DRO (**photo 30**).

During the fabrication process the end of the shaft needs supporting to avoid deflection when loading the cams and the dividing head tailstock is ideal for this purpose. **Photograph 31** shows the successful fabrication of the camshaft.

Once all the angular positions of the camshaft have been proven against the valve movement when assembled in the engine, then a belt and braces operation can be carried out where each cam can be cross drilled and pinned to ensure no slippage occurs. If a bonding agent specifically designed for this application is used there shouldn't be any issues but as a test of the bonding agent try bonding a test piece of 6mm rod and a piece of scrap material with a close fitting 6mm hole, wait till cured and try and get them apart.

Before final assembly there's no really sure method of checking all the cam positions are correct, but on the drawing showing the assembly of the camshaft and timing gears the depicted camshaft is good enough to do a visual comparison of the angular positions of the cams.

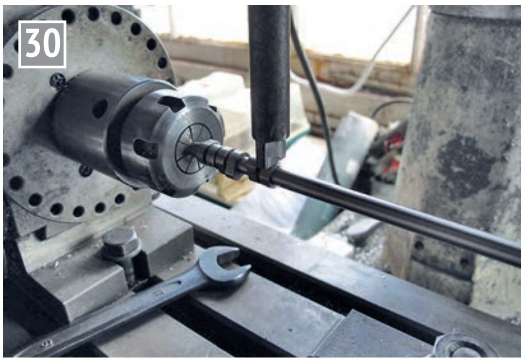
●To be continued.

NEXT TIME

It's the turn of the cylinder heads.

Gauge plate strip located ready for machining.

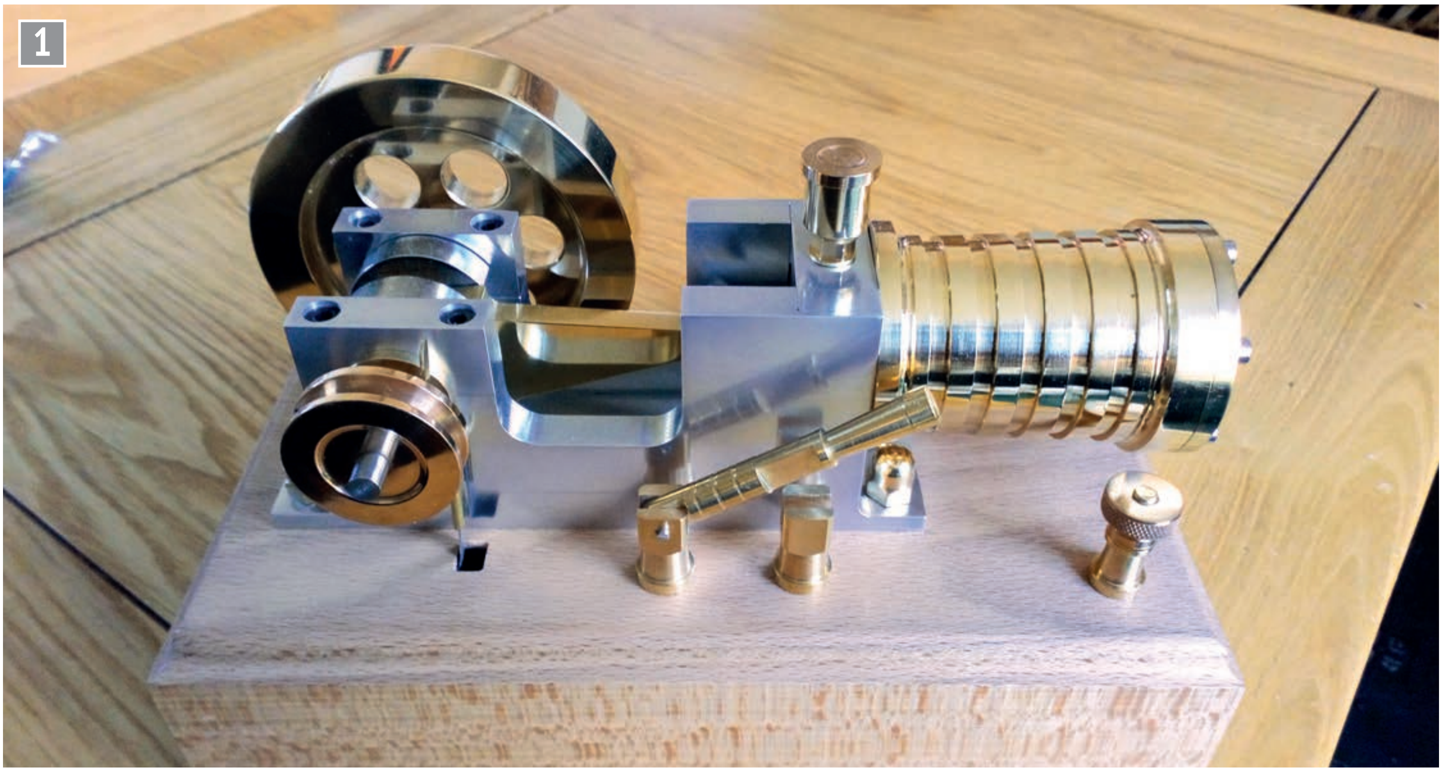
Generated cam.



Initial location of cams.

Final fabricated camshaft.

1



The coil engine.

PART 1

Making a Solenoid Engine

Tony Swinfield constructs an electrically driven horizontal engine.

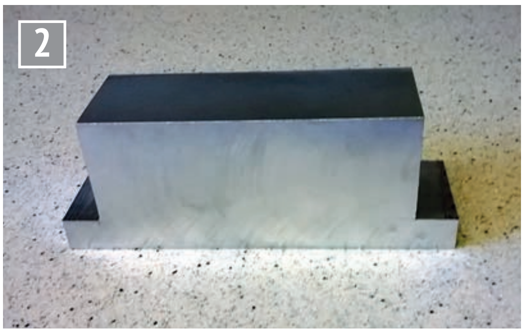
It all started because I wanted a working engine that did not use steam or fire to work, so I looked on YouTube for inspiration, and found lots of engines which were solenoid operated powered by a battery. I have a CAD package but I like to use graph paper to get the basic layout first, so using this I drew out what looked about right, then checked on the materials I have in stock - having been collecting for several years I had all the parts needed.

The first engine I made was a year or so ago. I did have some problems with it, as I wanted to make all the components myself, so I wound my own coil and then found it did not work on 6 volts. I had to use a 12 volt battery, so I then had to make the wooden base deeper for the larger battery.

The engine worked very well when first made but after a time stopped working. Thinking it was the battery, this was charged but still no luck, so I decided to dismantle it, clean all the contact areas and make the fit of the parts with more tolerance. This time I did not use any oil on the moving parts when I assembled it - this worked and all was well.

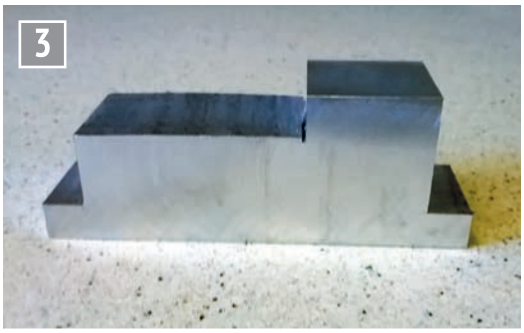
It was at this time I decided to make another engine and write it up with plans (**photo 1**). The first engine's main frame was made from a solid block of aluminium but having some flat plate I thought this would be a cheap and easy way to make the frame. Having made the second frame this way, **I now know this is not an easier way to make the frame** - there is a lot of drilling and tapping and counter boring of holes. You live and learn.

2



Starting with a solid block of aluminium.

3



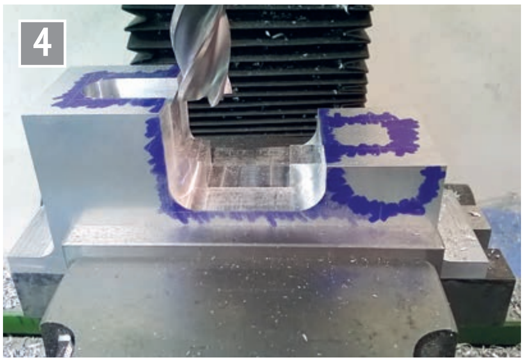
Cut to rough shape with a hacksaw.

Making the frame from a solid block

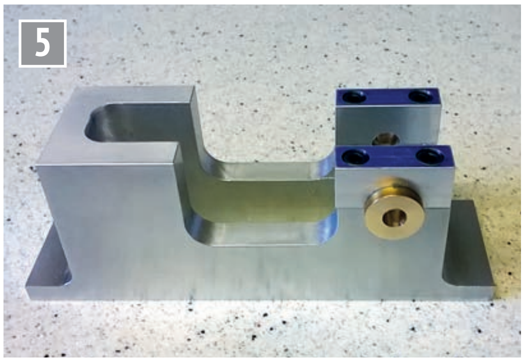
If you are going to make this engine I recommend that a solid block of aluminium is used. If you are going to include the base then start with a block slightly bigger than needed. I used a hacksaw to remove the waste, then I mounted the block in the vice on parallels on the milling machine and used a fly cutter to bring it to size. I set the stops on the mill so as not to cut outside the marked area. I then used a long milling cutter to remove the centre part, a few mm at a time. When the depth was reached, I then took a facing cut of a few thou at full depth to clean up the insides of the hole (**photos 2** to **5**).

At this point let me say that I decided to buy a coil that worked on 6 volts. This was purchased from RS Components. Unfortunately, this did not work, as it was not powerful enough. So I made another coil. The coil I made was not hard to make but it needs a 12 volt battery to work. The battery I used is 12V 2.1Ah, used for security alarm panels.

After making the bobbin (see later) I used 0.8mm diameter wire for the first engine and 0.7mm diameter wire for the second engine, because that is what I had, winding the bobbin as neatly as possible to just below the flanges. Both coils work well.

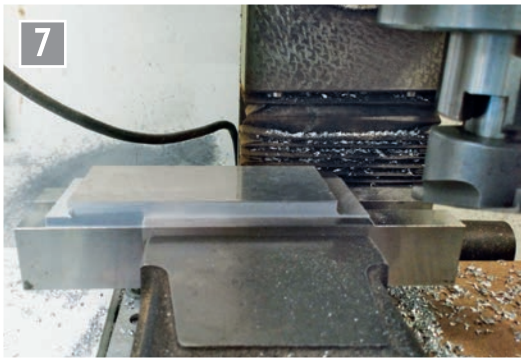


Removing the centre part.



The fully shaped base.

Making the base from flat plate – trimming the sides.

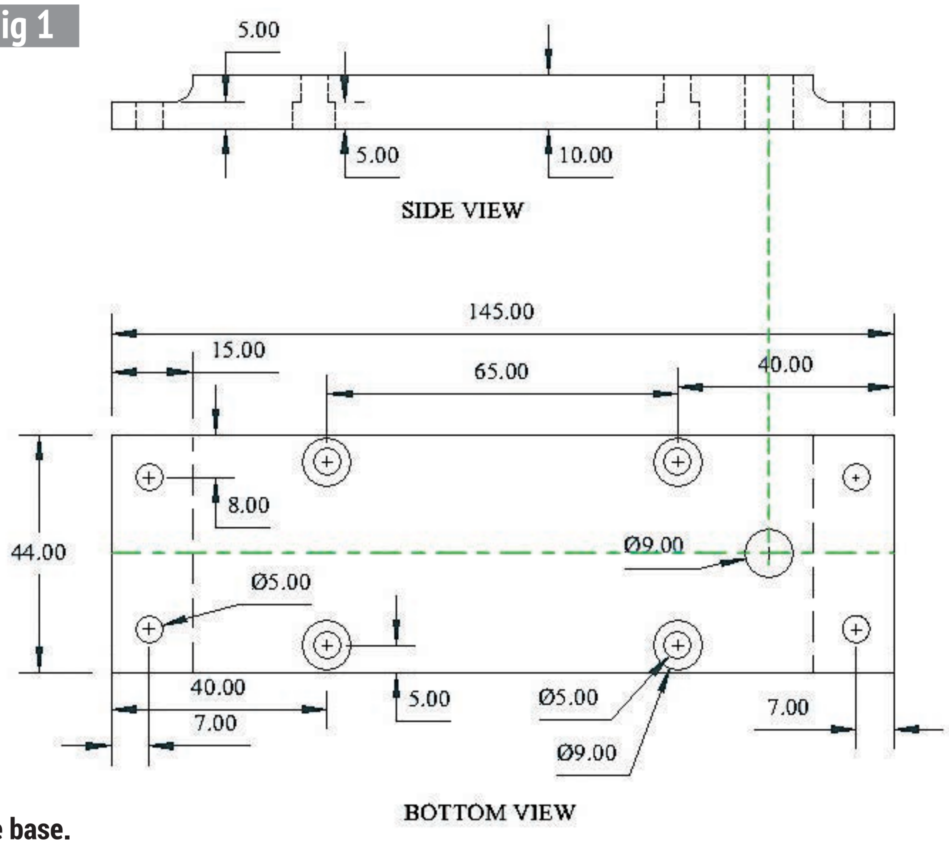


Machining the base.

To make the frame from flat plate

The main frame is made up from four parts: the base, two sides and the front. These were mostly cut from 12mm thick aluminium plate, because that's what I had, and reduced down to 10mm. The front plate was cut from 16mm thick plate. All were cut over size, then fixed in the mill vice, and a fly cutter used to bring them to final size as in the drawings (**photo 6**). I much prefer to use a fly cutter than a milling cutter as they give a superior finish and are easy to sharpen, and to grind to different profiles, and they are cheap.

Fig 1



The base.

The base

This is 145mm long x 44mm wide x 10mm thick (**fig 1**). It has four outer holes 5mm diameter which are for mounting it on the wooden base. There are four holes 5mm diameter counter bored on the bottom 9mm diameter x 5mm deep for cap head screws for holding it to the side frames, and one hole 9mm diameter for the coil cables. Using the milling cutter, the ends are reduced down to a thickness of 5mm x 15mm wide (**photo 7**).

The front

This is 50mm long x 40mm wide x 16mm thick (**fig 2**). The front part was marked for the central hole 20mm in from the edge and 16mm from the top and a 6mm pilot hole was drilled at the centre. It was then set up on the face plate using the tail stock with a revolving centre to centralize it. It was then clamped to the face plate – make sure to use packing

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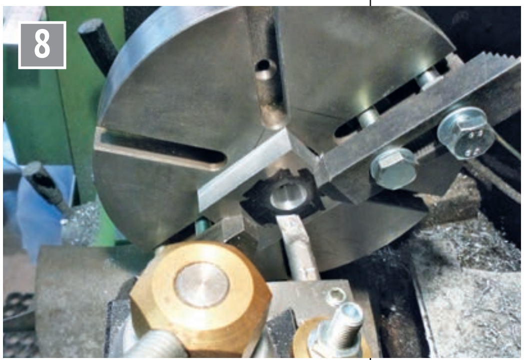
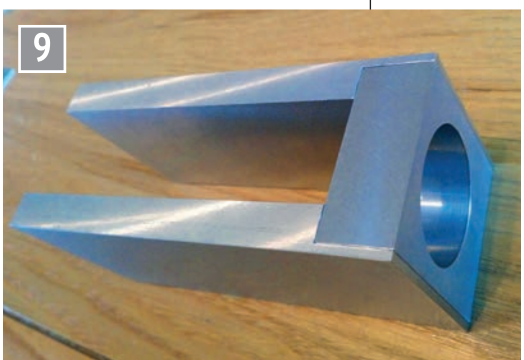
behind the work if the face plate central hole is not large enough to clear the drill. First drill and then bore the hole to finish at 30mm diameter (**photo 8**). Then drill from the bottom 5mm all the way through and open up the bottom hole to 9mm. Do not drill the 3mm holes yet (see below).



Boring the front plate.

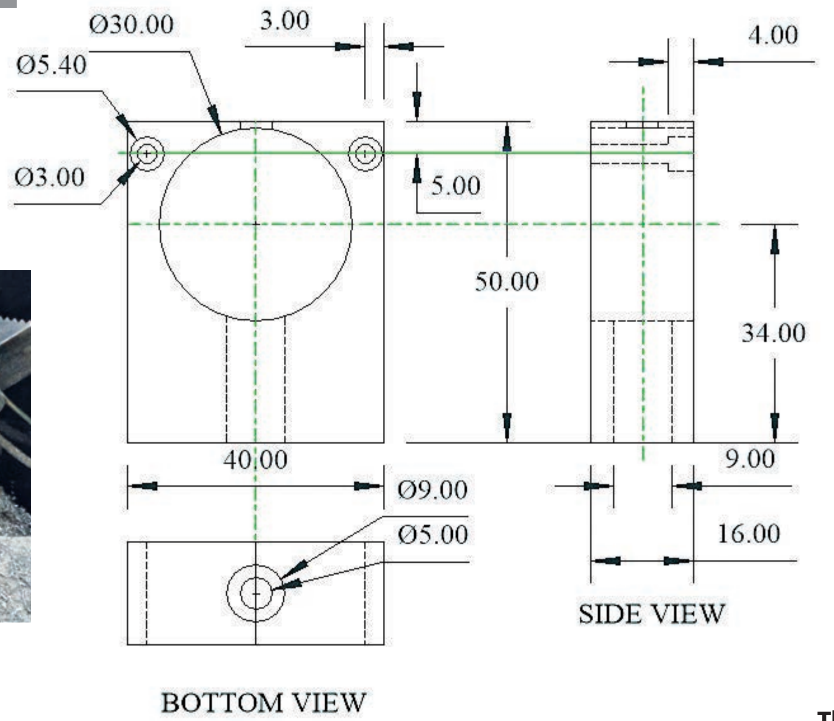
The sides

These are 115mm long x 50mm wide x 10mm thick (**fig 3**). To ensure these are identical they were fly cut together as a pair to finished size. The front inner parts of the sides need to be milled out so that the front part sits inside, such that the edge of the front part is not seen from the side view (**photo 9**). The parts are first marked out then set up in the mill vice, on parallels, with the edge aligned with the side of the vice. Be careful to make sure that the base height above the vice will clear the cutter. A milling cutter was used to remove the unwanted section, width 16mm and depth 8mm. The two sides were marked out for the centre section to be removed, two holes were drilled (**photo 10**) and then a saw was used to remove the



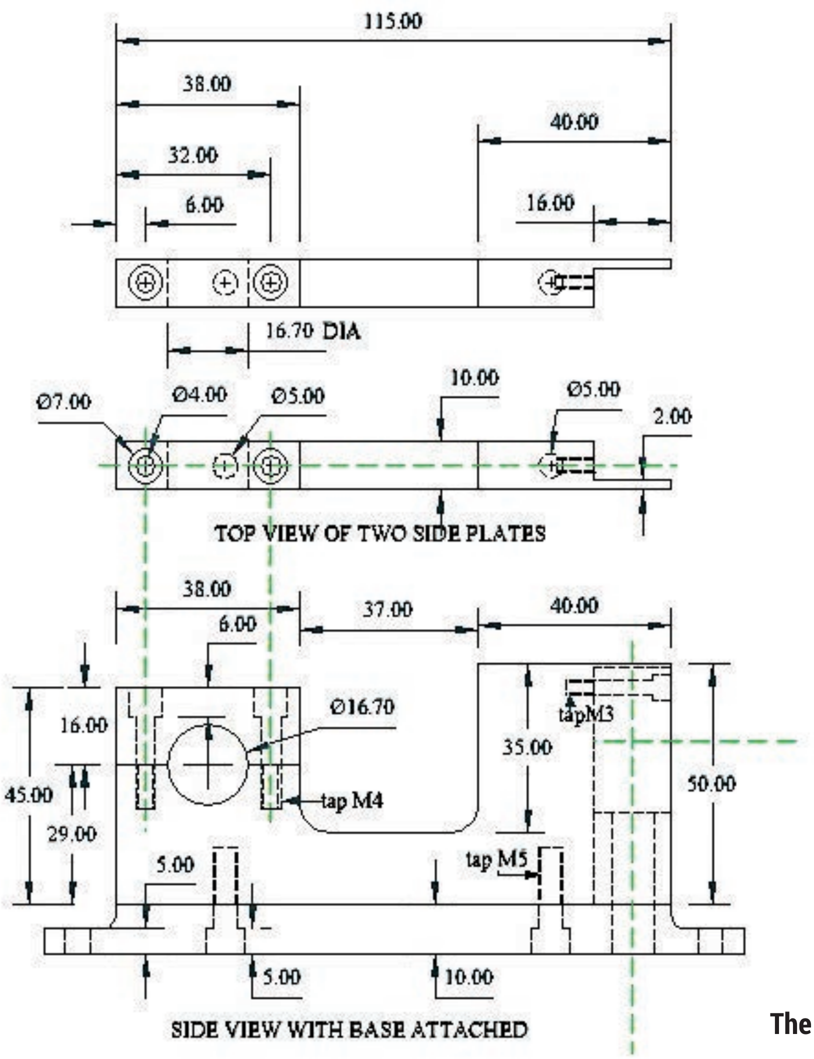
Fitting the sides and front.

Fig 2



The sides.

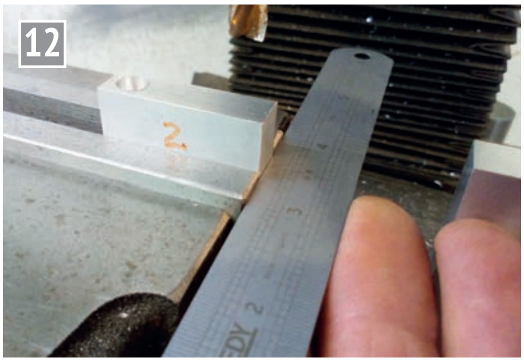
Fig 3



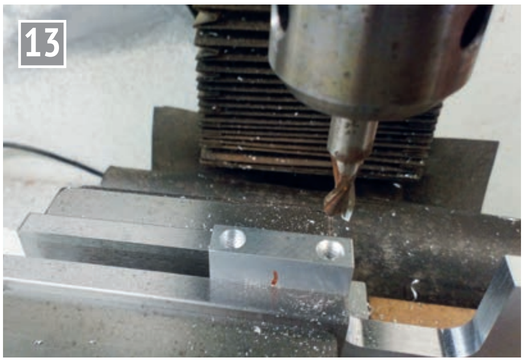
The front.

Marking out for shaping the sides.

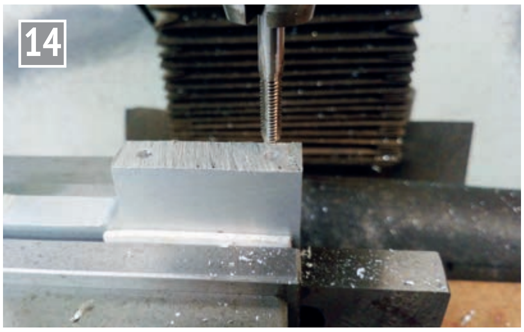
Shaping the sides.



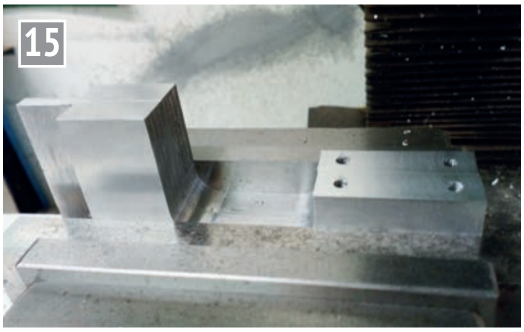
Lining up the edge to position the bearing cap bolt holes.



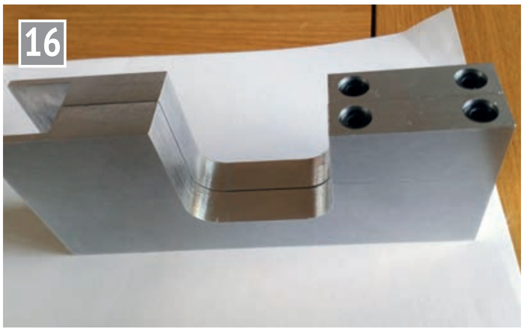
Counterboring the bolt holes.



Tapping the bolt holes.



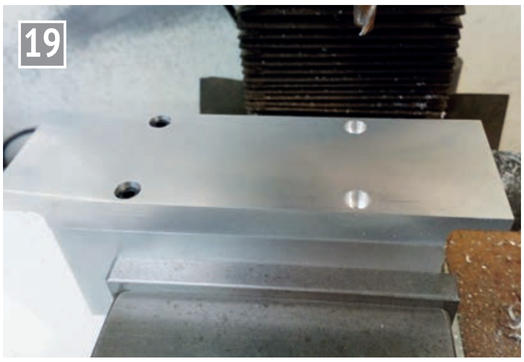
Cleaning up the sawn faces.



The two sides, with bearing caps fitted.

Initial drilling of the bearing hole.

Opening out the bearing hole.



Counterboring the fixing holes for the sides.

rest. The parts were fitted on parallels in the mill vice, the stops were set and, using a milling cutter, the hole was brought to size (**photo 11**).

Do not cut the side frames where the bearings fit yet.

The two sides were marked on the top for the bearing cap bolt holes. Each side was then fitted in the mill vice, with the edge aligned with the edge of the vice, which is made the reference edge. This ensures all the holes are at an equal distance from the edge of the work (**photo 12**). The hole marks were lined up with the spindle and the table locks set. The holes were then drilled 3.3mm tapping size for M4 screws to a depth of 30mm. The holes were also counter bored 7mm diameter and 5mm deep - I used a milling cutter because they give a flat bottom for the cap head screws (**photo 13**).

The height position of the joint for the bearing cap was marked out on the sides - mark the cap and body with a centre punch so that they fit when next assembled. The top part was then hacksawn off in the bench vice. Then, having not moved the position of the mill, the side parts, one at a time, were again aligned with the edge of the mill vice to tap the holes. Using the chuck to hold the M4 tap to start the tapping makes sure that the hole is tapped square with the work (**photo 14**).

After this both parts were fitted in the mill vice, making sure that the parts were sitting square, and the fly cutter used to clean the sawn faces (**photo 15**). This was also done to the top parts, then the two parts were joined together using M4 cap head screws (**photo 16**).

The next thing to do is to mark the position of the crank bush hole on the joint line. Mount both parts in the mill vice, on parallels, line the spindle up on the mark, lock the table, centre drill then drill a 10mm hole through both parts. This way they should both be in line and square with the base and sides of the body. This hole was then opened

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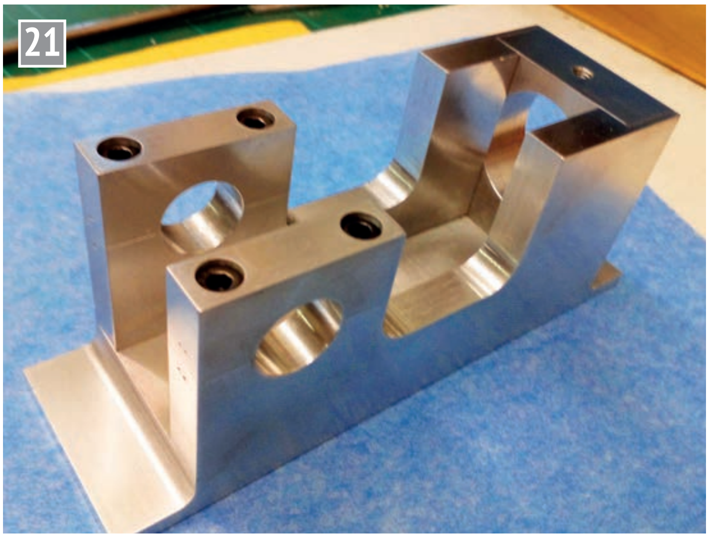
out with a milling cutter to $^{21}/_{32}$ inch (16.7mm). This cutter size was used because it's the size I had. If you do not have a milling cutter of this size, the hole could be bored out with a boring head (**photos 17** and **18**). After the 16.7mm hole is formed, the top parts of the clamps are unscrewed and returned to the mill, to remove a few thou from the joint edge. This is so that when next assembled it provides a clamping action on the crank bush.

A spacer was to hold the sides parallel in the vice then the body (two sides and front) were clamped in the mill vice and the base was lined up and clamped in place. The hole positions were transferred from the base to the sides, the base was removed and the hole marks lined up with the spindle. Using a 4.2mm drill, the holes were drilled to a depth of 15mm and tapped M5, 12mm deep into the bottom of the sides (**photo 19**). The threads were cleaned of swarf and the base was reassembled, using M5 x 10mm long cap head screws. To fix the front end to the sides, the assembly was fitted in the mill vice, with the front end uppermost, and a square was used to make sure all was correctly lined up (**photo 20**). The 3mm hole positions were each centred under the chuck and the table locked. They were then centre drilled then, using a 2.5mm drill, drilled 30mm deep. At this same setting the hole was opened out to 3mm for a depth of 17mm and counter bored 5.4mm diameter x 4mm deep for the M3 cap head screws.

Some of you will have noticed from the photograph that the base is wider than the body, which was allowed for when I drilled the base. When the front part was screwed to the sides, and with the base fitted, it was fitted in the mill vice on its side and the bottom edges were fly cut down to the width of the sides. **Photograph 21** shows the frame assembled.

20

Drilling the holes for fixing the front to the sides.



21

The completed frame.

●To be continued.

NEXT TIME

We add the cylinder.

NEXT ISSUE

Pennies from Heaven
Brian Baker revisits the Penny Arcade, with his restoration of a Scooter Racer machine.

GL5 Rally
John Arrowsmith pays a visit to East Somerset again to attend this year's GL5 rally.

Mabel
Eddie Castellan builds LBSC's gauge 1 LNWR 'Jumbo' locomotive.

Viljoen
Luker continues his occasional series on great South African model engineers with the story of Charles Viljoen.

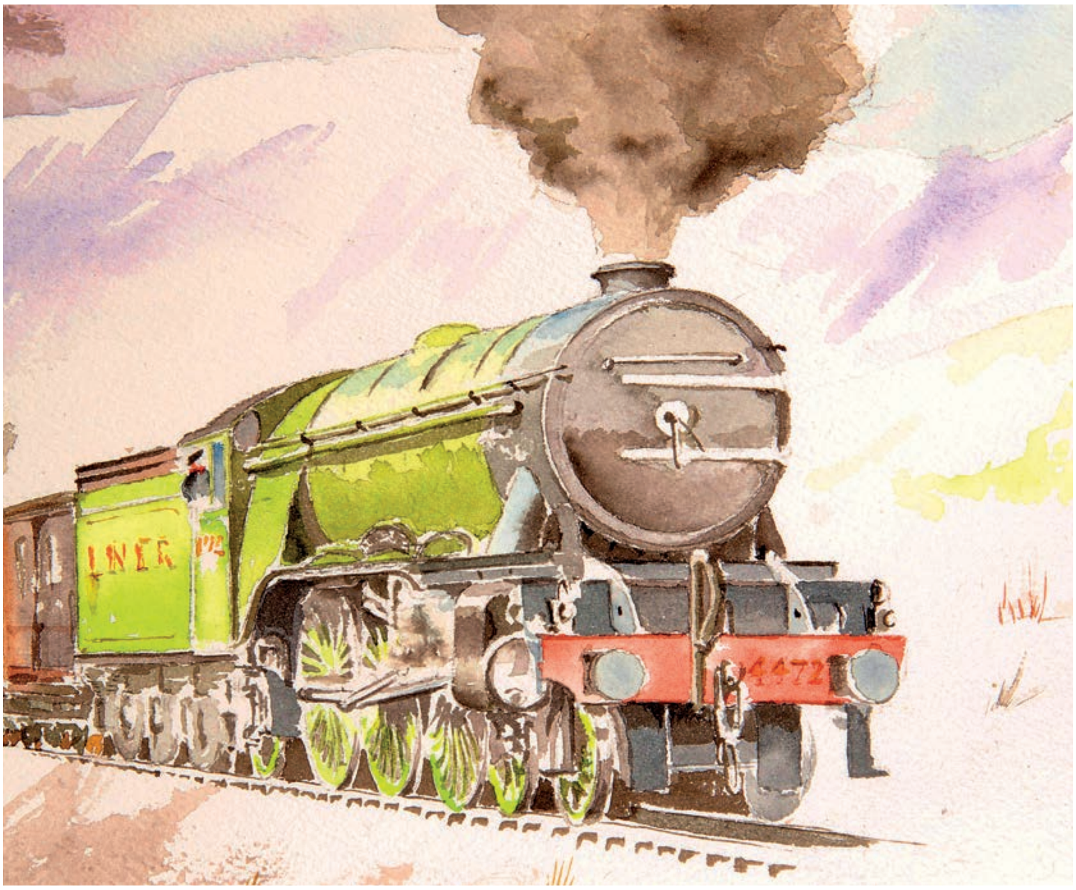
Bristol Foundry
Graham Gardner pays a visit to a busy foundry in Bristol.

Content may be subject to change.

ON SALE 3 JUNE 2022

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

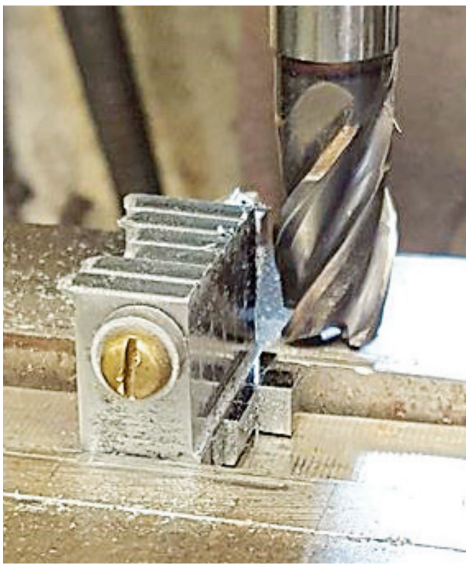
Continued from p.629
M.E. 4690, 6 May 2022



Painting by Diane Carney.

PART 35 – MAIN SPRINGS

Flying Scotsman in 5 Inch Gauge



1. The tabs are bolted together through the holes and the assembly set up in the mill vice. Here is the first side being machined. A button is used to gauge the size and the bottom edges are sitting on some flat steel. After a little clean up with a file the assembled parts were turned over and placed back in the vice along the other axis for the lower sides to be machined. With that done I then removed the access material from the bottom.

2. I now needed to machine the scallop along the top edge to fit the cylinder ready for brazing. Each tab was set at the same height in the vice by sitting on a suitable strip of steel and was sitting upright as the top face was still the un-machined face of the original steel bar.

Next on the list is the spring gear for the main drivers. I think I have most of what's required, I bought the spring steel some time ago and since it mainly consists of small components there's a good chance that I have what I need.

Spring swivel

So where to start? As this assembly hangs below the axle-box I shall start with the part that connects the two which is the 'spring swivel', a simple part to make but a little time consuming due to its shape. The swivel is made up of two parts, a cylinder that the axlebox bottom central pin slides into and the tab that's brazed to this cylinder for the spring buckle to fit with another pin. This part allows the spring assembly to pivot on both axes.

The tabs were made first, from a length of 4mm steel strip. Holes were drilled along the length of the strip and then the strip cut into sections, with one hole in each section.

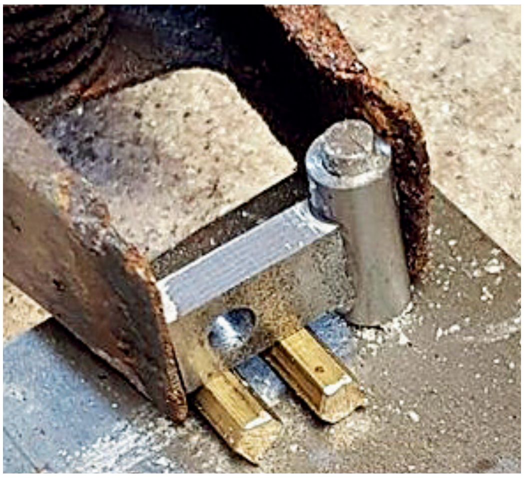
Spring leaves

The spring leaves are a mixture of spring steel and Tufnol as with the tender and trailing axle. There's always going to be trial and error with springing but the tender and trailing axle steel/Tufnol mix works very well and can't be seen once painted so I'll stick with what works. I have used 0.048 inch steel and 0.047 inch Tufnol which are the closest thicknesses that I could find, cut into 7⁄16 inch strips.

I started with the spring steel which is in its annealed state. The top two leaves are 4.218 inches long and have a No.21 hole drilled centrally each end. I first cut 12 lengths oversize, held/taped together in the machine vice and machined each end square. Next was the No.21 hole, which was done in three steps after finding the centre of the strip - first, centre drilled, then ⅛ inch and lastly the No.21, all taken slowly with plenty of cutting oil to ensure the drill didn't wander.

Spring buckle

The spring buckles started out as a strip of 10mm steel. This was cut into six pieces and the pieces machined square. A hole for the swivel was then drilled through each piece. Two operations then remained – to machine a fork in the end to accommodate the tongue of the swivel and to form a square hole through the buckle to accommodate the stack of springs.




LEFT: 3. I then needed to braze the parts together. The white stuff seen is soap - I used a bar of soap over the jig parts to stop any parts becoming stuck due to unwanted silver solder and the parts are held with a rusty clip. RIGHT: 4. Here we have the finished parts.


LEFT: 5. Here we have all of the steel springs cut/machined to size ready for forming. RIGHT: 6. I then scaled up the digital drawing and printed that to scale and cut out the top spring profile from it, which I then used as a template to cut out the shape from a suitable piece of wood as shown in this picture. I then shaped each spring steel leaf using the heavy round steel bar also seen in the picture. Forget the decorating roller shown - this wasn't heavy enough for the job in hand. The Tufnol leaves were simply boiled up in a saucepan.

7. The steel leaves were then hardened and tempered in the usual way (but not the Tufnol leaves of course!) and here we have a set of leaves ready to assemble into springs.

8. The fork is 4mm wide - simple enough but I had to be extra careful here as the only cutter that I had was a cheap, plain shank cutter and with no 4mm collet for my ER25 I was forced to use the drill chuck. This took more than a day but I got there in the end and most importantly with no mishaps.

9. With each block then stood upside down I drilled the hole ready to be tapped 6BA for the leaf retaining grub screw.

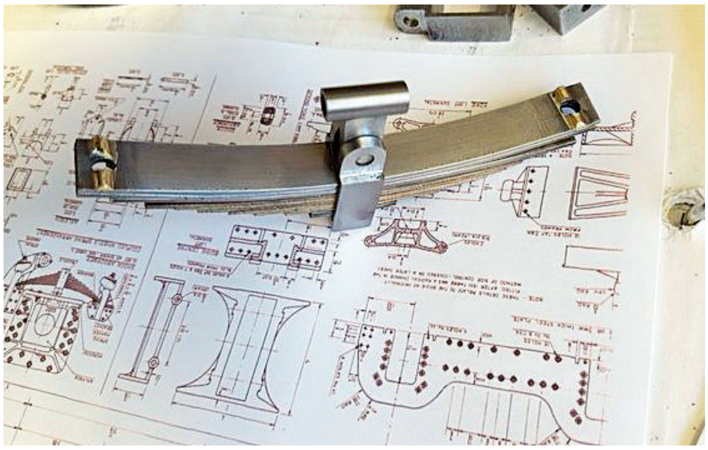
LEFT: 10. It was then time for one of my pet hates, forming squares in round holes or in this case rectangles. I placed the block on its side (still using the same stop I used for the fork) resting on two oak strips so that I could drill straight through. RIGHT: 11. Using the stop again and this time a 6mm cutter now held with a collet chuck, I machined out the bulk of the material needed to form the slot. I then checked each one with one of the steel springs to ensure that there was enough clearance for the spring to work. And then my favourite part (!) - filing the rectangles by hand.

12. I then returned to the top leaf springs and silver soldered on the half round grips. A trusty 'spud' was used to protect the hardened middle section while brazing on the grip.

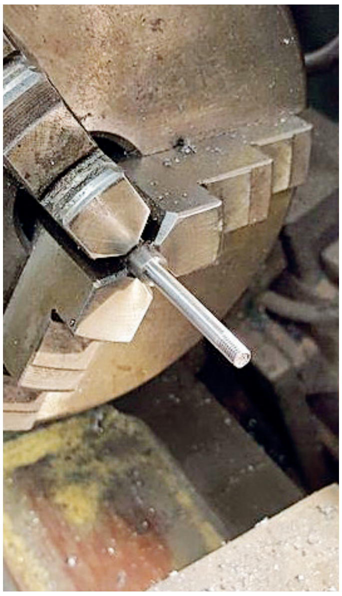
Spring hangers

Before the springs could be fitted and finally give me a fully sprung chassis, I needed to machine the spring hangers, washers and nuts and then make a start on another pet hate of mine, 'shock absorbers', 12 of each of all those.

The hangers themselves and the nuts are simple enough but the washers are a bit of a challenge. To form these, I needed a ground tool, with two radii - one is ⅛ inch radius for the bottom of the washer (front face of the job as held in the chuck) and the other, smaller radius is for the top of the washer. The washer then needed a groove (or 'scallop') on the underside to engage with the grip on the spring and the top needed a groove to accommodate the nut.

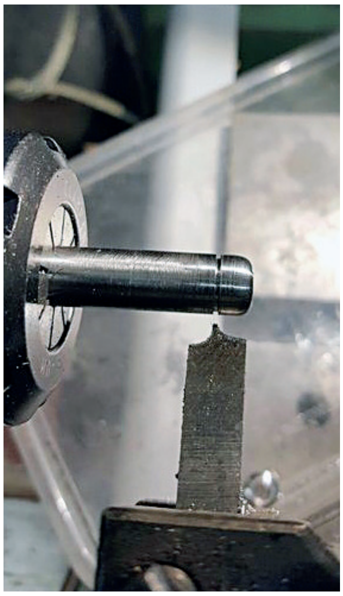


13. Six retaining pins were then machined and the springs assembled. The fork tongues were rounded off with the usual hardened button and hand file.



14. Spring hangers, or in fact machined bolts, are simple enough but there's twelve of them. First, the shank including the threaded section was turned down to size, the thread cut with a die in the tailstock, then parted.

15. The twelve bolts were then held the other way round in the chuck to finish the hex head to the correct height. I also added a small chamfer to the top of the hex to finish off. Here are all twelve spring hangers completed, two of which I have fitted to one of the springs to check its fit.



16. Here the special tool is about to be used to machine the back of a washer, the front already having been machined using the other side of the tool.

17. I now needed to machine the scallop to fit over the top leaf grip. I did this using a 3mm ball nose cutter.

18. The washer was then turned over and the slot machined using a ¼ inch endmill, to fit the nut.

19. Here is the nut sitting comfortably in the slot.

20. After machining to size, all twelve blocks were drilled, using the Perspex stop to ensure all holes were central to the block.

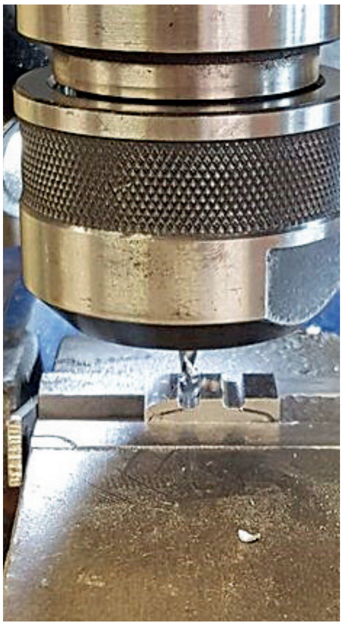
21. Each block was then returned to the vice and placed against the same stop to have the recess machined in the centre. I machined the recess to a length that leaves enough metal on each end after allowing for the tapered ends. The depth is enough to allow for the rubber insert that forms the 'shock' to fit inside.

22. I then needed to make the twelve metal inserts which trap the rubber within. These were all done by hand and the picture shows one shock with its insert.

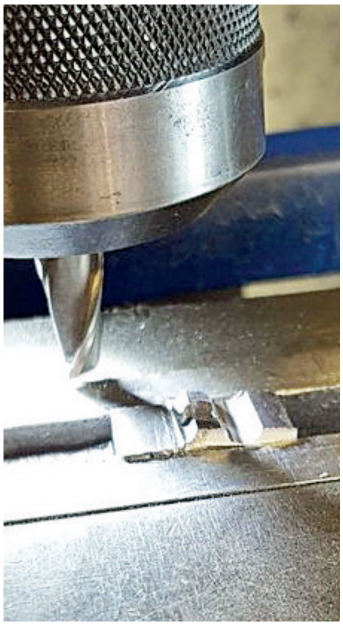
Shock absorbers

My next job was to tackle the twelve main driver shock absorbers.

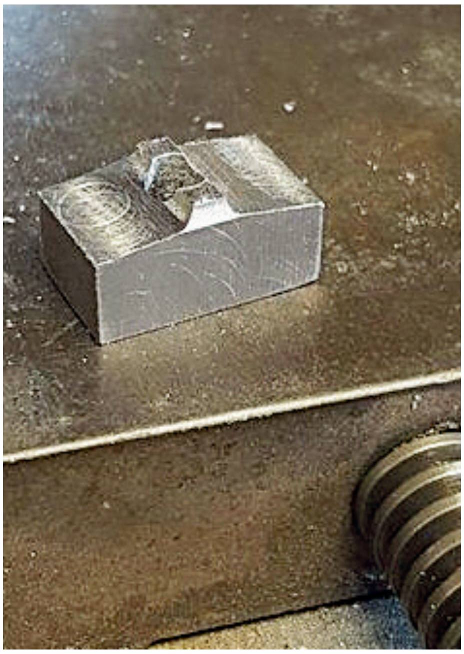
I started by machining a couple of pieces of Perspex which I used through the various stages to hold the shocks in a fixed position in the machine vice during each machining stage. One is a simple stop and riser to set each block of steel at the desired height/position, the other is angled for machining the slope down each side from the middle of the top face. As before I started with a strip of steel and cut it into, in this case, twelve blocks.



23. The next job, still using the same stop, was to machine the concave section either side of the middle hump with a suitable ball nose cutter.



24. The second perspex stop was then used, which was machined to an angle to hold each shock for the top face to be machined.

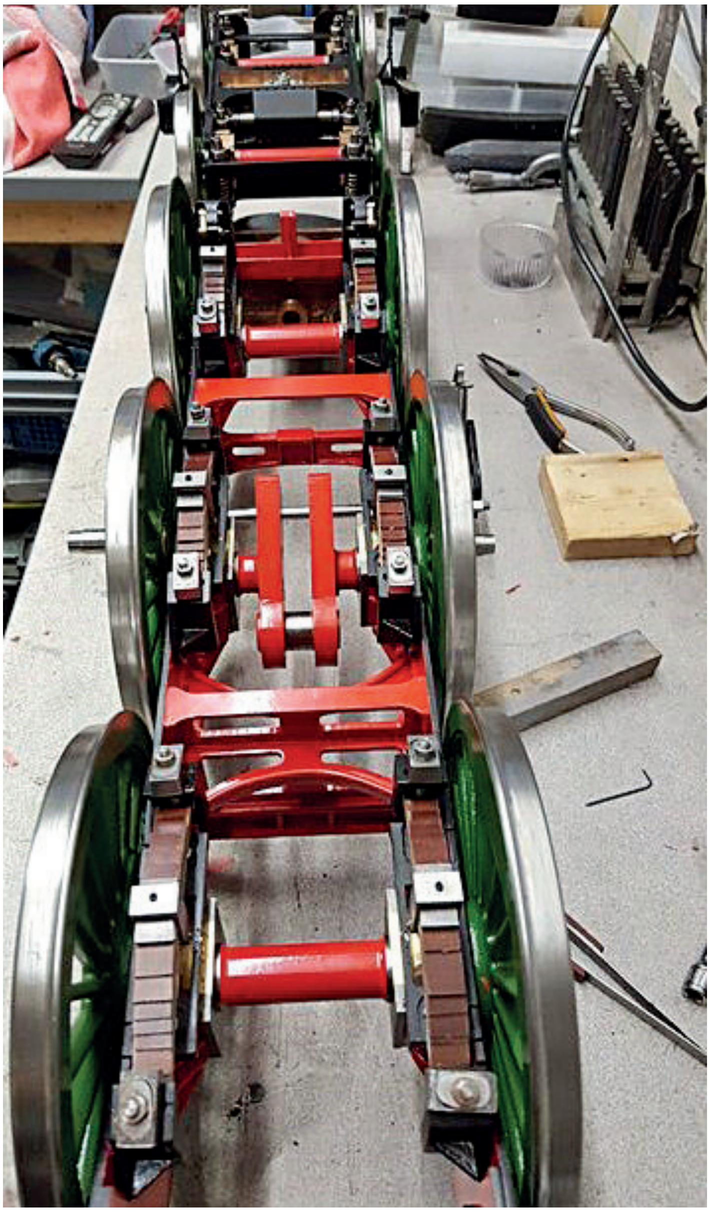


25. Here's one machined both sides.

26. Here's, a close up of the nearly finished shock absorber. As can be seen, I still had some cleaning up to do but to be fair the camera is much crueller than the eye, which can't see most of these marks.

27. The main driver springs are now finished except for a little polishing to remove the last marks and then I'll need to give them a coat of semi-gloss black paint after first giving them an acid 8 coating.

28. This picture shows the swivels fitted to the axleboxes on the rear driver, I had to remove the horn stays, lift the axle assembly partially out of the horns, drift out the pins in the axlebox, insert the swivel, replace the pin, lower the axle and then refit the horn stay.



29. All six springs fitted.

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

Continued from p.583
M.E. 4689, 22 April 2022

The Stationary Steam Engine

PART 33 – OTHER MACHINE TOOLS AT THE SOHO FOUNDRY

The boring machine has usually been treated in isolation by historians of the new Soho works but it should perhaps be more accurately viewed as part of a comprehensive plan for what, in modern terms, would be regarded as a machine shop. After boring the cylinder, the intention seems to have been to carry out the related tasks of turning cylinder covers, the piston and the piston rod under the same roof as the boring machines but to deal with the fittings attached to the cylinder - the valve boxes, the valves with their seats, bearings, pins etc. - in an adjacent machine shop or turnery. To all of these machining operations the lathe was central but past writers on Soho have generally paid it cursory attention.

This tendency to overlook eighteenth-century jobbing lathes extends to the wider history of machine tools where interest inclines towards the more refined clockmaker's and instrument maker's lathe. The two outstanding studies of the history of machine tools, Tom Rolt's *Tools for the Job* and William Steeds' *A History of Machine Tools 1700 – 1910* are mainly concerned with developments which were to become the fundamentals of the modern machine tool, beginning with Henry Maudsley in 1795 (**ref 179**). This emphasis on the Maudsley revolution overshadows the equally important incremental and evolutionary changes that the general purpose lathe had undergone in the preceding half-century.

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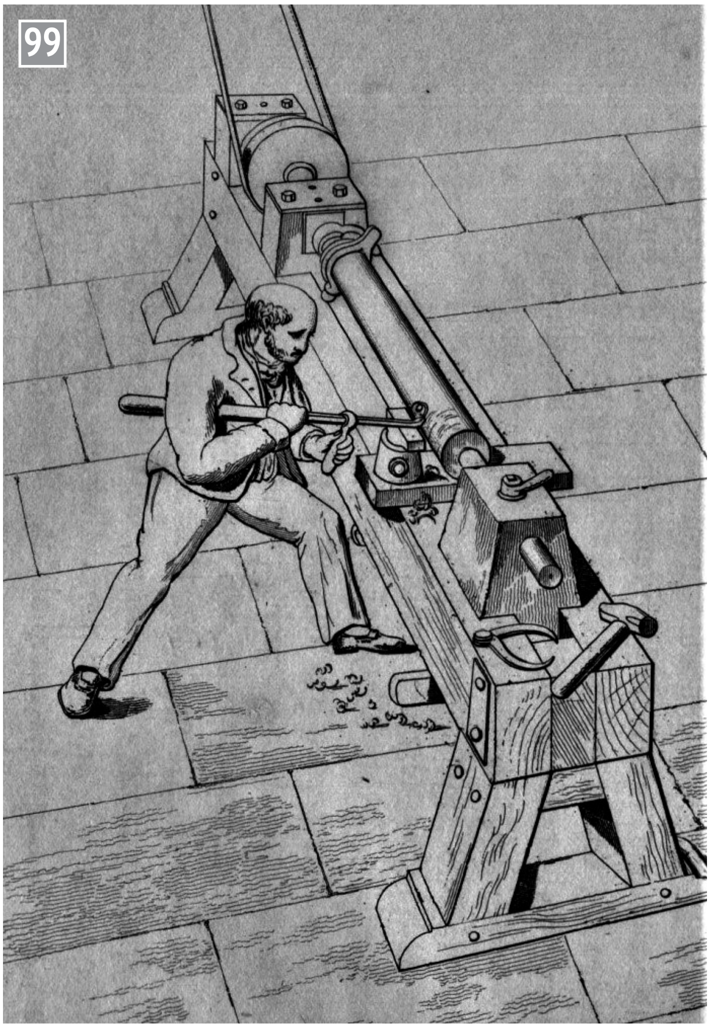

A heavy metal working lathe. The illustration is nineteenth century but the lathe is of eighteenth century form. Buchannan on Millwork and Machinery, 1841. P. 396. Drawing by James Nasmyth.

The well-known depiction of hand turning on a large lathe by James Nasmyth was drawn by him in the nineteenth-century but it serves to show the principal features of the pre-industrial period heavy-duty lathe (**fig 99**). The structure is made up of a twin-shear bed composed of two substantial timbers with timber headstock and tailstock. It is likely that the top surfaces of the bed would have had iron sliding strips, a feature not shown. The cutting end of the tool is supported by a Tee-rest. A skilled turner with this equipment could produce results that were of perfectly good finish and tolerable accuracy over a limited area but the Tee-rest required frequent re-adjustment when turning longer pieces of work. Maudsley's leadscrew actuated slide rest dealt with this problem.

Maudsley's claim to fame is frequently extended to the invention of the slide rest itself but a version was already well known by his time, not only in instrument and clockmaker's lathes but also in the heavy industrial lathe. Jan and Pieter Verbruggen, father and son, were master founders of the Woolwich Arsenal in the second half of the eighteenth century. It is believed that Jan was responsible for a magnificent and meticulously drawn series of watercolours showing each stage of cannon manufacture at Woolwich (**ref 180**).

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Cannon boring and turning machine at Woolwich Arsenal. Watercolour By Jan or Pieter Verbruggen. The original watercolours are part of the Semeijns de Vries van Doesburgh Foundation collection but the reproduction is taken from Prof. Ing. Carel de Beer's The Art of the Gunfounding.

One of these drawings shows a large gun being machined (**fig 100**). At the muzzle end, a boring bar is being used to open out the bore but the machine is also simultaneously turning the exterior of the barrel. The lathe function of the machine can be seen on the left of the picture. The workpiece is rotated by a mandrel and chuck with the gear drive out-of-frame, to the left. A massive wooden construction forms the tool post. Although substantial, this can be re-positioned along the axis of the gun to deal with different parts of the barrel. On the top of the tool post there is a longitudinal leadscrew which carries the toolholder and the left hand of the operator is winding a crank handle which traverses it along the screw, parallel to the surface to be turned. The operator obstructs the view of the slide rest but level with his hands can be seen a telescopic swarf guard protecting the screw.

In the Science Museum there is a model of the slide rest (**fig 101**), a copy of the original built in 1782 which is now in the possession of the Royal Arsenal Museum, Woolwich. Slide rests of this type may have been introduced in Holland by Jan Maritz, the Dutch gunmaster, in the seventeen-forties and the Verbruggens are credited with bringing the idea to Woolwich in 1770 although by this time, similar slide rest equipped lathes were in use by instrument makers. Diderot in the *Encyclopedie* of 1762-72 illustrates a more complex compound version (**ref 181**).

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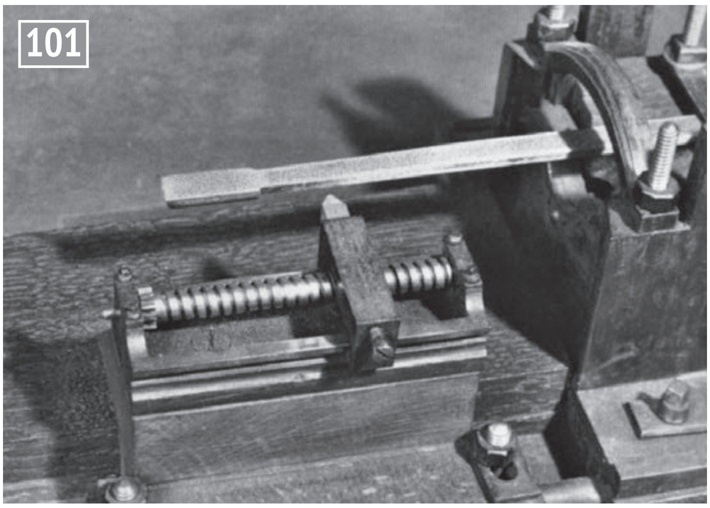

Model slide rest as used in the lathe at Woolwich Arsenal. Reproduction from Prof. Ing. Carel de Beer's The Art of the Gunfounding.

Over the next thirty years axial-travel slide rests seem to have become common in England for heavier lathes. Advertisements in Lancashire newspapers offer slide lathes for sale in the seventeen-nineties which are likely to have been similar to the Woolwich version and Matthew Boulton's personal lathe which is now preserved by the Birmingham Museums Trust incorporates what is probably the earliest surviving example. A nineteenth-century photograph (**fig 102**) shows Boulton's lathe before it was presented to the museum and a series of modern photographs taken by the Museum shows its current condition (**ref 182**).

In the early photograph the lathe is complete with a flywheel, foot pedal and crank mounted below the bed. Various accessories are shown on a shelf above the machine and mounted on the wall behind. As it is preserved in the museum today, the treadle drive has been removed and the four-screw bell chuck has been replaced by the faceplate chuck which is visible on the shelf in the earlier photograph.

The bed consists of two parallel timber shears with wrought iron strips forming the sliding surfaces. These strips are fastened to the timbers with countersunk head woodscrews. The headstock is built up from timber and the front bearing pedestal can be moved and locked in position (**fig 103**). A two-step flat pulley is mounted on a forged wrought-iron mandrel which has a point-ended pivot bearing at the rear. An iron casting forms the tailstock body which is clamped in position by a screw and plate under the bed. The tailstock spindle is advanced by a screw and lever carried in a

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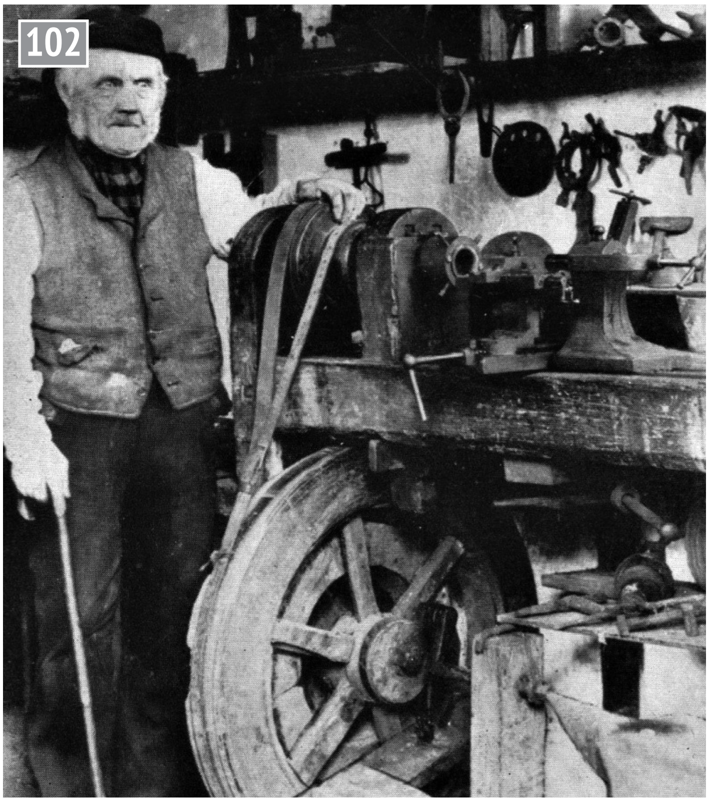

Matthew Boulton's lathe. Photograph before preservation at the Birmingham Museum of Science and Industry. Photograph in the Birmingham Reference Library.

103

Matthew Boulton's lathe. Detail of the headstock as preserved at the Birmingham Museum of Science and Industry. Photograph by kind permission of Birmingham Museums Trust.

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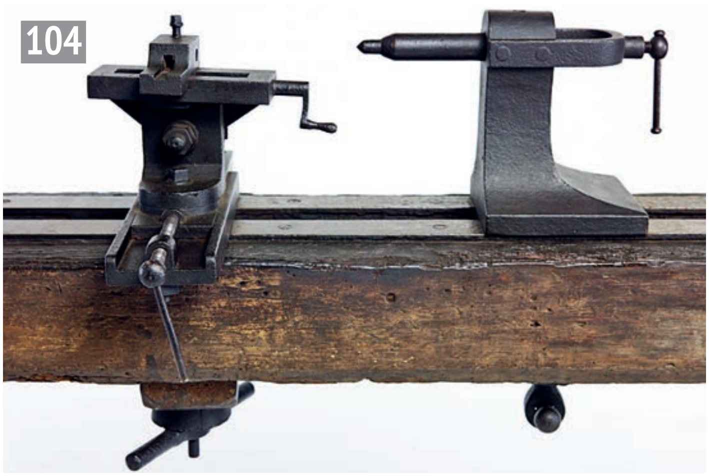

Matthew Boulton's lathe. Detail of the tailstock and compound slide rest toolholder. Photograph by kind permission of Birmingham Museums Trust.

U-shaped bridle at the rear of the casting.

The compound slide rest has transverse and lateral directions of movement (**fig 104**). In both cases screws propel the slides but the transverse screw uses a lever whilst the lateral has a crank. A clamping screw passing between the bed shears locks the slide in position. The toolholder has two tool positions at right angles to each other so that the slide can be used either for cross facing items held in the chuck or faceplate or alternatively the tool can be mounted to work parallel to the bed.

Similar lathes must have been in use at the Soho Manufactory from the begining of engine building in order to machine the nozzles and valves that had always been made there. The discussion between John Southern and James Watt Junior after Bersham's closure shows that at least one large lathe was in use by 1795, a machine that was sufficiently substantial for it be considered as adaptable to boring cylinders. As there is no evidence that machine tools were transferred from the Soho Manufactory to the Soho Foundry it would appear that a completely new set of machines was to be made.

That there was some novelty in the machines that were being planned for the Soho Foundry is apparent from a letter of 20 June 1796, which celebrates the first casting made at the new foundry, a nozzle. This jubilation was tempered by the fact that there was no lathe available to finish it and due to the … *uncommon construction*… of the new machines (**ref 183**) it was towards the end of 1799 before the first lathes were operational, even though dates on the small number of surviving drawings of lathes and drilling machines indicate that the drawing office was involved in design work between February and July 1797. These months coincide with William Murdoch's period at Soho and it is probable that he was responsible for designing the machines. His commitments in Cornwall and his recurrent ailments led to the delay in delivering them.

●To be continued.

REFERENCES

179. L.T.C. Rolt,.*Tools for the Job*. First published 1965, B. T. Batsford Ltd. William Steeds. *A History of Machine Tools 1700 – 1910*. Pub. Oxford University Clarendon Press.1969.The American author Robert S. Woodbury has also published a number of monographs on individual machine tools upon which other authors have subsequently drawn.

180. A debt of gratitude is owed to Prof. Ing. Carel De Beer whose several publications on eighteenth-century gun-founding and his high quality reproductions of Verbruggen's paintings are an invaluable source. See *The Art of the Gunfounding. The Casting of Bronze Cannon in the late 18th Century*. Carel De Beer. Pub. Jean Boudriot Publications 1991.

181. History of Machine tools. W. Steeds op., cit. Plate 12.

182. My thanks are due to Felicity McWilliams and Nadine Lees of the Birmingham Museums Trust for supplying these illustrations.

183. Matthew Boulton writing to his son 20 June 1796, B&W Parcel D/6 and John Southern to Watt Junior 20 June 1796, B&W Box 19/8.

Soft Soldering PART 2

Graham Astbury and **Mike Tilby** delve into the background behind fluxes and soft solders.

Continued from p.649
M.E. 4690, 6 May 2022

Very many types of solder have been described. Currently, on Wikipedia details of about 170 different compositions are listed (**ref 15**) and that list seems not to be fully comprehensive. International standards for solder compositions have been published (e.g. **ref 16**) but these publications are expensive and probably are of little relevance to hobbyists.

The first part of this series discussed the action of fluxes used in soft soldering and ended with an outline of the properties of plumber's solder. The next type of solder that is commonly found is the 50% tin 50% lead solder which is described as a solder for 'general engineering work on copper, brass and zinc' and is also known as 'tinman's solder'. This has less lead than plumber's solder but more than the solders described below. For general constructional use, such as soldering tinplate and non-electrical components, it is perfectly suitable and the reduced tin content does not seem to materially affect the joint strength. As predicted from the phase diagram (fig 1 in Part 1) it has a narrower melting range (183-215 degrees C) than plumber's solder. According to Hall (**ref 17**), tinman's solder can also contain antimony as a substitute for tin. Incorporation of antimony can be acceptable, but in excess of around 7% it adversely affects the properties of the solder (**ref 18**). Also, as discussed in Part 1, solders containing antimony may not be suitable for soldering zinc and there is a potential safety issue with certain fluxes.

Electrical solder for joining electronic components together needs to have specific properties such as a sharp freezing point along with a low melting point. Traditional electrical solders have been of nominally the eutectic mixture. However, it is known that this composition, of either 63% Sn 37% Pb or 60% Sn 40% Pb, can dissolve copper from the soldering bit. Iron is practically insoluble in molten tin or lead, so that is why many soldering bits are iron-plated in an attempt to stop the bit dissolving when using the pure eutectic alloy. Dissolution of copper in solder can also cause weakening of fine wires (**refs 19** and **20**).

This problem of dissolving copper into the molten solder has resulted in a small amount of copper (typically 1.9%) being added to the solder to saturate the tin-lead alloy with copper, but this was applied to a nominally 50% Sn 50% Pb solder to make it 50.2% Sn, 47.9% Pb, 1.9% Cu solder which is more akin to the tinman's solder, having a melting range of 183-215 degrees C. With this composition, when the solder contacts the copper soldering bit, the molten solder does not dissolve the copper from the bit quite as rapidly. That is the theory, and in practice it does make some difference, but doesn't completely stop the solder dissolving the soldering bit. The melting range of this alloy ('Savbit No.1') seems to be the same as tinman's solder namely 183-215 degrees C (ref 20).

As there are now greater environmental concerns about using lead-based solders, there is a move to electrical solders which do not contain lead and in many countries it is illegal to use lead in solders for many applications, especially drinking water pipes. There are a large number of lead-free solders which are substantially pure tin but do contain a small quantity of copper, silver or both. Tin is a metal with some unusual properties which are described in **Box 1**. There is a eutectic alloy of tin and copper containing 99.3% tin and 0.7% copper which has a melting point of 227 degrees C (**ref 21**), which is a little lower than the melting point of pure tin. Again, as these contain copper, there is a reduction in the propensity of the molten solder to dissolve the copper soldering bit.

There is a class of high melting point solders which are still permitted to be used under specific circumstances and these are substantially lead with small quantities of alloying elements, with a typical composition of 1.5% silver, 5% tin, 93.5% lead. This alloy, widely known as 'Comsol' (see **ref 22** for the datasheet) is described in EN ISO 9453:2006 as Alloy No. 191. It has a melting point of 296 degrees C, but requires a special flux which is classed as corrosive, so needs to be thoroughly cleaned off after soldering. Despite its high lead content this solder is legally allowed for use in Europe and the U.K. because it has a high melting point compared to most soft solders and it can be used where service temperatures for soldered articles are too high for a low lead content soft solder which would either melt or be very weak at those service temperatures.

Finally, several low melting point solders are sold under the brand name Carrs, with melting points of 145 degrees C, 100 degrees C and 70 degrees C. Strictly, these should be termed 'fusible alloys' as they are liquid below the 180 degrees C lower limit for soft solders, » but we will consider them to be soft solders as that is their primary use as far as this article is concerned. They are rather specialised products generally used for soldering white metal castings in model railways. Their composition is somewhat difficult to confirm, but there is a good discussion by Thompson about these alloys in **ref 23**. The 70 degrees C melting point solder is almost certainly Woods Alloy (also known as Lipowitz Alloy). This is a quaternary (four component) eutectic and slight variations of the composition are well known within the published literature, with the most likely composition given in **ref 24** of 50% Bismuth (Bi) / 25% Lead / 12.5% Tin / 12.5% Cadmium (Cd). The 100 degrees C melting point alloy is probably the ternary (three component) eutectic alloy of 52% Bi / 32% Pb / 16% Sn, as described in ref 23. Finally, the 145 degrees C solder probably has the ternary eutectic composition of 49.8% Sn / 32% Pb / 18.2% Cd, according to ref 23. All these solders are summarised in increasing melting range in **Table 1**.

Table 1. Composition of common soft solders

Solder	Composition, (% w/w)	Melting range, (degrees C)
Carrs 1001®	50 Bi / 25 Pb / 12.5 Sn / 12.5 Cd	70
Carrs 1044®	52 Bi / 32 Pb / 16 Sn	100
Carrs 1002®	49.8 Sn / 32 Pb / 18.2 Cd	145
Alloy 45 (Alu-sol) for aluminium	80.1 Pb / 18 Sn / 1.9 Ag	178-270
Ternary eutectic solder	62 Sn / 36 Pb / 2 Ag	179
Sn / Pb Eutectic solder	63 Sn / 37 Pb	183
Tinman's solder*	47-48 Sn / 50 Pb / 2-3 Sb	183-215
'Savbit'® Electronic solder‡	50.2 Sn / 47.9 Pb / 1.9 Cu	183-215
Plumbers' solder*	30 Sn / 68 Pb / 2 Sb	185-243
Electrical solder 60 Sn / 40 Pb	60 Sn / 40 Pb	183-186
Silver-bearing solder (alloy 96). Eutectic solder for stainless steel	96 Sn / 4 Ag	221
SAC305 lead free solder	96.7 Sn / 2.8 Ag / 0.5Cu	217-220
Lead-free eutectic solder	99.3 Sn / 0.7 Cu	227
High Melting Point solder†	93.5 Pb / 5 Sn / 1.5 Ag	296

Ag = silver, Bi = bismuth, Cd = cadmium, Cu = copper, Pb = lead, Sb = antimony, Sn = tin.
* composition from ref 17, but not all plumbers and tinman's solders will contain antimony.
‡ Available with 1% or 2% flux in the core.
† only allowed to be used in the UK as '...*high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85% lead)*...' (**ref 25**).

Wetting

Difficulty in causing solder to 'wet' the parent metal is a problem found with many solder/metal combinations. One of the easiest of the common metals to be wetted by a molten solder is copper. If you are a multi-millionaire, you could always try sheets of gold which can be wetted with solder even without a flux, as gold does not readily oxidise or tarnish. For the rest of us, we will have to make do with a base metal and use a flux.

Of the metals used in solder, it is the tin which wets the parent metal the easiest, which is why most soft solders contain tin. In pre-history when soldering of lead was practised by the Romans, the solder was originally lead and tallow was used to prevent the surface of the hot lead oxidising. Once hot, the tallow was applied and the surface of the lead scraped to remove the oxide. Lead was then run onto the parent metal to solder the items together. This was more akin to welding than soldering and was extremely difficult to do. It was found that adding tin to the lead solder reduced the melting temperature and made it easier to join the two pieces of lead together without melting them. They also found that it was easier to 'wet' the lead parent metal when there was tin in the solder.

In modern times, it is found that certain parent metals are difficult to wet because of their propensity to form hard or refractory oxide layers. The most common of these is aluminium which is notoriously difficult to solder as is cadmium plating. The latter is now becoming rarer due to its toxicity and it is best avoided completely unless there is no alternative, where scraping or abrading of the surface until the base metal is visible is one option to achieve good wetting of the parent metal. Chromium, as a constituent of stainless steels, rapidly forms a protective film which makes it difficult to wet but this can be

TIN - A METAL THAT CAN CRY, GROW WHISKERS AND TRANSFORM INTO A NON-METAL

Since tin is the main ingredient of most soft solders it is worthwhile briefly discussing some surprising properties of it. Solid tin is generally seen as a shiny metal. It is attacked by strong acids and alkalis but in many circumstances it resists corrosion. As for many other metals, the atoms of which tin is composed are arranged in specific and very regular patterns. In other words they are crystalline. Because of the particular arrangement of its atoms, when a bar of pure tin is bent it emits a crackling sound known as 'the cry of tin'. (See **www.youtube.com/watch?v=Xbk5t061x4c**). However, the atoms of tin can arrange themselves in two different patterns called alpha and beta. In the beta arrangement they form typical metallic or white tin but at temperatures below 13 degrees C they spontaneously re-organise themselves into the alpha arrangement which is dramatically different in appearance. Alpha tin looks like a grey powder and is classed as a non-metal rather than a metal due to its crystal structure being typical of non-metals. This dramatic change is very slow at just below 13 degrees C but occurs more rapidly at lower temperatures - (see **www.youtube.com/watch?v=sXB83Heh3_c** - Note that this is a 20 frames per hour time-lapsed film of beta tin to alpha tin transformation at -40 degrees C - the total elapsed time of the clip is 20 hours). The ease with which tin atoms can re-arrange themselves is reflected in their ability to move into the inter-metallic zone (to be explained in Part 3) of a soldered joint. As this movement occurs, stresses are set up in the bulk of the solder and these can cause tin atoms to move out to form fine whiskers. These are so fine as to be of no importance for many applications but for miniature electronic circuits they can be disastrous. The presence of lead in many solders prevents whisker formation but if pure tin or certain lead-free solders are used for soldering electrical components whiskers will form over long periods of time.

removed using the appropriate aggressive flux.

Tin is seen to be the optimal constituent of solder for wetting the parent metals. The other metal which wets the work well is silver, but the sheer cost of it and its high melting point means that it cannot be used alone as all soft solders are fully molten well below the melting point of silver (962 degrees C). This is why tin is the preferred constituent for wetting the parent metal - hence the term 'tinning' and the common practice of having the copper wires on electronic components tinned. However, with pure tin alone as the solder it can sometimes prove difficult to wet some metals and the addition of a little silver, typically around 1.5% to 4%, helps the wetting. So, silver is often used in lead-free solders or solders not containing significant amounts of tin. Similarly, when soft soldering stainless steel, a 4% silver 96% tin solder is used to ensure adequate wetting. This is where the use of the correct flux is key.

Usually, solder suppliers and manufacturers specify which flux is suitable for their products. The exception is when multi-cored solder is used for electrical and electronic soldering where the flux is already incorporated within the solder wire. For all others, the flux will need to be chosen carefully as corrosive fluxes will have to be removed after soldering.

This article has previously appeared in *The Journal of the Society of Model and Experimental Engineers*.

●To be continued.

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Club Diary 22 May - 9 July 2022

May

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

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

22 Southport MEC
Diesel Day, Victoria Park 10:00 – 16:00. Contact: Gwen Baguley, gwenandderrick@yahoo.co.uk

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

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

June

1 Bradford MES
Loco Competition 2022, Northcliff Railway 19:30. Contact: Russ Coppin, 07815 048999

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

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

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

11/12 North Wilts MES
Club Rally, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

18/19 Cardiff Model Engineering Society
Welsh Rally, Evening hog roast, Heath Park - see www.cardiffmes.co.uk Contact: secretary@cardiffmes.co.uk

18/19 Fareham and District SME
Sweet Pea Rally, Club Track 10:00 – 16:00. Contact: sweet-pea-2022@fdsme.org.uk

18/19 Melton Mowbray MES
Steam Show, Whissendine Sports Ground – see mmdmes.wixsite.com/home Contact: jacced@hotmail.co.uk

18/19 Reading SME
LittleLEC 2022, Prospect Park, Reading. Contact: littlelec@gmes.org.uk

18/19 Southport MEC
Open Weekend, Victoria Park 10:00 – 16:00. Contact: Gwen Baguley, gwenandderrick@yahoo.co.uk

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

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

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

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

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

July

3 Bradford MES
Rae Gala 2022, Northcliff Railway 14:00 – 16:30. Contact: Russ Coppin, 07815 048999

2/3 North Wilts MES
Charity Weekend, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

6 Bradford MES
Boating Competition and Social Evening 2022, Wisbey Park 19:30. Contact: Russ Coppin, 07815 048999

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

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Well! Following the return to sanity, or what passes for it here, I find my locomotive *Deborah* has survived the winter, except that a nearby toolbox which appeared to be empty, was in fact full to the very brim with rainwater. This fact had escaped my attention until I reached for a spanner and got a surprise.

Fed up with loose wires everywhere, I thought this idea 'had legs'. The usual way of dealing with straggling bits is a combover... er, laying conduit, that is, using *Spirawrap*, which works well enough but is expensive (£7 for two metres). What I needed was a tube split along its length but retaining its circular form. Hosepipe, air hose, plastic piping for car windscreen washers, all work, but I have odd, short-ish lengths of coaxial cable and decided to sacrifice one of the cheaper kind in the interests of science. Great! it does everything I need (**photo 1**).

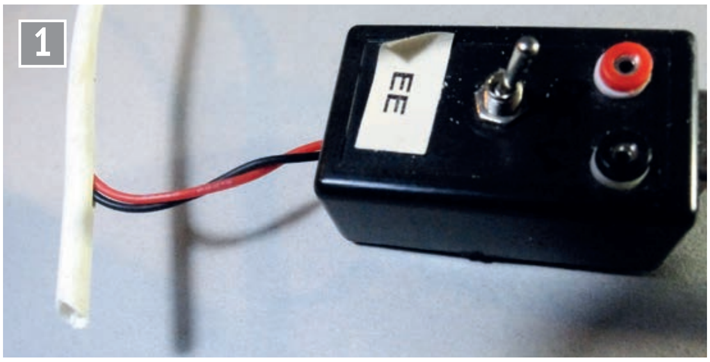
So, on with the motley, and let us see what the *'rude mechanicals'* have been doing.

In this issue, free floating balance, Anzani, Meyer locomotives, EMP, a monorail, wiggles, a co-ed and oil dispensers.

Murray Lane is first out of the trap, with the March **Model & Experimental Engineers, Auckland,** *Newsletter*. An historical 1850s blacksmith's forge may be in danger from the local H&S busybodies, whilst Bruce Lawson had a clock movement which he hoped to fit into a Keiniger case. The movement is interesting in that the balance wheel has no pivots, but is located at the midpoint of opposed spiral springs which coil both ways, so it 'floats' without bearings.

Model Engineers & Live Steamers Association, Maryborough, sends their March *Newsletter*, in which Chris Arnold writes on Du Bosquet locomotives, starting with this phrase 'The French have always been a strange lot, just ask the Poms...'. Ah yes, I well remember standing on the White Cliffs of Dover shouting "À bas les Francais" and other such pleasantries across La Manche. Then there was André Citroën, who put the gearbox in front of the engine, but I digress. Gaston du Bosquet, Grande Fromage of the Nord railway system in 1905, invented several improvements to their Meyer locomotives, the design of which was produced in 1861. To help solve the usual problem, difficulties with an articulated flexible steam joint, Du Bosquet placed the driving wheels at the extremities and the cylinders in the middle. The rear 'bogie' was pivoted only laterally, whilst the front one had full movement to guide the engine into curves. (Not when in reverse - Geoff) This meant that only low-pressure steam used the flexible joint, which was easier to make and maintain. See also Douglas Self and Wikipedia. Girardus Mol tidied up the workshop, to reveal a beautifully clean and ordered activity centre, with three locomotives under construction. A NZR diesel electric locomotive, a design from Japan's Mitsubishi, has been modelled in 5 inch gauge by John Sekold of Rockhampton, Lat 23 degrees S, which has the world's only fully restored steam tram in revenue earning service. Made by Purrey, in Bordeaux, it was rebuilt in 1988.

W. www.melsamaryborough.org



DIY cable tidy.

The Newsletter, spring, from **Bristol Society of Model & Experimental Engineers** has an intriguing idea from Colin MacEke for setting up his lathe with greater accuracy than it seems to offer. A pocket laser, used for tormenting the cat in some circles, was pressed into service to set the toolpost square. Then it was turned so that the red spot moved along a mathematically accurate scale and 'Robert's your aged relative'. The UK Government has confirmed that the use of coal in heritage steam vehicles will not be banned and they have no intention of changing this policy. Contemporaneously, Neil Dare reports favourably on 'eCoal', very hot and no clinker, he says. Editor Richard Lunn encountered Anzani i/c engines, which he assumed were Italian. Not so, he found, they went into motorbikes, small aero engines and outboard motors (my Dad had one of the last mentioned). Programme secretary John Allen remarks that most people had never heard of Zoom, the online conferencing system (and never read Molesworth? - Geoff) until the restrictions on attending meetings in person were imposed, that is.

W. www.bristolmodelengineers.co.uk

Now then, I've had a request, but we don't provide that service here, even were it lawful. However, if you (see page 42)...

The Smokebox is a stylish publication, which seems to be produced by a retiring lot, as they keep their light under a bushel, not giving prominence to the name of their organisation. Steve and Leon are nearing completion of their locomotives, followed by repairs to Leon Kamffer's Shay. A column has been started to

CONTACT

geofftheasby@gmail.com

give the younger members an idea of the club in previous years, as some older members have been 'in good standing' for longer than some of their fellow modellers have been alive. For those who wish to identify these young sprigs, the details are provided, written in a form most easily decoded in the bathroom. On reflection, use a mirror... Finally, we find that we have been reading the newsletter of the **Rand Society of Model Engineers**.

W. www.rsme.co.za

Thinking of the effects of nuclear weapons upon everyday objects (as you do, well I do… led by the awful news coming from Ukraine), most of today's electronic technology would be useless through lack of electricity, even if surviving the Electro-Magnetic Pulse. Steam power would not, of course, so long as there was coal and oil. The paintwork might be singed, and the colours dulled, but the mechanisms would be unaffected. The excellent TV series Doomwatch in the early 1970s explored the idea, assuming only a handful of survivors after a virulent pandemic, as does Keith Roberts' 'steampunk-like' novel, *Pavane.*

Welling & District Model Engineering Society's April-May newsletter sees editor Tony Riley visiting Edinburgh and includes an item about Princes Street and Waverley Stations. Bob Underwood writes on the club history and their proceedings with Greenwich Council and the National Grid, mainly concerned with finding the right person to get things done. This concluded with a move to Hall Place, where they hope to spend the next 76 years. By Christmas 2021 they were aiming to reopen by Easter 2022 when the council asked to make some video recordings of the club in action, to support a local Councillor. All non-essential work stopped as the site was hastily made presentable and safe, the track proving very smooth as the venerable president took the said dignitary for a spin, with his equally venerable scratch-built 'Atlantic' locomotive. In Bob Underwood's *'First Train out of Kings Cross'*, we find that it wasn't one of the Great Northerns. Ten acres of gardens were previously there, in which a suspended monorail was operating, provided by a Mr. Thorrington, of whom nothing further has been traced. (Unless, of course, you know different…) More successful was H.R. Palmer, who, amongst inventing the shipping container system, a means of measuring the towing resistance of boats and several other ideas, was the inventor of corrugated iron, which fact recently made it into a recent PhD thesis. Wuppertall in Germany runs a modern, up to date overhead suspended tram, introduced in 2015 as an addition to its 120 year old system, which runs for 8 miles.

W. www.wdmes.co.uk

Bradford Model Engineering Society's *Monthly Bulletin*, April, in Road Vehicle Report is concerned with tractors, esp. the Huber, a new one on author David Jackson, but selling all over the world. He visited Broughton Game Show near Skipton. (An excellent country show, I used to work in one of their properties, and have had a guided tour of the house. Very grand, but like Huddersfield railway station, only the facade is impressive, Broughton Hall is only one room thick, linked by a rear corridor.) The transport is provided by Craven Old Wheels, who provide a magnificent range of interesting and historic vehicles.

W. www.bradfordmes.uk

Trackerjack, February, from **Teeside Small Gauge Railway** (yes, I've checked!) has a seascape on its front page. Why? Well, under a grey and forbidding sky, a grey and forbidding North Sea is a hint of words to come. Editor John Palmer goes on to discuss the cover photo, water and its 'magical' properties. As a friend of mine would say, "it's all due to impurities". He (John) has acquired a mostly-built 5 inch gauge Speedy. The chassis is for a 2-6-4 Jubilee tank needing 'only' platework and plumbing. Finally, John threatens to resign as editor if more contributions are not forthcoming by April.

W. www.tsgr.co.uk

CoSME Link, spring, from **City of Oxford Society of Model Engineers,** begins with the news that Jack Lester, a Junior Member for 8 years, has been awarded a 1st class honours degree in International Politics. He is now studying for a Masters, based on the UN. Well done, Jack! The 5 inch gauge ground level track is to be lifted after consulting the membership. Only a quarter responded, mostly in favour, so that will save a bit of maintenance. All the raised track carriages have names, Pullman-style, so the chairman Denis Mulford writes to say why, and who the personalities celebrated are, or were. Ron Head explains how to set up an eccentric, in a detailed article. There are many items about quartering wheels but I have seen none on this subject, which was read with interest. In another detailed piece Brian Holland then describes how he made wooden cylinder cladding for his 'Victorian' stationary engine. Co-Ed (not that sort!) Richard Brown then describes the making of a steam fountain, turret or manifold thingy for a GWR tender goods locomotive. These useful items skulk or lurk, in remote parts of the cab and distribute steam to the ancillary items distributed about the locomotive but, despite being small and unobtrusive, are essential.

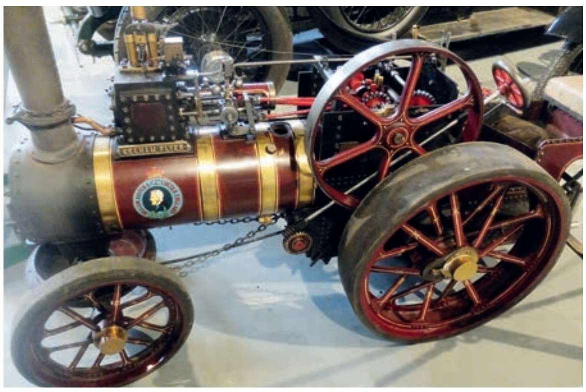
W. www.cosme.org.uk

On Track, April, from **Richmond Hill Live Steamers**, starts without a prompt or inspired idea but gets straight on with it; Peter Rock has for the past ten years been using medical syringes for oiling round his locomotive, as the standard workshop variety oil can dispenses too much. He finds that the water pump eccentric is the hardest to reach. He also says that with EP90 oil at least, it does not leak out even with the cap off. The nozzles may be extended with suitable copper piping - see Peter for details and syringes.

W. www.richmond-hill-live-steamers.tripod.com

And finally, Ambrose Bierce, author of the Devils Dictionary, says, on Railways: 'The chief of many mechanical devices, enabling us to get away from where we are to where we are no better off'. This was echoed by John Ruskin: '... and now, every fool in Buxton can be at Bakewell in half-an-hour, and every fool in Bakewell at Buxton'. And read his account of a train journey to Dolgellau (hootingyard.org/archives/2496), which illustrates what a right sourpuss he was. (Bierce once visited Deadwood in Dakota Territory, for his journalism. Doris Day appeared in a famous local theatre, known throughout the country East of the Pecos as *The Deadwood Stage.)*

No suitable pictures are available from the massed ranks of eager readers, so I append another picture from Kelham Island Industrial Museum in Sheffield.



Foster traction engine *Kelham Flyer.*

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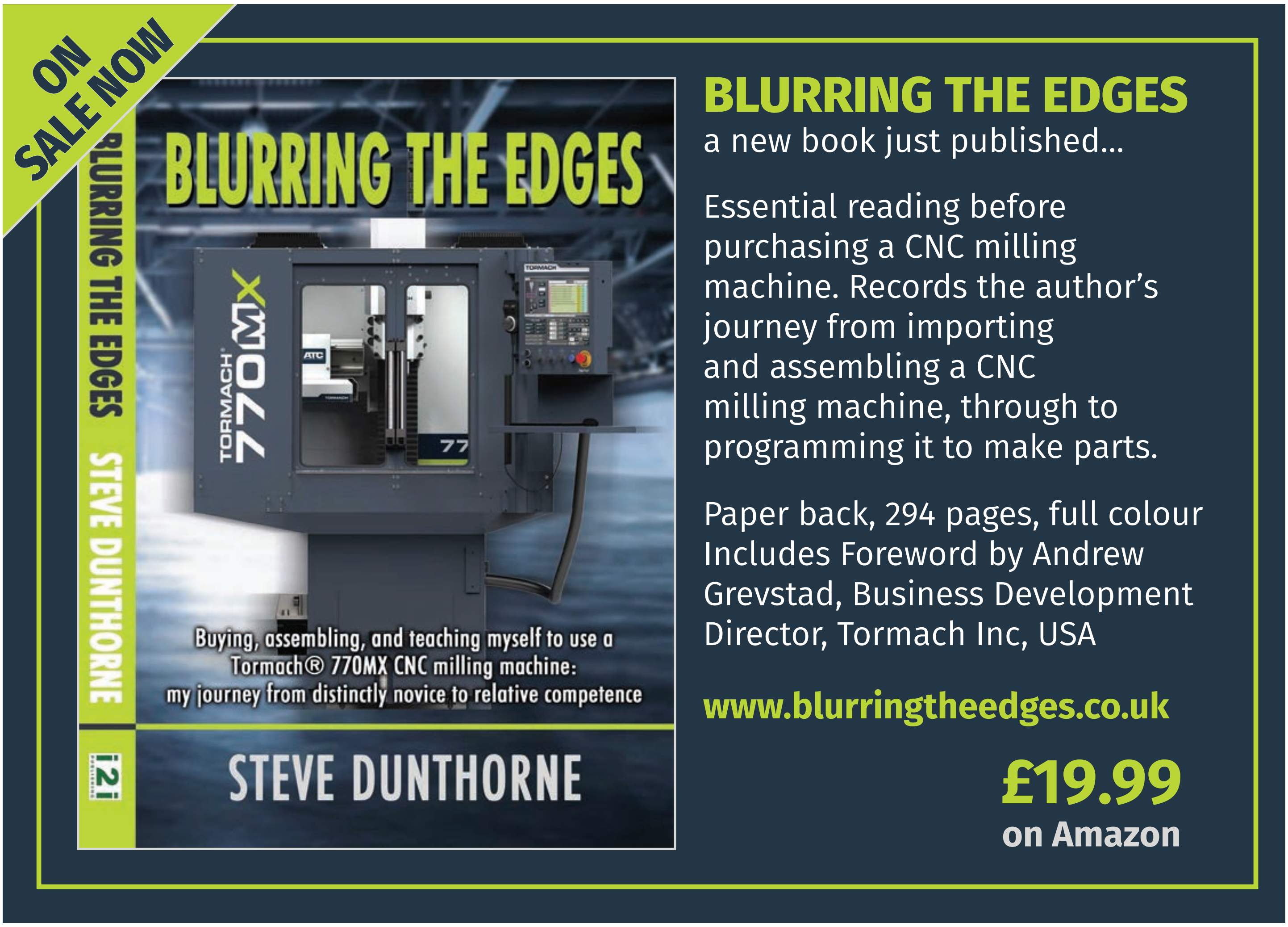
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