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Vol. 233 No. 4753 4 – 17 October 2024

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THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

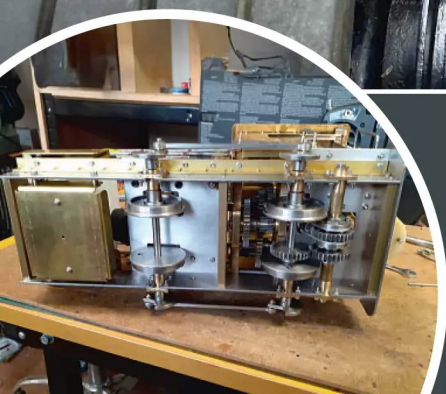


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EDITORIAL

Editor: Martin R. Evans
MEEditor@mortons.co.uk
Deputy editor: Diane Carney
Designer: Druck Media Pvt. Ltd.
Club News: Geoff Theasby
Illustrator: Grahame Chambers
Publisher: Steve O'Hara

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Mason Ponti mason@talk-media.uk
A: Talk Media, The Granary, Downs Court,
Yalding Hill, Yalding, Kent ME18 6AL
Investment Manager: Karen Davies
karen@talk-media.uk

PUBLISHING

Sales and distribution manager: Carl Smith
Marketing manager: Charlotte Park
Commercial director: Nigel Hole
Publishing director: Dan Savage

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A four inch McLaren traction engine belonging to Barry Buckley, seen at the Erewash Model Engineering Society (photo: John Arrowsmith).

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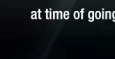
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MARTIN EVANS
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DIANE CARNEY
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Cheltenham SME

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.
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Rebirth of a Club

The Saffron Walden and District Society of Model Engineers (swdsme.co.uk) was founded in 1982, over 40 years ago, and for many years occupied a site at Audley End House, by courtesy of Robin Neville, Lord Braybrooke. This was a symbiotic relationship as, in return for use of the site, the club helped out with the maintenance and running of Lord Braybrooke's 10¼ inch gauge railway that runs through the nearby woods. Visitors could take a ride on the 'big' railway and then another ride on the 'small' 7¼/5 inch gauge railway next door.

This arrangement came to an end soon after the death of Lord Braybrooke in 2017 and the club was asked to leave the site, rendering them temporarily homeless. Fortunately they recently found a new site near Bishops Stortford and have now constructed a fine new track on a field next to the M11. A pipeline supplying fuel to nearby Stansted Airport runs though the site and at one point lies within three feet of the surface. The club consequently found themselves being closely watched by the 'men in black' as they laid a section of track over that spot! The development of the site continues and there are now steaming bays, a traverser, storage containers and a brand new clubhouse so the club is once again 'up and running'. There is even a tunnel! The club held its first public open day on September 14th.



Cheltenham SME's newly opened clubhouse, complete with rather fine verandah.

So – congratulations to the SWDSME on re-establishing and reviving the club in such fine style and here's our best wishes for the next 40 years.

Cheltenham

I had the pleasure recently of attending the opening of another new clubhouse, this time at the Cheltenham Society of Model Engineers (www.cheltsme.org.uk). I had previously visited the club almost exactly a year ago and was able then to see the beginnings of the new clubhouse's construction. This time the clubhouse was complete and your editor was privileged to 'do the honours' and declare it open. It's a very fine building and I particularly like the verandah along the front, giving it a rather 'colonial' feel. I wished that I had brought my banjo and a rocking chair along!

Fame Beckons

Now that the equinox has passed and the nights are drawing in (and that right rapidly, it seems) it's time to

chuck an extra log on the fire, charge the chalice from the palace with the brew that is true, squeeze the squeaky squid and sharpen the quill. We, your fellow readers, want to know what you have been getting up to in the seclusion of those 'dark satanic mills' at the bottom of the garden. So let the approaching season of mists and mellow fruitfulness inspire you to scale the lofty literary heights and seek immortality in the pages of *Model Engineer* magazine. It really doesn't get better than that, does it? By the way, it doesn't matter if your middle name isn't 'Charles Dickens' – Diane and I will happily wield our magic blue pencils and add whatever polish may be required.

Club Secretaries

I imagine that you are currently in the process of firming up your programmes for the coming year. If that is so, why not send me a copy for inclusion in the Club Diary? This is a good way to raise your profile and to encourage other model engineers to visit your club – and perhaps even to encourage prospective new members!



Chairman Jonathan Leech (second from right) and the 'Wednesday Gang' at the Saffron Walden SME's new track near Bishops Stortford.

A BR Standard Class 4 Tender Engine

PART 4

Doug Hewson describes a 5 inch gauge version of the BR Standard 2-6-0 tender engine.



15



Front buffer beam and front plate of the saddle.

It has been brought to my notice that 16swg CR4 steel plate is no longer available, even though I have specified it in a lot of my laser cut parts. It is only a few thou short but it may mean that some of the slots may not be such a good fit for the tabs. It is such a convenient thickness being 1/16th inch. I have had some parts which are almost 6 thou undersize. I am hoping that at least if the pieces in your kit are cut out of one sheet, then at least they will be uniform. The other slight problem is that the overall thickness means that your frames may be a little undersize.

We now come to the smokebox saddle and I can't help but think this is not going to be an easy task. The assembly is not the problem

if you buy the laser cut kit but when you get to the exhaust pipes, that might be! My friend Geoff sorted it out very nicely on his Class 4 4-6-0 by using ½ inch copper tube and bending them into submission and then belling the lower ends out to fit into the frame plates. I have shown the pipes as they should be but feel free to make your own arrangements! As long as the smoke goes up the chimney in a straight line that will be fine. Of course, the two front ones are similar but opposite hand and, similarly, with the two rear ones. I would assemble the sides and ends first, including the various stiffeners underneath and then assemble the exhaust system one piece at a time later.

Now, I always convert my drawings to metric to produce

the laser cutting drawings as it saves rather a lot of anguish when it comes to the results. I had someone who did not understand that the ratio was simply 25.4mm to an inch - simple isn't it?! I had a Britannia cab kit cut but it wasn't quite correct for 3½ inch gauge but it was meant for a 5 inch gauge engine! Anyway, that aside, what I was getting at was the fact that the width of the top plate of the saddle is 122mm wide, although you may want to add a little bit to that so that when you put it into your rolls you can roll it to the 2¾ inch radius (inside) without a problem. I have used some photographs I took some time ago to illustrate the front buffer beam and **photo 15** shows the buffer beam and part of the front plate of the smoke



16 Rear view of the smokebox saddle (photo: Toddington Standard Loco Ltd.)



17 Rear view showing the four stiffeners (photo: Toddington Standard Loco Ltd.)



18 View of locomotive 76018 (photo: John F. Meakin via the Transport Treasury.)

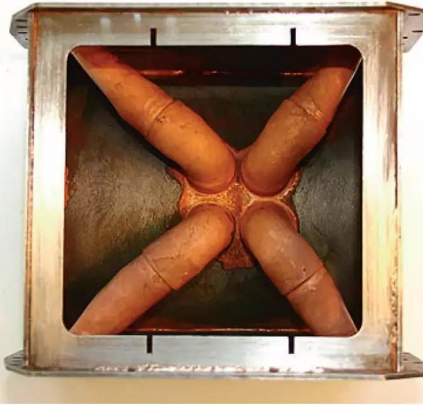


19 Exhaust ways wired ready for silver soldering (photos: Geoff Whittaker.)



20

21



Underside view of the exhaust system (photo: Geoff Whittaker.)

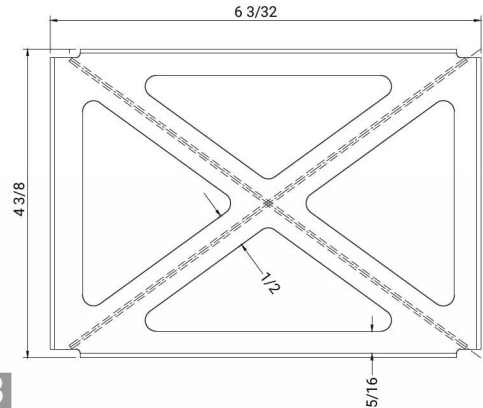
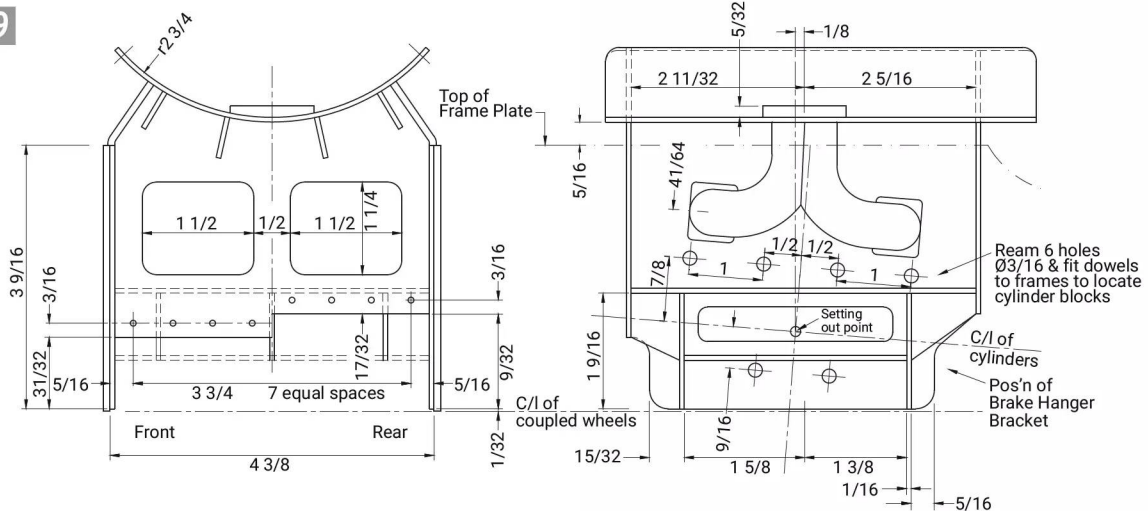


Fig 8

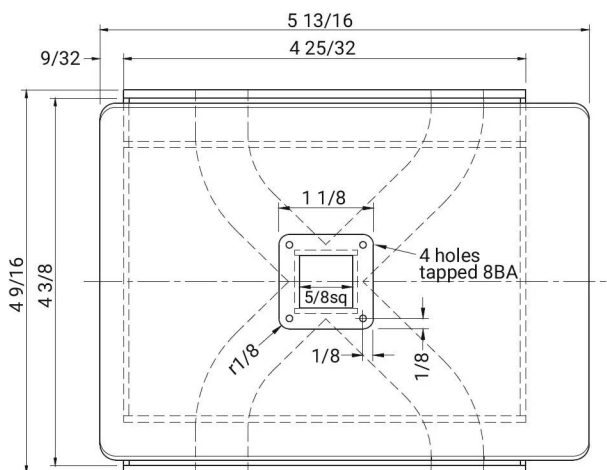
Stretcher no. 2.

Fig 9



Smokebox saddle.

Fig 10



Smokebox saddle plan view.

box saddle. There is also part of stretcher no. 1. I have also included **photo 16** to show the rear of the smoke box saddle the best I can. **Photograph 17** also shows the rear plate of the saddle and it shows the four stiffeners silver soldered to the back plate. Also worth noting here is the top of the weighshaft bracket with its two projections which sit on the top of the frame plates. Now, as if by magic, **photo 18** just happens to be engine number 76018. One wonders how that could have happened!

I have used some of Geoff Whittaker's photographs to illustrate the assembly of the smoke box saddle which was for his Class 4 4-6-0 tender engine. **Photographs 19** and **20** show the cross piece of the exhaust ways silver soldered

together and wired in place ready for silver soldering the assembly into position. **Photograph 21** shows the exhaust system from the underside.

●To be continued.

Part 21:

Pastures New - Part 5

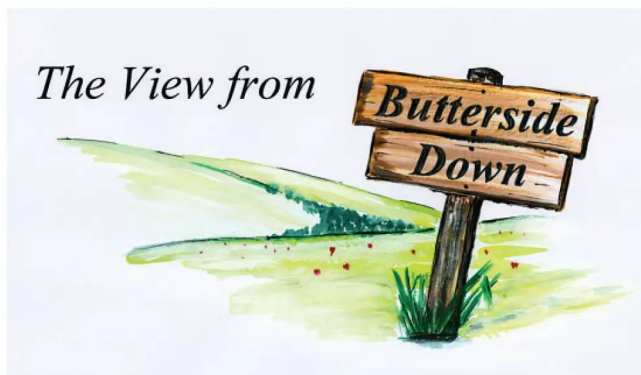
Spatter, Barstock, Castors and Rust

Steve Goodbody takes a random walk through model engineering.



Continued from p.453
M.E.4572 September 20

The View from



With interior walls finished and exterior landscaping complete, we return to the story for the final time as the author readies his shed for its intended purpose. Oh, happy day!

I beg your pardon?

Spatter, Barstock, Castors and Rust; it sounds like a firm of accountants you'd be wise to avoid, doesn't it? But rest assured, bemused Reader, for with the shed complete and a paved access route enabling it to be filled with workshop, this is simply my perverse way of introducing four parting tips before I wrap up this series of *Butterside Down* and head downstairs to plan my next project which may one day appear in these pages. Time will tell.

Anyway, since it's first on the list let's begin with spatter; a messy subject familiar to us all.

Spatter

Now in truth very little explanation is needed, for suffice to say that, if you practice metalwork, and

especially if your workshop machinery is as old and unguarded as mine, then you will be very familiar with spatter – the inevitable trails of oil and muck distributed widely (and at high velocity) from the total-loss bearings and rapidly-spinning cutting surfaces as we turn perfectly good raw materials into voluminous quantities of swarf. While it is not feasible to protect against it all, I bet there are some areas in your workshop where spatter is a sure-fired guarantee, aren't there? For me, the inevitable spatter-zone lies immediately behind my elderly lathe's countershaft where, the moment I turn on the machine and engage the spindle, a stream of lubricating oil emerges from the adjacent bearings to be flung unceremoniously against the wall.

Knowing this, several workshop-moves ago I purchased a sizeable sheet of thin stainless steel – nothing fancy or expensive – and screwed it to the wall in the offending location. And that simple expedient – just a sheet of stainless attached to the

wall and easy to wipe down – makes workshop clean-up a far easier proposition and its pleasantly shiny surface helps illuminate the rear of the workpiece, a supplementary bonus provided I keep it clean. So as my first parting gift idea, I can highly recommend adding a plain sheet of stainless steel to your Christmas list, to be attached to the walls and surfaces where you experience spatter, because it might make your life a little bit easier too (photos 113 and 114).

Barstock

Next on the agenda we have barstock, the lifeblood of our activities and a royal pain in the backside to organise and store. To demonstrate this, I posit the scenario where Colin, our erstwhile stunt-driver, in the middle of an interesting job, finds himself in need of several inches of 5/16-inch round brass to finish things up. He knows that he has a couple of feet of it somewhere, but can he lay his hands on it?



A strategically positioned spatter guard, ready for the lathe's imminent arrival.



The lathe in place, a cautionary sign guarding against injudicious metal removal and the spatter guard protecting the wall behind.



The wooden storage rack, resting on its beneficial wheels.

Searching among the random lengths of various metals all jumbled together and piled haphazardly on a shelf in the corner, he eventually gives up, orders a few more feet from his favourite stockist and, upon its arrival a week later, discovers the original length sniggering behind his workshop door. Sound familiar?

Now I can't claim to have solved every conundrum regarding materials storage – that would take a miracle – but I will happily summarise the system which I eventually arrived at and which seems to work well; at least for me. In essence, it all centres around a single wooden rack, six feet high, six feet long and two feet deep, having four flat shelves, one above the other, and a few wooden cross-pieces providing longitudinal supports beneath



Offcuts of each metal type are stored in segregated containers. Longer items - up to 2 feet long - lie adjacent with their ends visible for quick identification.



Even longer materials, those between 2 feet and 6 feet in length, are segregated and stored lengthwise beneath the shelves, their ends plainly visible once again.



The finished workshop with everything in its intended place. A simple rack for the very longest materials hangs from the ceiling joists above.

at least two of them. In fact, there it is in **photo 115**. Isn't that convenient?

Now this rack holds a lot of other items beside raw

materials - you will probably get a sense of that from the picture - but on that simple foundation, and with the over-arching proviso that different

metals are not stored together if they can't be distinguished at a glance (brass and gunmetal for example, or mild steel, stainless steel and silver steel to give another), here's how I organise my materials:

- Offcuts less than a foot long are stored in containers which sit on the shelf, a different container for each material type (brass, copper, mild steel and so on). However, if I have a lot of offcuts of one type of material, these are further segregated by shape (round and hexagonal brass sits in one container for example, rectangular and square brass in another).
- Next, materials between one foot and two feet in length are stored on the shelf beside their related container (an eighteen-inch length of silver steel sits on the shelf beside the container holding silver steel offcuts for example), each having its end facing frontwards so that its shape and size can be easily determined (**photo 116**).
- Continuing onwards, materials between two feet and six feet in length are stored longitudinally on the supports beneath the shelves, their ends visible from the side of the rack for rapid identification (**photo 117**).
- Once again, these longer materials are segregated by type; mild steel sits alone because there's always a lot of it, while I typically combine brass, copper and silver steel lengths because they're easy to tell apart.
- Finally, material exceeding six feet in length – mostly copper pipe in my case - is stored in a separate rack which hangs from the joists above: as you perhaps already suspected (**photo 118**).

And with that summarised, we arrive, believe it or not, at the penultimate subject for this series: castors.

Castors

To me, castors are the secret to an easy life in a workshop, especially for those having workshops with limited space

which is, let's face it, all of us. If mounted on castors, a heavy object is moved with ease – rolled into a corner if it's in the way, moved to centre-stage for greater access or shifted sideways to reclaim the workpiece dropped on the floor and lying beneath, inevitably just beyond arms reach.

In my own workshop, recently relocated from basement to shed, and with the obvious exceptions of the workbench, lathe and pillar drill, almost everything else sits on large-diameter rubber-wheeled castors and boy does it make life easier. *Jennifer Ann's* construction stand? On castors. Railway wagon storage rack? On castors. Materials storage rack? You've guessed it – castors once again.

In short, if it's in my workshop, heavy and doesn't have its own wheels, then it's on castors so that I can shift it with ease. And that, let me assure you as I pause to rescue yet another union nut which has rolled beneath the materials storage rack, is a real boon.

... and finally, rust

Did you notice that, despite my rude remonstrance and belligerent bombast in Episode 18 of *Butterside Down*, I have since remained remarkably quiet about rust? If so, then please rest assured, frustrated Reader, for the time has finally arrived to redress the balance, correct the omission and dazzle you with my profound insights concerning the prevention of that nasty red oxide from forming upon our decidedly ferrous-laden workshop contents.

Are you ready? Drumroll please, for here it comes.

Keep them oiled, don't let them get wet and if they do get wet, dry and re-oil them as soon as you can afterwards.

What? Is that it?

Well yes, disappointed Reader, that really is the crux of the issue, but with your permission perhaps I should provide a little more information because I realise that: (a) the statement was somewhat underwhelming

and (b) you have paid good money for this magazine and want to get your money's worth. So here we go.

In my experience, to effectively combat rust we must tame that most significant rust-causing foe in our workshop, the climate. And while that sounds like a bit of a challenge, if we can address just two things – humidity and temperature – then success is at our fingertips.

Water, water everywhere

Now *controlling* humidity – the amount of water vapour present in the air – is not a straightforward exercise, so from a practical perspective the best that I can do is offer a simple suggestion to keep humidity in check: please don't bring water into your workshop if you can avoid it and, if you must bring water in, take it out again as soon as possible!

But you're absolutely correct, while that is an ideal and overarching goal and one to keep firmly in mind, it is a rather impractical suggestion, isn't it? So, as a second attempt, here are some more actionable recommendations to keep workshop humidity at bay:

1. If you have a container of water (or any water-based liquid) in your workshop, then please keep it tightly sealed when not in use to prevent evaporation.
2. Don't use a gas heater to keep your workshop warm for, in addition to the risk of carbon-monoxide poisoning which won't do you any good at all, combustion generates water vapour and raises humidity which you definitely do not want.
3. Seal and insulate your workshop, preferably including a plastic vapour barrier, to keep the rain and damp squarely outdoors where it belongs.
4. Install at least one decent extraction fan if you can, preferably a quiet one, and turn it on whenever you are brazing, working with a flame for any other reason (remember: *combustion generates water vapour*),

or indeed doing anything else involving or generating water. And don't forget, that includes painting with water-based paints.

5. Avoid running steam engines in your workshop! Yes, I know it can be tempting, but don't be surprised if everything goes rusty afterwards.

And to conclude, you may have noticed that items 2, 3 and 4 from this list were integral facets of my shed-based workshop – electrically-powered heating, slavish attention to caulking and insulation and a couple of decent extraction fans – and humidity limitation and rust prevention is part of the reason why.

Temperature: that's the key

And finally, we arrive at *temperature*, arguably the most important factor in the fight against rust.

Picture this bucolic scene: the rolling grassy fields of *Butterside Down*, still and sublime in the pre-dawn light, the sun soon to break the horizon. As the first rays emerge, the dawn chorus announces the arrival of a new day and we see that the field before us, dry as a bone when we went to bed last night, is now covered in glistening dew. Beginning our morning constitutional, we stride purposefully towards the distant hamlet of Toast Landing and in very little time our shoes, brushing through the foliage, are soaking wet. *But why?* we ask ourselves. It didn't rain last night – it hasn't rained for days – so where has all this water come from?

The answer of course, and this won't come as a surprise, is that as the sun set the previous evening and heat from the unsheltered meadow began radiating away into the cloudless night sky – outer space is a very effective radiant heatsink for surfaces pointing in its direction – its temperature began to fall. Eventually, the pasture's temperature was so low, lower than the temperature

of the surrounding air, that water, present in the air as gaseous *water vapour*, instantly turned to liquid as it met the leaves of the sufficiently chilly greenery. And this process is of course called *condensation*, and the condensed liquid water on the grass is called *dew*, and the exact temperature at which the grass became sufficiently cold to cause condensation to occur and dew to form was, unsurprisingly, the *dewpoint*. And thus, our feet became uncomfortably wet the following morning.

However, condensation doesn't just occur on the verdant fields of *Butterside Down*, it will happen on any surface which is colder than the dewpoint of the surrounding air. And if that surface is a machine tool or a model, and the air is within your workshop, then the former will liberate water from the latter and your precious items will soon be covered with liquid H₂O and, not long thereafter, an unpleasant patina of Fe₂O₃. Fortunately, the prevention of this sad state of affairs is very straightforward: all we must do is keep the temperature of the items within our workshops above the dewpoint.

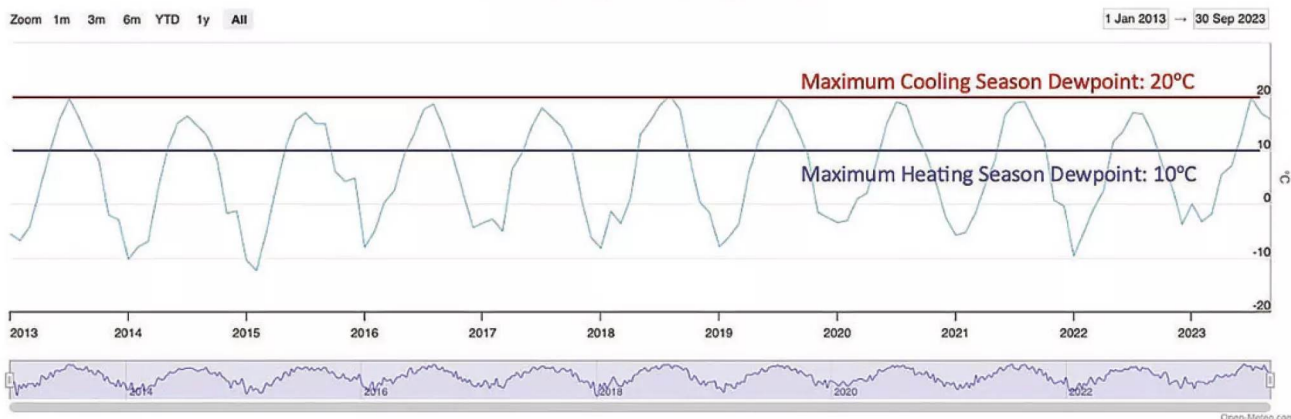
With that simple fact stated, what does this mean in practice? Well, first and foremost, it means that we must always maintain the temperature of our workshops above the dewpoint *whether we are working in them or not*. Furthermore, because the dewpoint continually changes thanks to a variety of factors, and it takes a long time for a lathe (for example) to warm up if it's been allowed to get too cold, it is wise to always maintain a decent margin – several degrees at least – between the workshop's temperature and the dewpoint.

Now that's all well and good, but it does rather presume that we know the dewpoint in the first place, doesn't it? Furthermore, because the dewpoint's temperature constantly changes (to use my own words against me) it also presupposes an element

Fig 12

40.70°N -74.50°E 115m above sea level

Generated in 2.24ms, downloaded in 880ms, time in GMT+0



A quick Internet search provides a wealth of historical dewpoint data (Source: Open-Meteo.com)

of clairvoyance. Put simply, we need to not only know what the dewpoint is now, but also *what it is likely to be in the near future* to ensure that our bulky and slow-to-warm-up workshop contents aren't too cold for that later date.

Again, fortunately, this is another solvable problem for, while the dewpoint does indeed vary, there exists a mountain of freely available historical weather data which can be used to our advantage.

Figure 12, for example, charts the average *monthly* dewpoint in my local area for the most recent ten years, located and downloaded from the Internet in five minutes flat, and you will spot a distinctly cyclical pattern in the data. Furthermore, you will also notice that I have

superimposed two horizontal lines on the graph – the upper one red and the lower one blue – representing, in the former case, the maximum historical average *monthly* dewpoint during the typical air-conditioning (cooling) season (roughly, June through to September) and, in the latter, its counterpart during the typical heating season (roughly, October through to May). And these figures respectively are: 20 degrees Celsius and 10 degrees Celsius.

But beware, for this does not provide a true picture, for these are average *monthly* values, and while the graph provides confidence that one year is very much like another in the grand scheme, you (like I) know that humidity changes far more

frequently than once a month. Fortunately, these data sources are based on measurements taken much more frequently – every two minutes, would you believe – and the closer we zoom in, the more detailed the picture becomes. But there's no need to go too far and, knowing that my insulated, sealed and equipment-filled workshop will provide a decent buffer to smooth things out, I'm content to refine the investigation to the average *daily* humidity figures for the past year: a maximum of 23 degrees Celsius in the hot season and 15 degrees Celsius in the cold as it turns out (**fig 13**).

And with just those two simple pieces of information in hand, we now know that, provided I maintain the

shed's temperature above 15 degrees Celsius (59 degrees Fahrenheit) in the frigid winter, and do not cool it below 23 degrees Celsius (73 degrees Fahrenheit) in the sweltering summer, then, unless I unwisely raise the shed's internal humidity by running steam engines or washing the floor (for example), the chance of condensation forming in my workshop is virtually zero. And that, to conclude, is knowledge I can use.

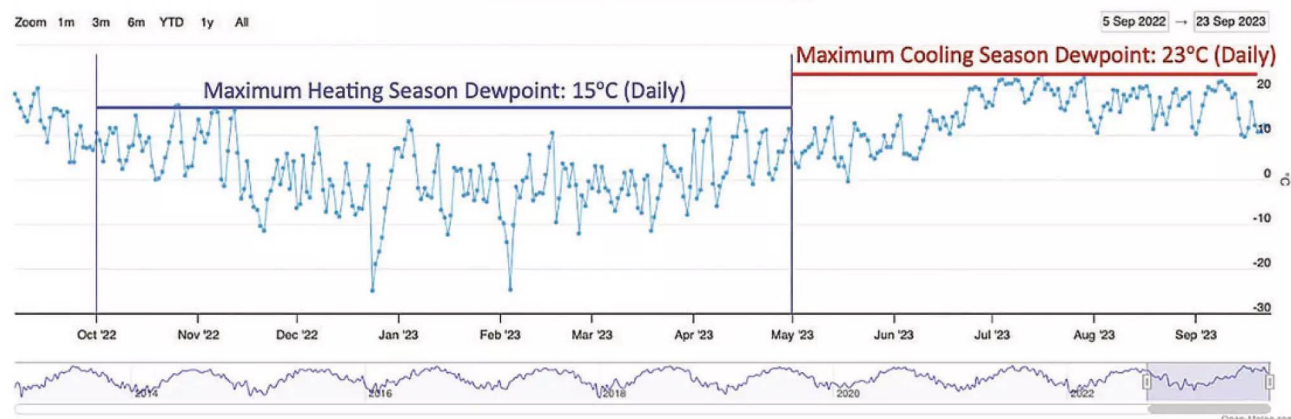
Was all the effort worth it?

Ah, the sixty-four-thousand-dollar question. Well, I now have a nice new office in which to read and write and collect my thoughts, a comfortable and ergonomic new workshop

Fig 13

40.70°N -74.50°E 115m above sea level

Generated in 1.92ms, downloaded in 864ms, time in GMT+0



Delving further, we discover that, on a daily basis in my location during the past year, the maximum daily dewpoint during the cold-weather season was 15 degrees Celsius and the equivalent during the hot season was 23 degrees Celsius (Source: Open-Meteo.com)



Yes, it does seem a whole lot smaller when full!

in which to practice model engineering, and Jenny will soon be able to depart the dining room for her new office in our house's basement. All in all, from this perspective the results are decidedly positive.

Regarding the mini-split heat pump system; In truth, it's early days as yet. However, with the usual hot summer and typically cold winter behind us, I am extremely pleased with the results so far. This summer, with the system in air-conditioning mode and set to maintain a temperature of 26 degrees Celsius (79 degrees Fahrenheit) with the building vacant, and despite daytime temperatures in the mid-thirties Celsius (mid-nineties Fahrenheit) and the sun beating down, the heat pump ran only occasionally, its energy consumption barely registering on the meter. In fact, comparing our electricity bills from the past two years, our average daily summertime electricity consumption actually *decreased* by 2.5 kWh this year compared to 2022, although the average daily ambient temperature was apparently also 2.75 degrees lower which probably accounts for the

surprising discrepancy.

Last winter however, with the system in heating mode and set to maintain a steady 16 degrees Celsius (61 degrees Fahrenheit) when the shed was empty, and with the day-and-night outdoor temperature continuously well below freezing, the system certainly consumed more energy during each 24-hour period than it did in the summer. However, that was to be expected – it must work much harder to maintain a stable indoor temperature in our brutal winters – yet, with the insulation doing its job, I see from the bills that our average electricity consumption increased by just 5 kWh each day to keep the shed both habitable and rust-free while the winter howled outdoors.

In summary, therefore, if I ignore the lower summertime energy consumption as a fluke, and instead assume that the additional energy required to air-condition the shed is negligible (all evidence points that way thus far), and if I then extend the daily additional 5 kWh to cover the entire eight-month heating season, then it appears that roughly 1200 kWh

of electricity will be needed each year to run the air-sourced heat-pump and make our new shed year-round habitable and keep rust at bay.

From the economic point of view, at today's prices in my neck of the woods, this equates to roughly two hundred and fifty annual dollars - seventy cents per day - or fifty-two cents per square foot of floorspace if you prefer. Whichever way I state it, the figure is certainly less than I assumed when embarking upon the project a year ago and that, of course, is a good result.

Furthermore, mid-way through the winter I discovered that it is necessary to run only one of the two indoor heat exchangers to maintain the desired temperature when the shed is empty: the upstairs one in the summer (because heat rises) and the downstairs one in the winter (for the same reason), which should have a marginal positive benefit upon electricity consumption in the future.

And finally, upon entering the shed to begin work each day, a quick tap on the appropriate thermostat causes the indoor temperature to quickly rise (or fall) to more comfortable levels

for habitation as the system ramps up and the blower circulates the heated or cooled air accordingly.

In conclusion, I am, as I say, pleased so far; however, I'll let you know if that should change.

Wrapping things up

Well, that's about it, patient Reader and to paraphrase the late, great and utterly peerless Humphrey Lyttelton: as the loose hamster-wheel of time catapults its occupant from the cage of eternity, and the peckish feline of fate enjoys a late-night snack, I see we have reached the end of another *Butterside Down* mini-series.

To wrap things up, it seems only reasonable to include one more picture of the finished workshop - tools and shelves installed and covered models taking up much of the remaining floorspace - and there it is in **photo 119**. And yes, it's amazing how much smaller it is when filled with stuff!

While it is unreasonable of me to hope that you enjoyed this five part epistle – *endured* is probably a more accurate word – I certainly hope that you discovered something useful buried under the mounds of fluff along the way. Perhaps you (like me) were struggling to find a simple way of organising your raw materials so that the right piece can be easily located? Or maybe you have been wondering whether to rent a mechanical digger for your next excavation project? Or possibly you are sitting with teeth chattering or sweat pouring and debating how to make your workshop a more habitable and less rust-prone place? If so, then I hope that my experiences are of some benefit and offer my best wishes for your own endeavours to come.

And with that I wish you *Adieu*, dear Reader, until next time.

● To be continued.

Nelly the Copter

Freya Hempenstall, of the Eastleigh Young Engineers Club, tries her hand at aeronautical engineering.



My name is Freya and I am now 10. I joined the Young Engineers in 2022 so I was 9 when I started and *Nelly* was my first project. I looked on the computer and found several helicopters. I picked out a simple one and saw how they are made and then copied one to make *Nelly*. Patrick won't work out what we have to do. He makes us work it out for ourselves but he does help. He said that *Nelly* would be far too heavy to fly but I still made the rotor on the tail and the propeller on the top spin using radio controls.

Patrick found some pieces of pink hard plastic foam and we decided to cut the body from this. It is very easy to cut up but I am not allowed to use the band saw.

In **photo 1** you can see how I built it up in pieces. The pieces of foam are glued together with Superglue. The body is made from five pieces and a lid. The tail is made from two pieces. You can see that I cut out four windows and two door holes. These were cut on the milling machine. You can see what you are doing when you use it because the mill has X and Y

readouts so you always know how many millimetres you have moved.

The windows are open but I ran into a problem later on and had to cover them with a plastic sheet.

The tail is made of a sandwich of two pieces of foam screwed to the body. For this I used a long wood screw. I had to put the screwdriver through one of the front windows. The wire for the motor at the back has to go down a hole through the foam and I was shown how to get the wire through the long hole.

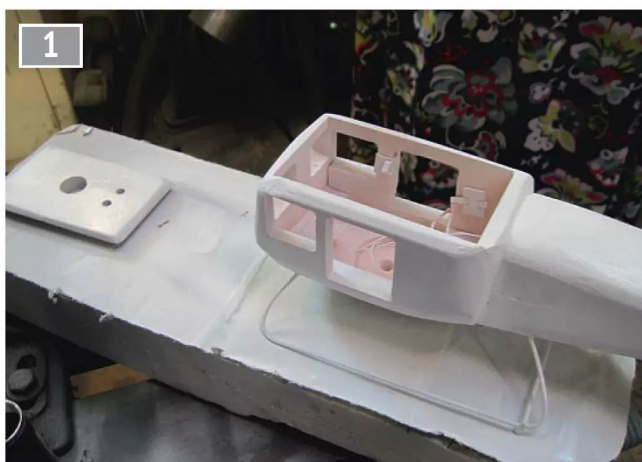
On the top is a lid which fits fairly well and that has the motor underneath it (**photo 2**). *Nelly* has a blue light in her bottom like all helicopters.

When I made the body and the tail, I rounded all the edges using the band sander.

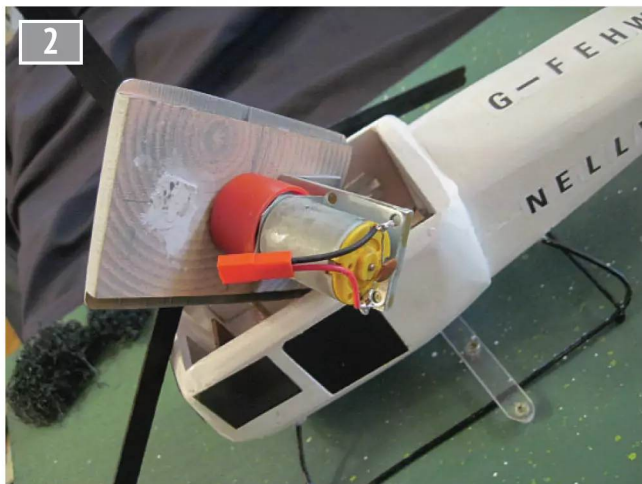
Rotor and motor

The motor came with a metal bracket so I glued it to an 'L' shaped piece of aluminium then screwed it into *Nelly's* lid. The rod coming out of the motor is buried inside a hole in the lid and I made a big bush out of brass to fit onto it. The bush was made on the lathe. I needed three rotor blades to be screwed on the top of the bush. The big gear on the lathe has 60 teeth and they are painted with numbers so I drilled a centre hole and then moved another 20 teeth and drilled another one until I had three holes at 120 degrees so it was exact. You can see me doing it in **photos 3 and 4**.

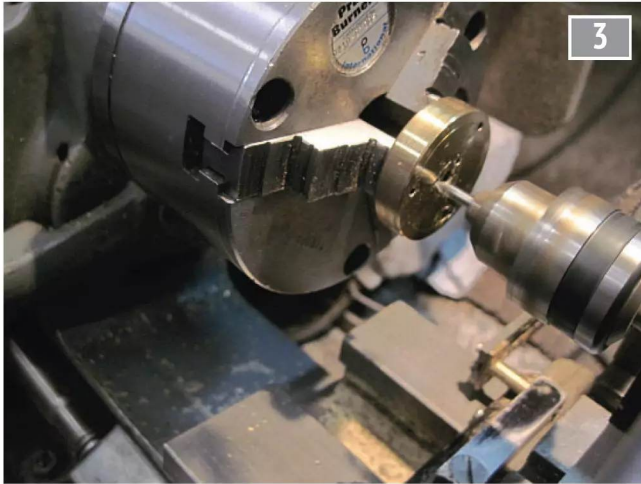
Then I used a 2.1mm drill to drill the holes (where the centre holes were) and tapped them M2.5. To do the tapping I put the tap in an electric screwdriver instead of doing it by hand. Patrick says we should always do it by machine if we can. I repeated this



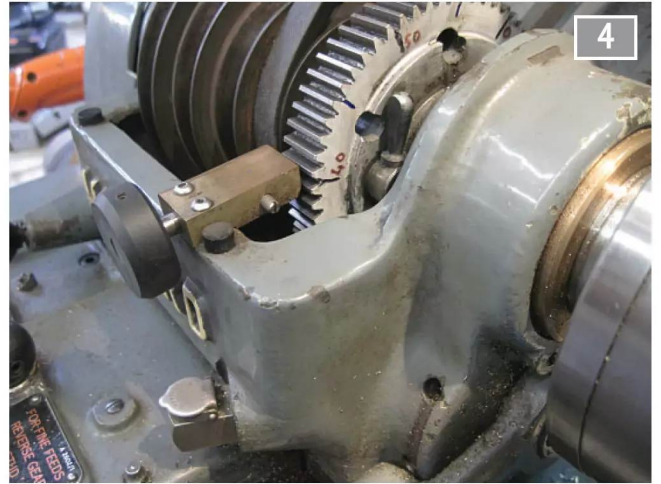
You can see the five pieces of the cab, the tail and the lid.



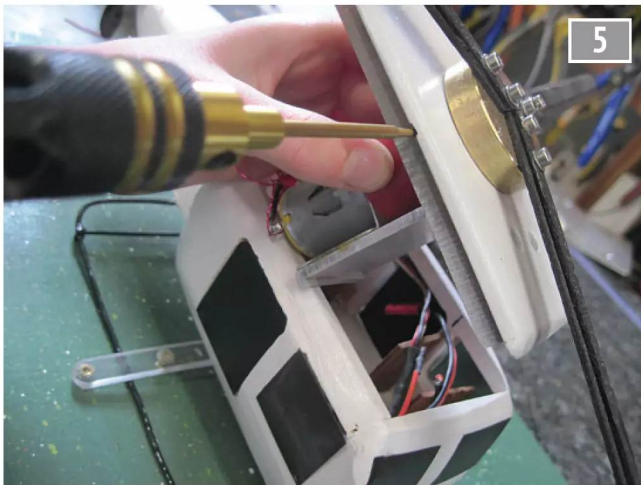
The motor under the lid.



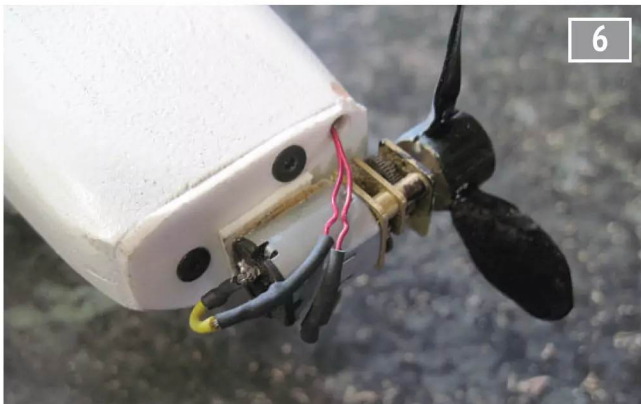
Drilling the six holes in the brass rotor.



Indexing using the lathe gear.



Grub screw buried in the lid.



Tail rotor.

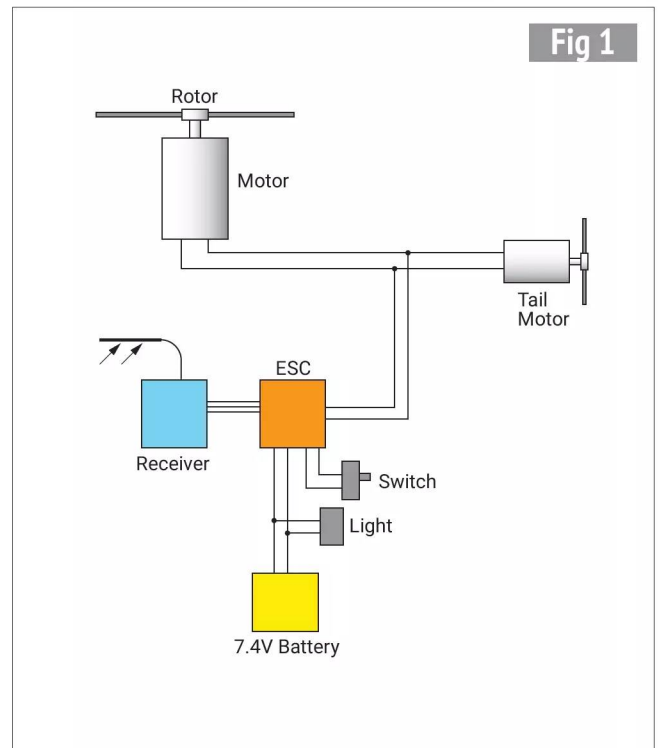
another three times under the first holes so I then had six holes (two for each rotor).

The rotors were made from three coffee sticks glued on top of each other. I had a problem mounting the rotors onto the motor because they are held on with an M3 grub screw which

I tapped into the bush but it is buried in the lid so I drilled a long hole in from the side so I could put a key into the screw to tighten it (photo 5).

Rear motor and propellor

I was given a little motor but it runs rather slowly. I was



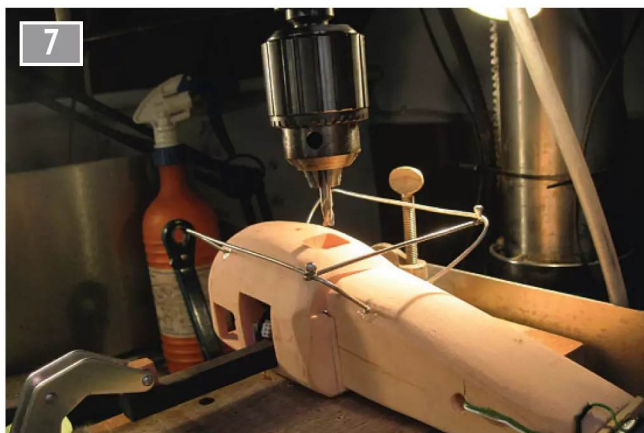
Control system.

also given a propellor with three blades. The motor and propellor were mounted at Nelly's tail (photo 6). I glued the motor to a small piece of acrylic plastic then screwed it to the end of the tail. I had to do this twice since the glue got inside the motor the first time and stopped the gears from turning.

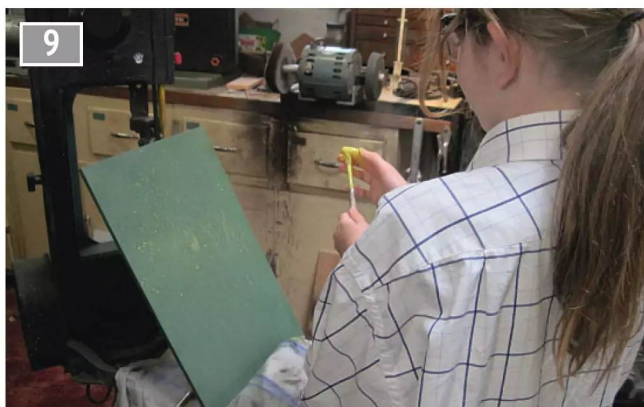
Wiring

Nelly is radio controlled so I was shown how to make it work. The circuit is drawn in fig 1.

The difficult bit was soldering the cables together and then getting all the bits and pieces into Nelly. When I soldered wires together, I used Shrink-Fit to cover over the joints. Soldering and shrinking were very difficult inside Nelly. I needed a switch to turn the motors on. The switch came with the electronic speed controller so it had to be cut off and then joined up again. First, I tried to put the switch in the roof of Nelly, so I drilled a hole at the top, but that didn't work



Milling out a hole for the switch.



Me splatting the grass.



Nelly the Copter.

so I covered the hole with filler and drilled another hole down through the bottom instead (photos 7 and 8).

The motor was too tall to fit in Nelly so I used a 32-millimetre diameter cutter to drill a hole in the bottom of Nelly's base. But then there was a hole in at the bottom of where I had drilled. To hide it I got a blue LED (Light Emitting Diode) light and stuck it in the hole to wire it up. It was

very hard though to get the soldering iron into Nelly. The light is connected to the battery so when I flick the switch to turn the battery on the light immediately turns on too.

Inside Nelly, there wasn't much room so I had to arrange the wiring carefully. I used Velcro and hooks to keep the electronics in place. I used Velcro instead of gluing everything, so I could take anything out if needed.



Fitting the switch.

Stand, Painting and the landing 'field'

Nelly needed to stand. I was shown how to bend 2 millimetre copper wire to make the stand. It is stuck into four holes that I had drilled into Nelly's bottom at each end. Once I had got one side to fit, I made another one exactly the same.

I decided to paint Nelly white. First, I gave her a coat of primer. We always use spray cans of paint but I had to paint the stand black using a brush. I then used black spray cans to paint the windows and doors. The windows are made of plastic and the doors are made of aluminium.

Nelly had to have landed on something so I decided to make it a field. To do this I got a large piece of plywood and painted it green (with a Halford's meadow green spray can). I then splattered the green with spots of white and yellow to look like flowers (photo 9). I did this by getting paint on the end of a brush, then I pulled back the brush hairs and let go so the paint left little yellow and white blobs on the green which gave a flower effect. The hedges are black plastic swarf off the lathe stuck to some metal which are then glued to the plywood with Superglue. I also sprayed the hedges dark green.

I then needed to clamp Nelly to the board. I got some Perspex and Patrick (using the band saw) sawed it to the right size then I rounded the corners on the electric belt sander and

drilled four holes in it. After that I put Nelly on the board, then threaded the piece of Perspex through the stands, then drilled four other holes this time into the board then tapped wood screws through the holes. Nelly was now clamped into position.

The windsock was made from some aluminium (which I painted orange) and a kebab stick. Windsocks are round so I wrapped the aluminium round thick metal rod then glued the ends together. I used plastic to make a small ring around a section of the kebab stick. I then drilled a hole into the plastic and glued a small rod into the hole. I glued another rod near the top. Finally, I wrapped some string round both rods and attached the metal wind sock to make a pulley system to move the windsock up and down.

United Kingdom aircraft are identified with registration letters which always start with G- then four letters. I used my initials as some of the letters so Nelly's registration plate is G-FEHW. Nelly the Copter is in photo 10.

Nelly was shown at the Littleton and Harestock (Winchester) Show in September and won the second-place Junior prize. Nelly will be on the Eastleigh Young Engineers Stand at Warwick in October. Please come and see her.

ME

Kinematics PART 2

Rhys Owen presents a readers' guide to the laws of motion.



Continued from p.467
M.E.4752 September 20

Rotational motion

We have just dealt with linear motion but the same principles apply to rotational motion, the equations being similar in form.

With linear motion, for a constant mass, we can express a force in terms of mass times acceleration:

$$f = ma$$

For a point particle the corresponding equation for rotational motion is:

$$\tau = I\alpha$$

Where τ is torque, I is the moment of inertia of the particle about the axis and α is the angular acceleration.

When examining rotational motion we cannot use the mass of an object as a measure of inertia, i.e., its resistance to acceleration. The inertia of a rotating body is expressed in terms of the moment of inertia, the determination of which we shall look at later.

Projectiles

As mentioned earlier, velocity is a vector quantity, i.e., its definition includes direction

as well as magnitude.

We can resolve vectors into components that are customarily at right-angles to each other. For example, if the barrel of a cannon is elevated at an angle θ degrees to the ground and fires a shell which leaves the barrel at $V \text{ ms}^{-1}$ then, at the moment of firing, the shell's vertical velocity is $V\sin\theta$ and its horizontal velocity is $V\cos\theta$ (note that $V\sin\theta$ simply means that the value of V is multiplied by the quantity $\sin\theta$). This is shown in **fig 1**.

For example, if θ is 60 degrees we can show that:

$$\sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\cos 60^\circ = \frac{1}{2} = 0.5$$

If the velocity V is 10 ms^{-1} and the barrel of the cannon is inclined at 60 degrees from the ground then, at the moment it leaves the barrel, the shell is travelling 8.66 ms^{-1} vertically (rounding the value to two decimal places) and at 5 ms^{-1} horizontally. We can check

this by applying Pythagoras' theorem:

$$A^2 = 0.866025404$$

$$5^2 + 8.66^2 \approx 10^2$$

The sign ' $\approx$ ' is used because the two sides are not quite equal since the vertical velocity has been rounded to two places of decimals.

How far will a shell travel for a given angle of elevation?

For simplicity we shall assume that the terrain is flat and that, over the extent of that terrain, gravitational attraction is at right angles to it. If we were looking at an engagement between battleships then the spherical nature of the earth would need to be considered but we shall not venture into these waters (if you will excuse the pun)...

Going back to our 'flat earth' assumption, we can determine how far the shell will travel by using the vertical velocity component to work out how long the shell will be in the air and then use the derived time and the horizontal velocity component to find the horizontal displacement.

For simplicity we shall assume that the gun is emplaced so that its muzzle is at ground level. We also assume air resistance and wind effects to be negligible.

Given a shell fired at $V \text{ ms}^{-1}$ at an angle θ degrees to the horizontal the vertical component is $V\sin\theta$ (as shown above) and its horizontal component is $V\cos\theta$ (also as shown above). To find how long the shell will be in the air we need to know how long it will take to return to earth, that is, under what conditions will the displacement be 0 metres, given that the shell is subject to gravitational acceleration g downwards.

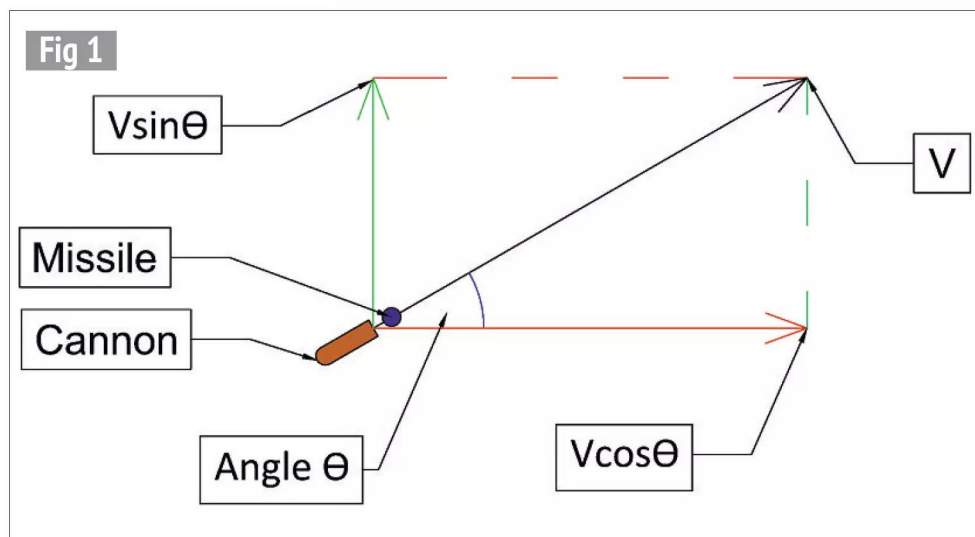


Fig 1
Resolution of velocities.

Since the gravitational acceleration is downwards, we put a minus sign in front of it, thus an acceleration of $-g \text{ ms}^{-2}$. We now use the second of our equations of motion:

$$s = ut + \frac{1}{2}at^2$$

Into the above equation we put in the displacement $s = 0$, $u = V \sin \theta$ and $a = -g$ and get the following expression:

$$0 = (V \sin \theta)t + \frac{1}{2}(-g)t^2$$

$$0 = (V \sin \theta)t - \frac{g}{2}t^2$$

$$0 = t \left(V \sin \theta - \frac{gt}{2} \right)$$

The right-hand side of this expression is zero only either when $t = 0$ (that is, just at the moment the shell is fired) or when the expression within the brackets is zero which is what we want. So:

$$0 = V \sin \theta - \frac{gt}{2}$$

$$\frac{gt}{2} = V \sin \theta$$

$$t = \frac{2V \sin \theta}{g}$$

This is a good moment to have a 'reality check'. In the above expression V (the velocity) is on top so that a higher V means that the time in the air t will be greater. This is what we would expect (the closer θ degrees is to 90 degrees the longer the time in the air since $\sin 90$ degrees is 1, which is the maximum value that the sine function can take). Also, the gravitational acceleration is on the bottom of the expression so that a lower gravitational attraction (such as would be the case on the Moon) would mean that the time in the air would be greater – which also makes sense.

So, what is the range? This question is, essentially, 'How far will the shell travel horizontally while it is in the air?'. We now return to the equation:

$$s = vt$$

Which is simply a version in mathematical symbols of this:

$$\text{Displacement} = \text{Velocity} \times \text{Time}$$

The time taken is the time that the shell will be in the air which we have just shown will be:

$$t = \frac{2V \sin \theta}{g}$$

We also recollect that the shell's horizontal velocity is $V \cos \theta$ (remember, we resolved the muzzle velocity V into $V \sin \theta$ vertically and $V \cos \theta$ horizontally). We also assumed that the air resistance and wind effects are negligible so that there is no reduction in horizontal velocity during the shell's flight. This gives us:

$$s = vt$$

$$s = (V \cos \theta) \left(\frac{2V \sin \theta}{g} \right)$$

$$s = \frac{V^2}{g} (2 \sin \theta \cos \theta)$$

Since $\sin \theta = \cos(90 - \theta)$ and $\cos \theta = \sin(90 - \theta)$ we can see that the range is the same whether we fire at an angle θ to the horizontal or an angle θ to the vertical. If the elevation of the barrel is low then the shell travels faster horizontally but does not stay in the air long while if the elevation is high then the shell stays in the air longer but travels more slowly horizontally.

Now for a bit of mathematical sleight of hand! The following trigonometrical identity is well known in mathematical circles but the proof is beyond the scope of this article so please take it on trust:

$$2 \sin \theta \cos \theta = \sin(2\theta)$$

In fact, we normally do not bother with the brackets around the 2θ , (in the trigonometrical identity above they just were only there for

clarity) so we now go back to our result and go one step further:

$$s = \frac{V^2}{g} (2 \sin \theta \cos \theta)$$

$$= \frac{V^2}{g} \sin 2\theta$$

Since the sine function varies between 0 and 1 then we can deduce that the maximum range (horizontal displacement) $s_{\max}$ that a shell can be fired is:

$$s_{\max} = \frac{V^2}{g}$$

At what angle will this be the case? Since $\sin 90 = 1$ then:

$$\sin 2\theta = 1 \Rightarrow 2\theta$$

$$= 90^\circ \Rightarrow \theta = 45^\circ$$

We can thus conclude that under our assumptions (effectively flat terrain, no variation in the direction of gravitational acceleration, negligible air resistance, no wind effects) the greatest range is obtained when the gun barrel is elevated at 45 degrees from the horizontal.

Change of mass

So far, we have been dealing with constant acceleration but this is not always the case. For example, a rocket's mass will reduce as its fuel is used up so that, if the engine gives constant thrust, the rocket's acceleration will increase.

A cautionary digression

When manipulating symbols, it is wise to be wary as the following 'proof' that 2 equals 1 will show:

$$\text{Let } x = y$$

$$\text{Then } x^2 = xy$$

$$\text{So } x^2 - y^2 = xy - y^2$$

$$\begin{aligned} \text{So } (x + y)(x - y) \\ = (x - y)y \end{aligned}$$

Dividing both sides by $(x - y)$ gives:

$$(x + y) = y$$

$$\text{But } x = y$$

$$\text{So } (y + y) = y$$

$$\text{So } 2y = y \Rightarrow 2 = 1$$

So 2 equals 1, QED...!

Although all the steps seem to be plausible this is clearly preposterous. We should have smelled a rat at the first line – why would we use two different letters to represent the same unknown quantity?

When we divided both sides by $(x - y)$ we were dividing by zero. Division by zero is undefined because 'Divide A by B' simply asks the question 'What quantity, if multiplied by B, will give A?'. But multiplying any number by zero will give zero so it follows that division by zero is undefined.

This digression will be worth remembering later...

Graphs

Let us review what we have done by looking at some graphs. **Figure 2** is a graph of a constant acceleration from velocity v_1 at time t_1 to velocity v_2 at time t_2 .

The gradient of the slanted line is given as follows:

Gradient =

$$\frac{\text{Vertical increase}}{\text{Horizontal increase}}$$

This is our old friend:

$$\text{Acceleration} =$$

$$\frac{\text{Increase in velocity}}{\text{Increase in time}}$$

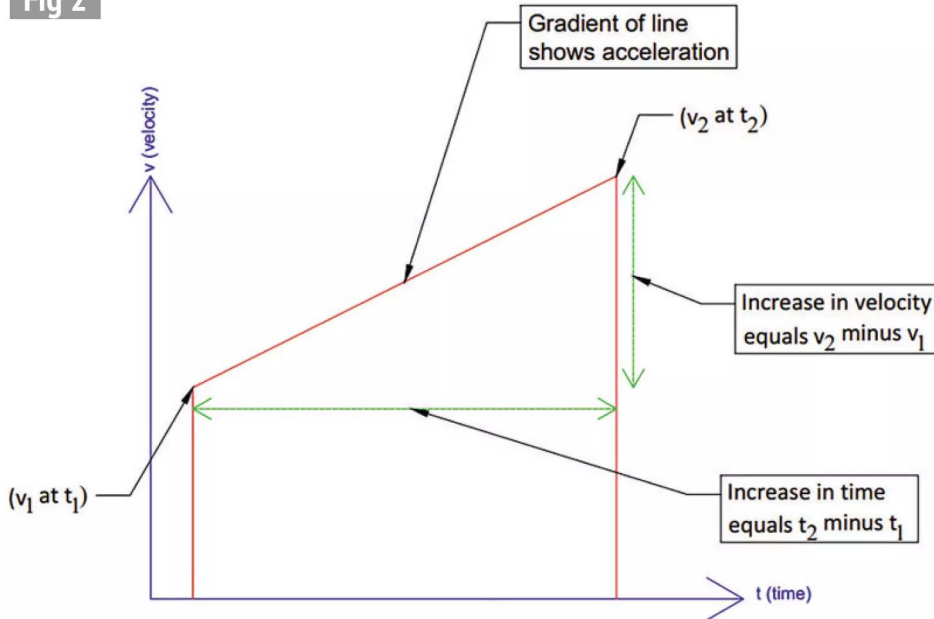
In symbols this is:

$$a = \frac{v_2 - v_1}{t_2 - t_1}$$

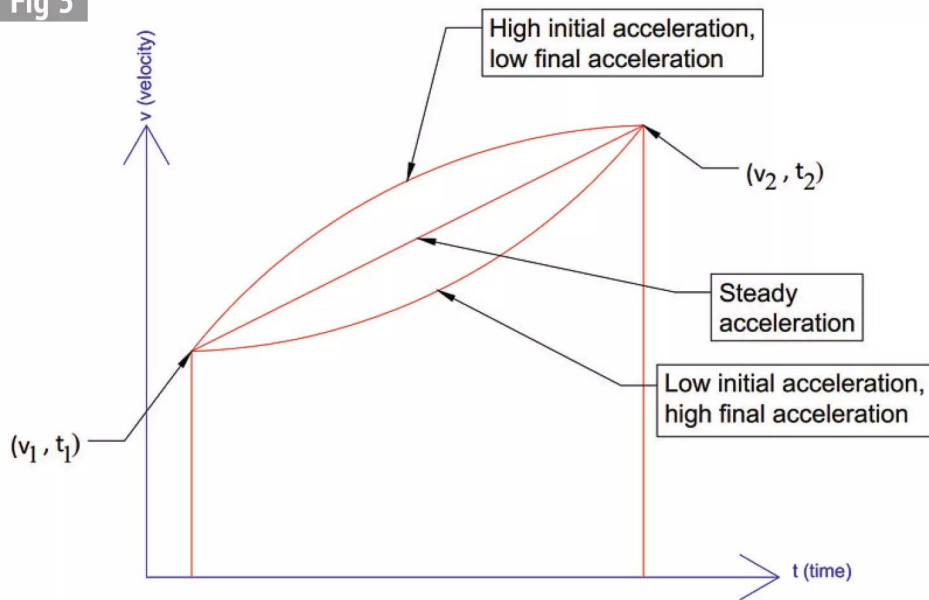
This is just the same as:

$$a = \frac{(v - u)}{t}$$

We have merely substituted v_2 for v , v_1 for u and $t_2 - t_1$ for t .

Fig 2

Graph of constant acceleration.

Fig 3

Variation in acceleration.

If we recollect the displacement equation:

Displacement =
average velocity $\times$ time

In symbols this was:

$$s = \frac{(u + v)}{2} t$$

Which in this case is:

$$s = \frac{v_1 + v_2}{2} (t_2 - t_1)$$

An examination of the diagram shows that the displacement during the period is represented by the area within the red lines and the horizontal axis.

So, we can say that:

- The slanting straight line at the top represents the (gradually increasing) velocity;
 - The slope of that line represents the (constant) acceleration;
 - The area under the line represents the displacement.
- Now let us look at **fig 3**.

At this stage we introduce a famous Frenchman, René Descartes, of 'Cogito, ergo sum' ('I think, therefore I am') fame. Descartes was not only a philosopher but also a mathematician. Legend has it that, while lying in bed one morning, he observed a fly on the ceiling and realized that its location could be defined by its distance from one wall and its distance from another wall that was at right angles to the first wall. Whatever the truth of this story, it is certainly the case that any point on a plane can be defined by two co-ordinates, given that there are two axes, preferably at right-angles to each other, on that plane.

In this case note that the left-hand end of the slanting line has changed from ' $(v_1 \text{ at } t_1)$ ' to simply ' (v_1, t_1) ' and the right-hand end has followed suit by changing from ' $(v_2 \text{ at } t_2)$ ' to ' (v_2, t_2) '. In other words, the velocity and time are expressed as points using Cartesian co-ordinates. If you are wondering why we do not say 'Descartesian' co-ordinates I suppose that the reason is that the 'Des' bit is French for 'of the, from the' which is rather appropriate because one meaning of 'cartes' is 'cards' and Descartes was something of a gambler. However, in this case 'Cartes' is probably the name of a place.

If we now look at the displacement (represented by the areas under the three different modes of acceleration) we can see that, although the average acceleration over the period is the same in each case, the greatest displacement occurs when there is high initial acceleration and low final acceleration. This is hardly surprising as a high initial acceleration means that a high velocity is reached sooner so that, overall, more displacement occurs.

● To be continued.

Before Its Time

Colin Hill,
now of
Blenheim
NZ, looks back at his
early days as a model
engineer in Derbyshire.



We can all remember buying our first lathe - the cost, availability and suitability for what was the intended use. I have to go back 60 years in the era of NSU Wankel engines and a rotary idea of my own that I wanted to build. Previously, I had gained a degree in civil engineering from Manchester University. Part of the course was a one-week secondment to the then-called Manchester Technical College (now part of the university). During the week, we were instructed in machine shop work and briefly handled a milling machine, lathe and gear cutter. So purchasing a lathe three years later I felt unphased by its use. After all, I had some training and I reasoned - how hard could it be?

I needed for my purpose a large machine to be able to bore a casting. I never thought of model engineers lathes even if I knew where to get one. There were, I recall, two instances of steam models in the village. The local plumber had built a traction engine in his shed and this would have been in the early 1950s. My father once sent me there at about 8 years old for a 6-foot Stilson and a dozen 5 amp screws. His son John Cottam has I believe carried on in his father's footsteps. Secondly, I can remember a small garden track. From putting the word out I was told of a lathe for sale in Wirksworth in Derbyshire. Wirksworth had been the centre of lead mining.

At that time I was employed nearby at the Derbyshire County Offices in Matlock on the princeling salary of £89 per month as a junior engineer in the Roads and Bridges Department. I therefore went to see the vendor, whom I have often described as the 'grey-haired old man'. This was not being disrespectful but stating

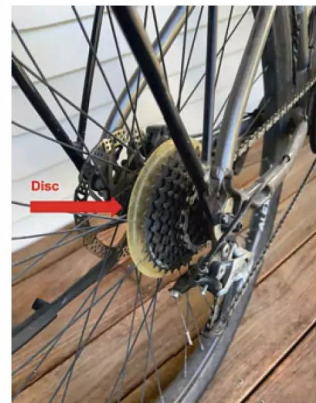
the obvious description as we did in those days. I remember going through a stone archway to get to the machine; it was a very significant piece of kit and I cannot remember the manufacturer's name.

It was powered by a 4HP three phase motor and centre to bed would have been about 10 inches with a bed gap plug that had never been taken out. With the lathe came his tools including a tool post internal/external grinder. I have never seen a similar grinder since. The price, which I did not challenge, was £250. I cannot recall 60 years later how I managed to have that amount but I must have had as I also needed £50 for an 8 x 6 shed to put it in.

The essence of this story is not really about the lathe but what the seller then told me. He was retiring, and was in some way involved with the old lead mining Barmote Court and had latterly been an 'inventor', hence the lathe. Barmote Court is the oldest industrial court in Britain - it began in 1288 and still sits twice a year.

As an inventor he showed me two devices, one of which was a pulley system that allowed you to hang onto the rope as it lowered you to the ground slowly. The other was a saucer-like aluminium disc. The disc was maybe 20 thou thick and was about 6 inches in diameter. It had been made by dishing on my new lathe. He explained his granddaughter, maybe 8 years old, was riding her bicycle and the chain came off the rear drive sprocket and jammed the spokes, and therefore, the wheel. In those days, at that age, her bicycle would have either a fixed drive or a drive and freewheel. This event caused her to be thrown off and she was tragically killed by a passing car.

He applied his mind to a



solution and came up with this disc, which fitted between the sprocket and the spokes. If the chain came off, it would lie in the valley created by the disc to the sprocket. A simple but effective solution. He told me that he had patented the device and had tried to sell the idea to Raleigh, the largest UK bicycle maker in Nottingham, but there was no interest.

The years have rolled on and I had forgotten about it until the more widespread use of plastics. I cannot see a bicycle now without remembering these events, and checking to see if there is a disc present and there does seem to be one fitted on about 90% of bicycles worldwide.

If the 'grey-haired old man' was alive today I wonder how he would view progress and use of his simple invention. I cannot believe that he made any money from the patent. He might reflect on how many injuries, or maybe deaths he stopped happening worldwide. It was after all an idea before its time.

ME



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Martin R. Evans,
The Editor, *Model Engineer*,
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Centre, Morton Way, Horncastle,
Lincs LN9 6JR
F. 01507 371066

E. MEeditor@mortons.co.uk
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Club News

Dear Martin,

In a recent issue of *Model Engineer* (M.E.4748, July 26) Geoff Theasby, in his Club News, provided a short comment on an article on early (c. 1900) EVs authored by me and contained in *Prospectus*, the monthly newsletter of Reading SME. The implication of his comment is that I have an issue with very wealthy people and Mr Musk in particular. I can't understand why this remark was made when there was plenty of EV fat to chew in the body of my narrative. If Mr Theasby has an issue with what was written then best to either ignore my article completely or write privately to me or Mr John Billard, the editor of *Prospectus*, who was equally upset by this unnecessary comment. I believe Mr Theasby just couldn't resist what he probably thought was a smart rebuke.

Let me make it clear, I have absolutely no issue with any person who has made money through innovation, hard work, brilliance etc, provided it was not obtained illegally or with significant detriment to others.

John Spokes (Reading)

Battle of the Boilers

Dear Martin,

I was interested in Eddie Castellan's article *The Battle of the Boilers* (M.E.4750, August 23).

Like many of my generation, it was LBSC and his 'words and music' which encouraged me to get involved in model engineering, for which I remain eternally grateful! I have been in the hobby since the mid 1960s and a member of Brighton & Hove SMLE since 1969.

The Battle of the Boilers was an interesting challenge and an event which is worthy of celebration one hundred years on.

In his opening paragraphs, Eddie comments that 'Amazingly, both competing locomotives are still with

us'. I believe that Ayesha's movements are well known since LBSC's passing in 1967. However, I wonder how many in the hobby realise that *Challenger* was re-discovered quite by chance many years ago now.

At Brighton, our late president Gerard (Gerry) Collins was the club honorary secretary from the very beginning of the club's formation for more than thirty years.

The exact year remains uncertain but at some time in the late 1980s, Gerry was made aware of a 2½ inch gauge locomotive that was being offered for sale privately in Brighton. Gerry made arrangements to view the loco and when he saw it, he felt that there were similarities to *Challenger*. He agreed to purchase the loco and then began an intense period of research using available drawings, photos and write-ups to try and ascertain if the loco could be *Challenger*. I understand that there had been some modifications to the loco after its period of fame in 1924.

I know that Gerry was fastidious in checking detail such as bolt or rivet positions compared to any published drawings and photos. He finally came to the conclusion that the loco was indeed *Challenger*. In the process, Gerry had put together a folder containing all available relevant documentation.

At this time Gerry was a member of SMEE and I believe a presentation and display of the loco together with the documentation that he had amassed convinced others as to the loco's identity. Maybe some members of SMEE may be able to confirm that?

Over the years, the loco remained at Gerry's house on display in the conservatory. Sadly, Gerry passed away in September 2018 and *Challenger* remained with Gerry's widow, Liz, for a time until she and I had a chat about what should happen to the loco, bearing in mind its history.

It was agreed that the loco should be sold by auction at

a local auction house who specialised in models and toys. Liz and I took the loco to the auction house along with all the documentation and sat with one of the auctioneers in order to impress upon him the history and importance of the loco. It was duly sold at auction, maybe the buyer was the present owner who has restored it. If so, then that is wonderful. Both Liz and I are delighted that *Challenger* is once again in fine fettle.

It is important that due credit should be given to the late Gerry Collins for spotting what is after all a unique artefact and part of model engineering folklore. Without his initial suspicion, purchase and research, *Challenger's* whereabouts might have been forever a mystery.

Sincerely,

Mick Funnell
(Vice-Chairman, Brighton & Hove SMLE)

Trailers

Dear Martin,

In response to Noel Shelley's recent 'Postbag' letter (M.E.4751, September 6), I should explain that, in my part of the world, it is illegal to build your own trailer and take it on the road. Furthermore, unlike Noel, I am most definitely not a welder!

Noel has a good point when he says that aluminum, like mild steel, is also prone to chloride salt corrosion, but our commercially available steel trailers in the USA are so poorly rust-protected that, in my view, aluminium was the better choice for a fair-weather hobby trailer, especially given the weight constraints. I confess that, although I have done so once or twice, I had no real intention of using the trailer in the winter, and its aluminium chassis shows no sign of degradation after nearly seven years of use and year-round outdoor storage.

As Noel correctly spotted, the winch does not have a catch to allow the cable to be manually withdrawn but this is no problem in practice - the drill

is simply run in reverse at high speed and the cable pulled out by hand as the spool unwinds.

Furthermore, Noel comments that there is no mechanical means to pull Allchin *Ruby Swann* rearwards to release her from the front wheel chocks and he is once again correct. However, the front of a traction engine is far lighter than the rear, and, with the leverage afforded by pulling or pushing on those large-diameter rear wheel rims, *Ruby Swann* is manually rolled into (and out of) the front wheel chocks without the aid of the winch. It would certainly be a different matter if her rear wheels were also chocked, a point alluded to in the Episode 14 Postscript.

Finally, on behalf of all contributors to our fine magazine, I would like to thank those who provide comments and questions through 'Postbag'. In this era of online forums, with their instantaneous (and sometimes unseemly) back-and-forth

bantering, it is gratifying to know that our efforts are of sufficient interest to prompt comment through a more traditional and (arguably) more thoughtful medium. Heck, it's great to know that someone is reading our efforts at all!

Steve Goodbody
(New Jersey, USA)

Rides for the Public

Dear Martin,

After 68 years of happy model engineering with various clubs to suit where I lived, I have been sufficiently incensed by the article on publicity etc. for model engineering societies by Roger Backhouse (M.E.4750, August 23) to have to write to you for the first time.

Right from my early teenage years a model engineering CLUB has been a place where like minded people have met up to play with their locos on a short length of track, and happily been willing to offer help and encouragement to

people newly interested in the hobby.

Nowadays the majority of these clubs have become railway civil engineering societies whose principal aim is to get their members to give up their model engineering hobby and spend their hobby time building bigger and better railways to attract more and more fare paying passengers to be pulled around behind ready to run battery powered diesel engines in order to pay for these massive railways and the excessive public liability insurance to cover their activities.

What has happened to the people who had the ambition to own a steam loco to run for themselves and club members and developed the pride of having spent several years developing their skills to do this?

For over 60 years people have been worrying about whether the HOBBY will have to shut down because of the shortage of new members.

Members are still there but I'm sure this current mad drive to get more fare paying passengers in is destroying the hobby for a great many.

Malcolm Sadler
(Horton, Somerset)

Clack Valves

Dear Martin,

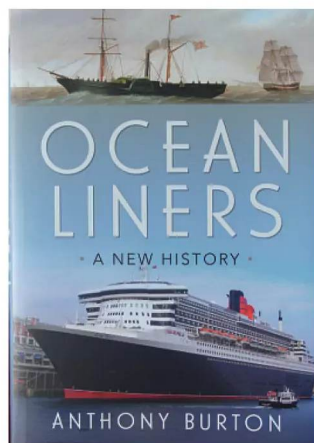
I'd like to add to Richard Taylor's article (M.E.4747, July 12). The area of the port is $\pi \cdot d^2/4$, where d is port diameter. If the valve were a flat plate, the area of the axial gap would be $\pi \cdot d \cdot l$, where l is lift. For constant area we equate these and finish up with a lift of $d/4$. This isn't quite right as the ball isn't a flat valve, but it is very close. I reckon pump delivery valves can have lower lift as once the pump has 'got hold of' the water a bit more pressure drop won't matter.

Duncan Webster
(Warrington)

Book Review

Ocean Liners: a New History

Anthony Burton



Pen and Sword, 2024
ISBN 978-1-39904-979-5
184pp, hardback, £25

A welcome and different book about ocean liners. Many other titles concentrate on the first class accommodation in luxury liners though that provision was never the whole story of trans-Atlantic and other ocean travel.

Anthony Burton describes the history of ocean shipping from the sail age through the development of steam ships to the cruise liners of today. Unlike some other authors he gives attention to engineering developments, shipbuilding improvements and the role of American shipping firms in trans-Atlantic service developments.

The author makes it clear that Brunel's *Great Western* and *Great Britain* were revolutionary in developing ships for long distance steamship services. Until they appeared no-one

seriously thought steam could cross the Atlantic but Brunel's vessels inspired other makers.

Unusually, coaling and stoking is covered. A ship like the *Titanic* burned up to 800 tons of coal a day and stoking furnaces was a complex job. Besides stoking, clinker had to be removed. Stoking control was mechanised after 1903 with the development of the Kilroy Stoking Regulator to show which furnace should be fired next. Oil firing was the eventual choice - and no wonder.

While shipping companies appeared to be examples of free market competition there were subsidies, usually enabling ships to be used as troopships if necessary. Even the *SS United States*, surely the most elegant Atlantic liner, was part financed like this. National prestige was important in shipping and if

French liners were not quite the fastest at least they offered the finest cuisine.

Safety at sea is covered in some detail but it is odd that the sinking of the *Empress of Ireland* with 840 passengers and 172 crew lost is not mentioned and remains far less well known than the loss of the *Lusitania* and the *Titanic*.

There are good chapters on liners at war, travel to the Far East, competition for the Blue Riband and passengers and life on board. The last also looks at the conditions experienced by steerage passengers, often beyond dire for those on sailing packets. A final chapter looks at liners in fiction and films.

Altogether a readable and enjoyable book with reasonable engineering interest.

Roger Backhouse

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"1366" design as featured in this magazine.

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PART 2 – MAKING A START

Gerald Martyn decides to build a locomotive that he can lift.



Continued from p.439
M.E.4752 September 20



Model Engineers Laser



Practicalities

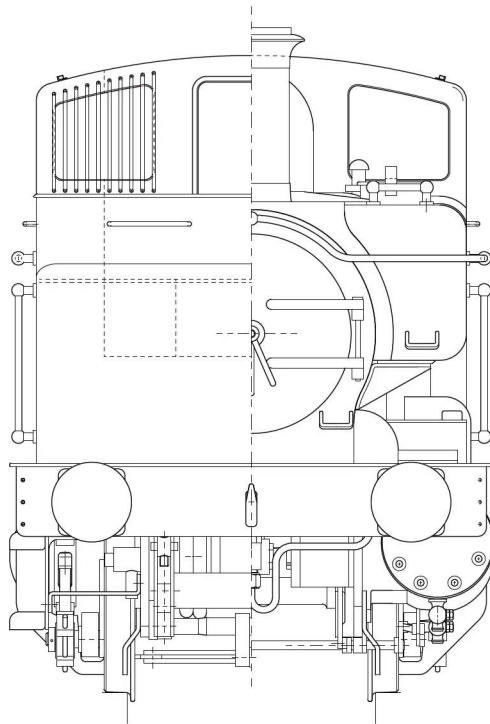
There's a lot of useful guidance in the Rob Roy book and I recommend it. There are also, now, plenty of other 'how to do it' books, too, but I have some of my own ways - for better or worse, as you will see. I will primarily (but not exclusively) be using imperial units as per both the original and Rob Roy. When scaling down a GWR general arrangement drawing dimensioned in feet and inches using a factor of 16 you'll not be surprised to hear that many of the dimensions come out reasonably well in fractional inches units. Raw material will be mentioned in whatever size is most available from our suppliers and I note

that imperial sized bar is still commonplace but sheet and plate materials are all now in metric thicknesses. I myself have no difficulty with mixing in the occasional metric dimension or drill, when the feature is truly metric. My machines are metric yet I work in inches most of the time. Just remember that 0.1mm is near enough four 'thou' (0.004 inch) when twirling the handwheels. Another thing I will try to achieve, where possible, is to specify materials, parts and castings which are available from more than one of our suppliers, so you can shop around for best price and/or availability. Small screw threads will be BA sizes as

these are still our most widely available fasteners, and with little sign of their long-predicted demise. ME fine-pitch threads seem to have no credible metric alternative so will be used as needed, particularly for the boiler and fittings. One thing I will try to do is to minimise the use of tapped threads. This design is to be as simple as reasonably possible and nuts and bolts are simpler and quicker than tapped holes, and with no risk of tap breakage.

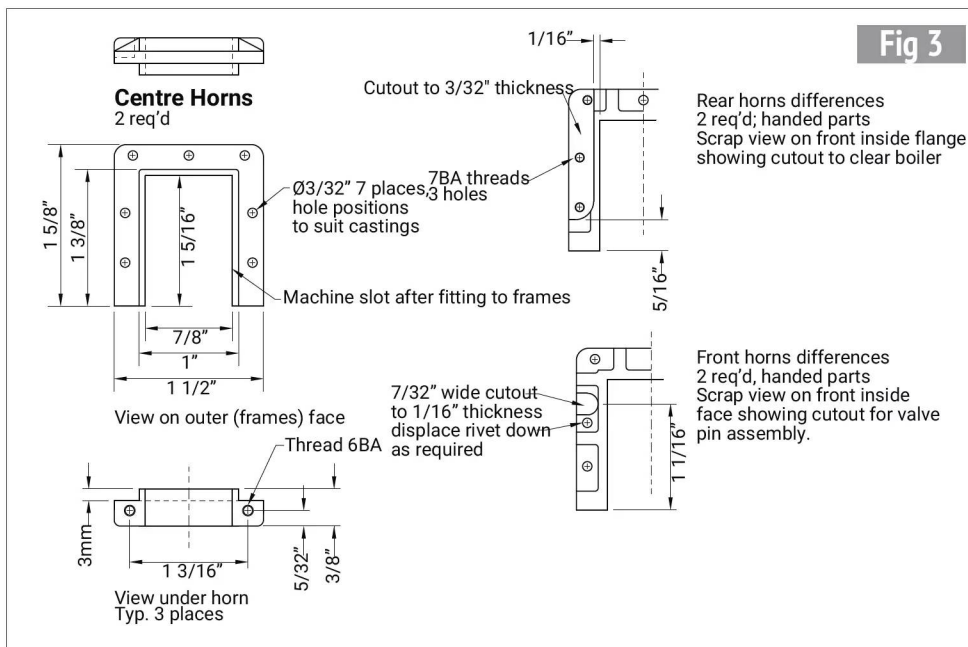
Model engineering drawings seldom mention limits and fits, or tolerances on dimensions. These things describe how accurately the parts need to be made so that they fit

Fig 2



General arrangement end views.

Fig 3



Horns.

together properly. I will try not to stray from these (our) norms and dimensions will therefore generally be nominal unless otherwise stated. For moving or sliding parts such as the piston or the crosshead, then some adjustments will be needed because if they were made at exact size they

would be too tight to fit easily together, let alone slide. So a running clearance should be provided by making one or other of the mating parts larger or smaller by a thou or two. This is often done by 'trial and correction' otherwise known as 'fitting'. For parts that bolt, rivet or solder together, then

make them as accurate as you reasonably can is the best advice I can give. For areas that do not mate with anything then generous deviations from drawing are no problem so long as appearance is not compromised. And remember, this model is just for you so provided your parts work

together then that's fine; you'll not be swapping them with anyone else. The other thing about drawings is that some features called for first and third angle projection. These describe where to draw the view (or projection) of the side of a part relative to its main or front view. You can look up the finer details elsewhere, but I will be using third angle projection. What this means, for example, is that what you would see when looking onto the right side of the part shown in the main view is drawn out to the right as a true projection with all the features aligned correctly with their positions in the main view. Once you get the hang of this then it makes interpretation of the drawing really simple and for this reason, then, our editor will hopefully be able to maintain the relationship between the views I have provided, for detail parts at least. The last thing to mention is that I will occasionally write 'Ref' against a dimension. These are where the dimension is perhaps defined elsewhere, so this is a duplication, or alternatively it may be cut to this size for you by the laser, but in each case it may be useful for you to know at this time what it should be.

Tools for the job

Tools needed are the basic model engineering hand tools: a surface plate and height gauge etc. for marking out, measuring tools, a small pillar drill and a lathe of course. It's possible to manage the milling jobs using a vertical slide on the lathe but there's no doubt that having a dedicated machine works better and saves a lot of set-up time. My workshop is not huge and has (compared to some we've seen in these pages) rather modest machines; a long bed Myford Speed 10 with a long cross slide (**photo 3**), a Hobbymat mill/drill and a small Machine Mart pillar drill. The lathe does everything I want, exactly as advertised years ago; if you can fit the work onto it then it can be machined. The mill is (was) cheap and fairly lightweight, as



The author's Myford Speed 10 lathe.

is the drill, but they do the job. All these are around 40 years old now. If you look after your machines then they may see you out, it seems.

To follow from last time, here are the general arrangement front and rear views (**fig 2**), shown as joined half views. The frames are the normal place to start any model locomotive. As mentioned, many of the parts will be available laser cut from Model Engineers Laser (**table 1**). The first batch, for the frames assembly and buffers, is tabulated there. It's worthwhile getting the buffer heads and base plates now as the base plates can be used as tools to spot-mark hole positions onto the buffer beams. Before laser cutting, small parts like guard irons would be considered cosmetic or non-essential extra bits to make so people building a first model may have left them off to save time. These days, with laser cut parts, this makes little sense. Other bits needed are Rob Roy buffer

beam steel and axlebox horns and some 3/16 x 3/4 inch bar to make the two stretchers. These bits should be available from our usual suppliers.

Horns

My axlebox horns, buffer beams and steel arrived first so I made a start on the horns. In the good old days in the last millennium these would have been made of hot-pressed brass that needed very little work before fitting to the frames. Nowadays they come as sand castings, supplied as toe-to-toe pairs, with all the usual mismatches, lumps and bumps and shrinkage allowances in funny places, which need a deal of work. Such is progress. I'll skim through the details on how to get from the rough casting to something like the drawing (**fig 3**). Start by cleaning the castings up a bit with a file and making the long edges fairly parallel so they can be safely gripped in the machine vice. The overall width is not terribly

Table 1

Title	M.E. Laser Part No.	Material	No. Required
Main Frames	25671	3mm Mild Steel	2
Motion Plate	25676	3mm Mild Steel	2
Motion Plate Flange	25672	3mm Mild Steel	2
Front Guard Iron	25674	1.5mm Mild Steel	2
Rear Guard Iron	25673	1.5mm Mild Steel	2
Drain Cocks Bracket	25675	1.5mm Mild Steel	2
Buffer Backplate	26267	2.5mm Mild Steel	4
Buffer Head	26268	2.5mm Mild Steel	4
Draw Hook	26269	4mm Mild Steel	2

Laser cut parts from Model Engineers Laser

important as long as it's around 1½ inches, but measure it and write it down as this number can be used to help get the finished upstanding portion central. Grip the casting lightly across the width in the milling vice and with the frame-facing side uppermost. Tap it down onto parallels such that just under ⅛ inch flange thickness is in the vice, and tighten-up.

Now, carefully mill down the edges to get the flange down to ⅛ inch thick, or a little over, and the distance across upstanding lips to 1 inch and centred in the flanges (**photo 4**). Keeping the same cutter height, mill across the end flanges, at what will be the tops of the horns, in a similar manner. Now mill the upstanding lips back to match the thickness of the frames (3mm). Do all three castings then turn over and grip across the lips, ensuring to tap it down onto the vice jaws (which

should be flat and level if the vice is any good) and mill the casting down to the ⅜ inch thickness. On one pair then take the faces of one side of the flange down to 3/32 inch thickness as per the drawing, removing the little buttress pieces which are really just for appearance. These two will be used at the rear axle to give boiler clearance and, of course, are handed so the metal is removed from one side only of the combined casting. On another pair mill little pockets in one edge as per the drawing, taking the flange down to 1/16 inch thick. These two will be used at the front axle and the pocket gives clearance to get the valve crosshead pin in place. I discovered this problem late in the day and had to use my mini-drill and a burr to make a less neat job of it. CAD only reveals these problems if you look for them, it doesn't do it for you - at least the affordable versions don't. Now mark out and hacksaw the casting across the middle. With the top flange lip sitting on a thin parallel in the machine vice, mill the toes back to get the 1⅜ inch dimension to match the frames (**photo 5**). After the first is done then keep the same cutter height and do the rest gently to the same setting.

I then put the horns aside and moved on to the frames, which had now arrived.



Milling the rear face of the horns.



Milling the toes of the horns.

● To be continued.

The Stationary Steam Engine

PART 62 – THE WELSH CONNECTION AND THE FIRST RAILWAY LOCOMOTIVE

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

Continued from p.379,
M.E. 4751, September 6

Amongst the earliest of Trevithick's apostles was Samuel Homfray of South Wales. At Homfray's Penydarren Ironworks a forge engine was installed in 1800 by Trevithick assisted by Rees Jones, an employee who was responsible for the existing forge machinery. In early January 1804 Trevithick was probably referring to this engine when he wrote from Penydarren to Giddy saying:

We have an 8 inch cylinder engine at work here ... it worked exceedingly well a hammer of the same size as is now being worked here by an atmospheric engine 28 inches in diameter 5 feet stroke ... the 8 inch is now moved to Swansea and is winding coals, the basket holds 6 cwt and it lifts 80 yards in one

minute. One of Boulton & Watt's 18 inch double engines about half a mile from here lifting baskets of the same size with the same velocity burns three times the quantity of coal ... The 8 inch requires steam to be about 46 or 48 lbs to do its work well ... (ref 332).

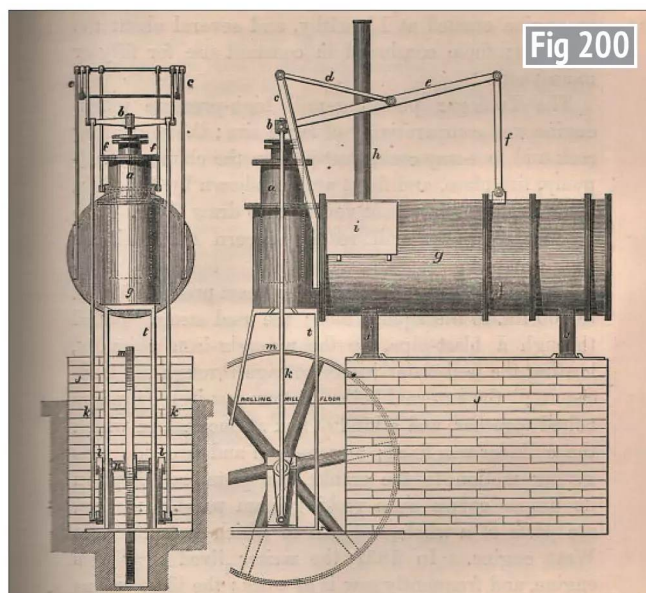
This machine may have been the Welsh engine that was the subject of trials in 1804 about which Farey wrote in Rees *Cyclopaedia* (ref 333). The cylinder was 8 inches by 4½ feet stroke. Like the Coalbrookdale experimental engine it was being tested to assess its duty by pumping water into a vertical standpipe; the pump was 18½ inches diameter and 4½ feet stroke raising the water 28 feet high. It worked at 18 strokes per minute and used 80 lbs of coal per hour, computed to be 17½ million pounds duty.

In his letter to Giddy Trevithick anticipated that: *... there will be another at work here for the same purpose in about six weeks, a 15 inch cylinder 6 feet stroke which is a great power for a winding engine ...*

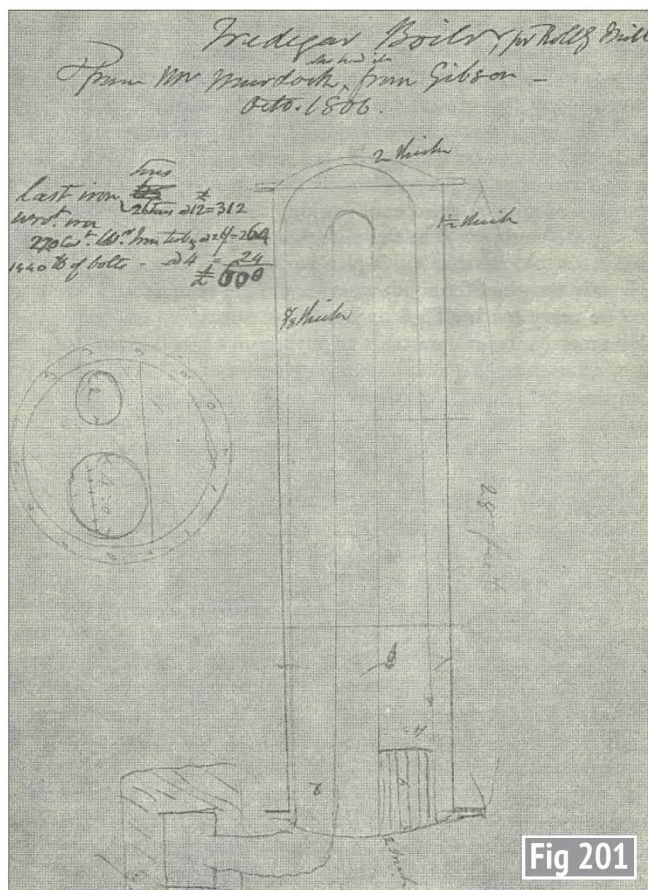
Nothing further is known of this winding engine but at least one other engine was operating at Penydarren by 1804. The rolling mill was being driven by an engine with a cylinder 18 inches diameter and 6 feet stroke making 18 strokes per minute on steam at 45 p.s.i. It consumed 3 tons of coal in 24 hours rolling 130 tons of iron per week from the puddling furnaces into 3 inches by ½

inch bars (ref 334).

At about the same time that the Penydarren engines were being built for Homfray, his works at Tredegar had a puddling mill rolling engine that, like the other engines, was built at Penydarren (fig 200). Work on constructing the Tredegar engine was carried out by Aubry and Thomas Ellis, the latter a patternmaker, later to be famed as an ironmaster at the Tredegar Ironworks. This engine had a 28 inch cylinder with a 6 feet stroke which was fixed in an outer cylindrical steam casing attached externally to the endplate of the boiler and carried on a cast-iron stool, the legs of which spanned the crankshaft which was below the cylinder. The piston rod worked to a crosshead and from the extremities of the crosshead descended two connecting rods that drove the twin cranks on the crankshaft. To maintain the straight-line path of the piston rod a grasshopper parallel motion was mounted on top of the boiler. The boiler was 6 feet 9 inches in diameter and twenty feet long, assembled from cast iron cylinders with flanged ends. The exhaust passed to the iron chimney via a feed-water heating cistern. Ellis, from whom Francis Trevithick obtained details of this engine in 1869, said that there were other engines of this type engaged in coal winding at Penydarren, Llanelli and several other collieries. Some of them survived until the eighteenth-fifties. The engraving of the



The Tredegar Ironworks rolling mill engine.



Homfray's greatly enlarged version of the Trevithick return flue boiler. The illustration shows a shell of cast iron and the internal flue of wrought iron. Sketch sent by Gibson to Wm. Murdoch, October 1806. Drawing in Boulton and Watt Collection, Birmingham Library.

28 inch Tredegar Ironworks engine contained in the *Life* probably represents the general arrangement of these large engines.

Compared to the combined engine and boiler pattern that had evolved from the patent in Cornwall and elsewhere, these larger Welsh machines represented a somewhat different line of development. Farey points out that engines conforming to the patent design never exceeded 12 horse power (about 12 inches bore by 48 inches stroke); above this the boilers could not produce sufficient steam. The solution was to separate the engine and boiler and lengthen the boiler rather than increasing its diameter (**ref 335**). Homfray may have been responsible for the initial moves in this direction. A letter written by him to Giddy on December 26th 1804 explains:

... We are now so thoroughly convinced of the superiority of these engines I have just begun another of larger size ... boiler is to be 24 or 26 feet long, 7 feet diameter, fire tube at the wide end 4 feet 4 inches and at the narrow end where it takes the chimney 21 inches. Steam cylinder 23 inches ... This boiler, on account of the length of tube inside, will, I have no doubt, get steam in proportion and work the engine with less coals than the present one.

A second letter from Homfray to Giddy followed in January 1805:

We are beginning another of larger size and I have no doubt but by making the cylindrical boiler larger so as to take a longer tube withinside it, by which means the fire will spend itself before it leaves the tube to go up the chimney that we shall work to much better advantage in point of fuel ... as this boiler is

so short that a great deal of the flame ... goes up the chimney. We are now better acquainted with the different proportions ...

In the Boulton and Watt Collection at Birmingham Library there is a pencil sketch of a boiler that may well have been the outcome of Homfray's proposal (**fig 201**). The cylindrical parts of the shell are of cast iron in three sections bolted together to give a total length of 28 feet. The wall thickness of the cylinder shell is 1½ inches. At the closed end the cast end-plate is dished, again bolted by flanges to the body of the shell whilst the thickness of the disc is increased to 2 inches. A similar dished end is used for the front plate but this pierced by two holes and from these a fabricated wrought-iron U-tube makes a double pass through the full length of the interior of the boiler so that the furnace is adjacent to the final gas outlet. At the firing end the tube enclosing the furnace is four feet in diameter and by the time it reaches the chimney outlet it has been reduced to two feet giving a total gas path within the boiler of 56 feet.

Homfray's wider role in developing the Trevithick high-pressure stationary engine forms the largely overlooked background to the part that he played in the seminal episode in the history of the steam railway engine, the Penydarren plateway locomotive. This series is only incidentally concerned with the locomotive steam engine but some passing consideration is justified as the earliest Trevithick locomotives were little more than self-propelling versions of his high-pressure steam engines and in several cases they worked interchangeably as stationary engines. Indeed, the rival contender to the Penydarren locomotive for claim to the distinction of being the world's first railway (plateway) locomotive has been suggested to have been a rebuilding of the Coalbrookdale experimental pumping engine discussed earlier.

The letter from Trevithick to Giddy written from Coalbrookdale in August 1802 (**ref 336**) describing this 7 inch cylinder pumping engine then under test at Coalbrookdale has a concluding sentence that reads:

The Dale Company have begun a carriage at their own cost for the railroads and are forcing it with all expedition ...

It was Francis Trevithick who first construed from this sentence which was actually by way of a postscript to the main body of the letter, that the 7 inch cylinder pumping engine became the basis for this projected locomotive (**ref 337**). This inference was almost certainly the source for the comments made by James Randall, nephew of William Reynolds of Ketley and author of the *History of Madeley*, written in 1880, eight years after the *Life* was published. Randall quotes the above sentence from the letter but whether he had access to the original is questionable, more probably it was extracted from the *Life*. Randall then goes on to accept as factual Francis Trevithick's account of the transformation of the pumping engine into a locomotive.

Nothing of substance has subsequently emerged to confirm that the pumping engine was converted into a locomotive and there are several reasons to doubt that it was the case. Raistrick's quotation from the Coalbrookdale Ironworks *Settling Journal 1798-1808*, discussed in an earlier part of this serial ([ref 338](#)) lists the charges that the Dale company made in connection with the pumping engine but it does not contain anything that would indicate the production of the additional items that would be required to rebuild it as a locomotive. Furthermore, the *Settling Journal* is a record of money due for payment to the Company and ... *Richd Trevithick & Co* ... was entered as debtor of the Coalbrookdale Company. Hence the pumping engine was built for the partners in the patent and they

would become the owners when it had been completed and paid for (ref 339). This runs counter to the underlying assumption of Francis Trevithick's statement which implies that the Coalbrookdale Company owned the pumping engine and was free to use it as they wished. Moreover, Richard Trevithick in his letter makes a point of stressing that the Company had ... *begun a carriage at their own cost* (author's emphasis) which would seem to differentiate clearly between the costs incurred by the patentees and those falling to the Coalbrookdale Company in building the proposed locomotive. Finally the evidence of Goodrich and the financial records support the view that the pumping engine had a double-skinned boiler of the type shown in the patent. Incorporating this feature in a locomotive would make it entirely distinctive and, incidentally, unlike any of the more recent reconstructions, literary or physical.

Even if a locomotive was built that did not embody parts of the pumping engine it is curious that no other evidence of its existence is forthcoming from the extensive Coalbrookdale records or from any other report. The only other comments come from Randall. He thought that Reynolds junior had located the boiler in its latter days, used as a water tank at the Lloyd's Crawstone coal pit and that the fire tube and a few other parts survived in the yard at the Madeley Wood works. A publication of 1884, *The Coalbrookdale Iron-works and what they produce* (sic – ref 340) says:

An old cylinder is also cherished as a valuable relic. It originally belonged to Trevithick's first locomotive. It is 4 inches in diameter with a stroke of about 3 feet and was taken out by the Company who replaced it with one of 8 inches in diameter.

(n.b. Trevithick's above quoted letter states that the cylinder of the pumping engine was 7 inches bore.)

Elsewhere however Randall refers to William Reynolds building his own locomotive prior to Trevithick's, the cylinder and boiler of which ... *are still preserved* ...

The association of these artefacts with the Trevithick locomotive is highly ambiguous. Even if they were identifiable with Trevithick, it by no means conclusively proves that they were parts of the locomotive. Trevithick had other engines made by the Company before 1805, one with cylinders 5 inches in diameter, for an unknown purpose, and another of 10 inches in diameter with a cylinder for a barge built for a Macclesfield cotton mill in 1804 and thought to have been left on Coalbrookdale's hands. In that year Coalbrookdale had six other Trevithick style engines ... *nearly finished* ... (ref 341) but there is no guarantee that all of these were delivered to a customer or that other unknown engines were not responsible for the surviving parts.

In spite of the conviction of Francis Trevithick, William Randall, his source W. Reynolds, and also of the otherwise creditable Arthur Raistrick, there remains only Trevithick's postscript sentence to indicate that Coalbrookdale had even an intention to build a locomotive. There is an ominous absence of any further substantive evidence that it was ever built.

The existence of the Penydarren locomotive in South Wales is more firmly attested than the Coalbrookdale locomotive but controversy continues to surround it. Again Richard Trevithick's letters to Giddy provide some contemporary evidence. Four letters were sent from Penydarren by Trevithick in February and March 1804 (ref 342). Giddy received the news on the 15th February that having tried the engine without its wheels on the previous Saturday it was on the following Monday put on the tramroad where ... *it ran up and down hill with great ease*. Five days later Trevithick gave some dimensions:

The engine with water included is about 5 tons. It runs up the tramroad of 2 inches in a yard forty strokes per minute with empty wagons. ... the steam that is discharged from the engine is turned up the chimney about 3 feet above the fire ... (the cylinder is) ... 4½ feet stroke 8¼ inches diameter ... I intend to make a smaller engine for the road as this has much more power than is wanted here. This engine is to work a hammer.

The chimney was eight feet tall and the exhaust had a perceptible effect on the fire. A damper was fitted below the exhaust nozzle that could be used to close off the draft.

Francis Trevithick obtained several testimonials concerning the Penydarren locomotive and at the same time that he was writing, another account appeared in the *Mining Journal* for October 1858. Rees Jones had been asked by William Menelaus, George Martin and William Jenkins to make an affidavit relating to his association with the Penydarren Ironworks and Trevithick:

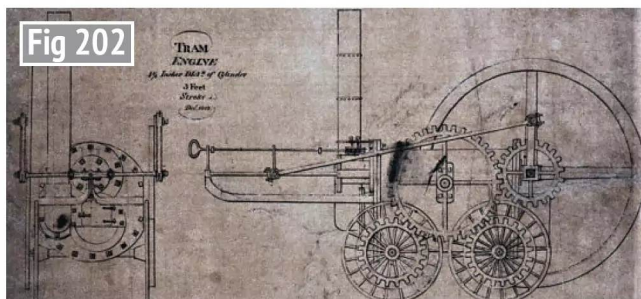
Rees Jones, engine-fitter, Penydarren says:- Dowlais, Sept., 9th 1858. I am now 82 years old. I came to Penydarren on 1st April 1794. I was eighteen years of age. I have been in the employ of the Penydarren Iron Company ever since. ... About the year 1800 Mr. Trevithick came to Penydarren to erect a forge engine for the company. When the forge engine was finished ... Mr. Trevithick commenced the construction of a locomotive. Most, if not all, the work of this locomotive was made at Penydarren. Richard Brown made the boiler and smith's work. I did the most of the fitting and put the engine together. When the engine was finished she was used for bringing metal from the furnaces to the old forge. She worked very well but frequently from her weight broke the tram plates and also the hooks between the trams. After working for some time in this way she took a journey of iron from Penydarren down

the Basin Road upon which road she was intended to work. On the journey she broke a great many of the tramplates and before reaching the Basin she ran off the road and was brought back to Penydarren by horses. The engine was never used as a locomotive after this, she was used as a stationary engine and worked in this way for several years.

I understood the reason for discontinuing using her as a locomotive was the weakness of the road. The boiler was made of wrought-iron having a breeches tube also of wrought-iron, in which was the fire. The pressure of steam was about 40 lbs to the inch. The cylinder was horizontal; it was fixed in the end of the boiler. The diameter of the cylinder was about 4¾ inches. A three way cock was used as valve. The engine had four wheels. These wheels were smooth; they were coupled by cog-wheels ... the steam from the cylinder was discharged into the stack.

Jones was writing fifty-four years after the event and his recollections have to be treated with caution. His statement that the cylinder diameter was about 4¾ inches is at variance with Trevithick's 8¼ inches. He mentions a three way cock as controlling steam entry and exit from the cylinder but this would have meant that the locomotive was not reversible. Also it is surprising that the boiler shell is stated to have been constructed of wrought-iron at a time when all of the other known Trevithick engines had cast-iron shells. Wrought iron however was by then the accepted material for the breeches tube.

John Farey in his *Treatise* devotes three paragraphs to the Penydarren locomotive where he refers to a trial on the 21st February 1804 when ten tons of iron were hauled for nine miles, the load increasing to 15 tons when seventy passengers boarded the train *impromptu* (ref 343). Farey repeats the cylinder dimensions that Trevithick had previously given to Giddy but adds that the boiler shell was



The Penydarren Locomotive or the Coalbrookdale Locomotive or the Sirhowey Tramroad Locomotive. One guess is as good as another!

a cast iron cylinder $4\frac{1}{4}$ feet in diameter and 6 feet long. The internal furnace and flue was made up of wrought iron plate.

Farey does not seem have been present at the trial and his information may have been partially based upon a piece that appeared in the *Cambrian* newspaper. More notoriously the explosion at Greenwich in September 1803 had attracted widespread attention and the matter of high-pressure steam was becoming a public issue. James Watt junior with characteristic malice was pressing the Government to enact a statutory prohibition of high pressure steam engines and this seems to have prompted a proposed semi-official visit to Penydarren by engineers from Woolwich Arsenal and the Admiralty. One of these visiting engineers was to have been Simon Goodrich. Trevithick was clearly aware of the significance of this development and whilst conscious of the propaganda value that a successful outcome would have, he was sufficiently apprehensive to beg Giddy to attend at the same time. He writes to Giddy on the 4th March (vernacular retained):

We are now preparing to get the matts (materials) ready for the experemnts for the London Engineers who is to here on Sunday next. We have 28 feet of 18 inch pumps fix'd for the engine to lift water as those engeneers paricularly requested that they might have a given weight lifted so to be able to calculate the real duty don by a bushel of coal. It's the waggon engine that is to lift this water, then go from the pump itself and work a hammer and then to

wind coals and lastly to go the journey on the road with iron. ... They intend staying here abt. 7 or 8 days and as the report that they will make on their return will be the standing or the condemning those engines its my reason for so anxiously requesting your presence. For as they intend to make tryal of the duty performed by Bolton's great engines which did upwards of 25,000,000 when their 20 inch Cylinders, after being put in the best order posiable did not exceed 10,000, 000. Therefore as you was consulted on all those tryals of Bolton's engines your presence wod have great weight with those gents, otherwise I shall not have fair play. Let mee meet them on fair grounds and I will soon convince

them of the superiority of the pressure-of-steam engines.

... Perhaps there may never be such an opportunity when your assistance in these experemnts will be of so great a benefit to mee as at this time, therefore I hope you will forgive me for again Requesting your attendance on this business that may be of such consequence to me.

He later added that the engineers were:

... to inspect and make trial of the strength of the materials and to prove that the steam gauges (safety valve) will admit steam through them in case the steam valve should be fastened ...

... The engineer from London will try a great many experiments with these engines as that is his sole business here ... he intends to try the strength of the boiler by a force pump and has sent down orders to get long steam gauges and force pumps ready for that purpose ...

In the event Homfray had an accident when his horse ran away with his gig and the trials had to be postponed. It is doubtful whether they were ever carried out as there is no further mention of the tests and Goodrich's diary would

have surely recorded the event. Giddy did go to South Wales and saw the engine working in late March.

Homfray was a sporting man and this gave rise to the celebrated 500 guinea bet with his fellow ironmaster Richard Hill (Dendy Marshalls's version but Richard Crawshay with Hill as adjudicator by other versions) who wagered that the locomotive would not haul ten tons in both directions of the tramroad. The result was inconclusive as the locomotive persistently broke the tramlates.

No drawing of the locomotive that can be directly attributed to Trevithick is known to survive. Later well-known representations have been critically dealt in a still expanding literature (**fig 202**). The reader who wishes to know more is referred to the footnotes (**ref 344**).

● To be continued.

NEXT TIME

The Coalbrookdale, Ketley and Bridgnorth Foundry.

REFERENCES

- Ref 332** Trevithick to Giddy from Penydarren January 5th 1804.
- Ref 333** *Rees Cyclopedia The Steam Engine*. David and Charles Reprints ed. Neil Cossons. P. 139. Farey's knowledge seems to have been second-hand.
- Ref 334** Letter from Homfray to Giddy. Dec 26th 1804.
- Ref 335** *A Treatise on the Steam Engine* John Farey. Vol II. P. 38.
- Ref 336** Quoted: *The Stationary Steam Engine* M.E.4745 17th June.
- Ref 337** Francis Trevithick, *Life* p. 152.
- Ref 338** *Dynasty of Ironfounders. The Darbys and Coalbrookdale*. Arthur Raistrick. Pub. Longmans 1953. Pp. 162-4.
- Ref 339** Provided of course, that Trevithick and partners paid their bill although it is unlikely that Coalbrookdale would have continued to carry out work for Trevithick, as they did, if he had defaulted.
- Ref 340** Reprinted by the Coalbrookdale Company from *Machinery Market*.
- Ref 341** Letter by Trevithick from Coalbrookdale to Giddy.... Sept. 23 1804.
- Ref 342** Quoted fully in Francis Trevithick, *Life* pp. 152-170.
- Ref 343** *A Treatise on the Steam Engine, Historical, Practical and Descriptive (1827)*. John Farey. Vol II. P. 14
- Ref 344** *A History of Railway Locomotives down to the end of the year 1831*. C. F. Dendy Marshall. Pub. The Locomotive Publishing Company, London, 1953. *Trevithick's First Rail Locomotive*. W.W. Mason. T. N. S. Vol. 12 (1931-2) pp. 85-103, *Links in the History of the Steam Locomotive*. A. E. Forward. *The Engineer*, 22 Feb. 1952, pp 266-8, 7th March 1952, 28th March 1952. *Merthyr Tydfil Tramroads and their Locomotives*. Gordon Rattenbury and M. J. T. Lewis. Pub R. & C. H. S., 2004. *Steam on the Sirhowey Tramroad and its Neighbours*. Michael Lewis. Pub. R. & C. H. S., 2020. *Early Railways* Vol 6 ed, A. Coulls. 2019. Pub. Six Martlets Publishing. Art. p. 147-193. *Penydarren Re-examined*. Andy Guy, Dr. Michael Bailey, Dr. David Gwyn, Dr. Michael Lewis, John Liffen, Jennifer Protheroe Jones and Jim Rees.

We Visit Erewash Model Engineering Society

50th Anniversary Celebrations

John Arrowsmith joins in the club's celebration of their first half century.



My visit to the Borrowash track site of the Erewash Valley Model Engineering Society coincided with their 50th Anniversary so it was a good time to meet the members and enjoy the occasion with them; they had really pulled out all the stops to mark this excellent achievement.

The track site is located in a very discreet area of an existing housing estate and as such the members here have a few restrictions imposed on their operations but, nevertheless, they have created a fine site with a very good track layout (**photo 1**). On arrival my wife and I were given a really warm welcome and introduction to many of the members; it was if I had known them all my life

and we quickly felt part of the club. Very soon, the club's very first member, Geoff Shipman, arrived to sign the attendance book (**photo 2**).

Being a fairly small site they have been very innovative with the track layout (**photo 3**). The ground slopes from one end to the other and this has been used to build an interesting crossover track plan with both an elevated multi-gauge track with 2½, 3½ and 5 inch gauges and a substantial ground level multi-gauge 5 and 7¼ inch gauge circuit. The track is approximately a quarter of a mile per circuit so gives both driver and locomotive plenty of scope to test themselves against the gradients and curves. A fully automatic signalling system

ensures safe running and this has been enhanced by the inclusion of two full size signals into the circuit - one a small ground signal covering the exit from the storage shed and the other an upper quadrant signal positioned just in front of the substantial pedestrian footbridge (**photo 4**) that crosses all the running tracks (**photo 5**). It provides an excellent viewpoint over the site (**photo 6**). This bridge is adjacent to the main station which has attractive tower clock on the roof.

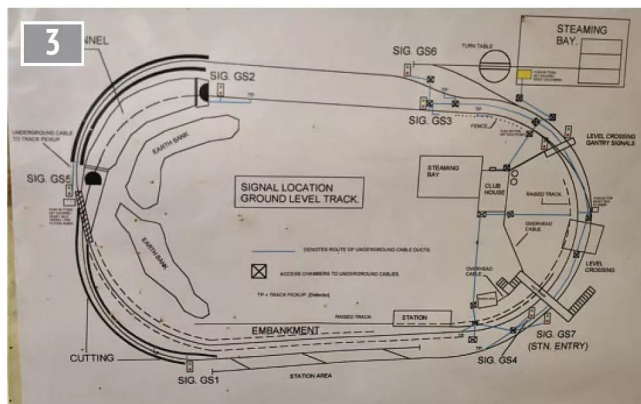
An extensive garden railway also provides a great deal of interest with a fine array of well made scale buildings, all based on existing prototypes (**photo 7**). There is quite a grand main station covering the



The Grand Central Station with clock tower.



Geoff Shipman, the oldest club member and member No. 1 signs the attendance book.



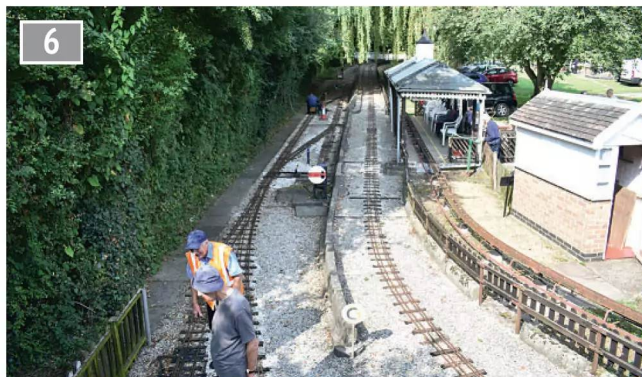
Track diagram of the Erewash club.



An impressive footbridge and entrance to the site.



A splendid full size Midland Railway signal by the footbridge.



Another view from the footbridge showing the different heights of the ground level track and the elevated track.



Some of the fine scale buildings on the Garden Railway system.



Inside the main station, looking towards the departure end.



The large covered steaming bays for the elevated track.



A good sized lifting table for the ground level engines.



The ground level turntable and sidings.



Edward Thomas, an excellent 0-4-2 Kerr Stuart saddle tank owned and built by Don Gregg.

elevated track (photo 8) and a smart club house together with all the usual facilities. The covered steaming bays for both ground level and elevated track (photo 9) are a good size and the elevated track structure has an interesting feature inasmuch as the steel roof trusses came from the superheater tubes of the LMS Pacific *Princess Elizabeth* when it was being refurbished at the Butterley

depot in 1996. That's what I call re-cycling!! On the ground level steaming bay a heavy duty lifting track (photo 10) is available together with a good sized turntable (photo 11).

One thing that impressed me is that the club and all its facilities have been funded by the members themselves through their subscriptions because the local authority will not permit them to operate

public running days. To have achieved all that they have on a subscription of a modest £35.00 per year, is quite remarkable! They have had a couple of grants from the council which have helped but even so, the club treasurer must have a very good system to balance the books.

On the steaming bays were a couple of locomotives being prepared and steamed, one being an excellent model of *Edward Thomas* from the Tallyllyn Railway. In 5 inch gauge and built by member, Don Gregg it looked a very fine model indeed (photo 12). It went as well as it looked and Don was soon putting it through its paces on the track (photo 13). The other locomotive was the 5 inch gauge Railmotor to the Don Young design which was built by Peter Hardy. It was being steamed here by his grandson, Chris Ayre who has been going to the club since he was 4 or 5. His grandfather,

Peter died a couple of years ago so Chris thought it would be a nice gesture to give his granddad one last journey on the railway he helped to build, so with the help of a newly built well wagon and a suitably built casket strapped to the wagon, Peter had his final trip around the track (photo 14). To complete this little tribute, Chris then stopped the train at the memorial garden and, after saying a few words to the assembled members, duly scattered Peter's ashes on the garden. It seemed very appropriate to do this on the club's Anniversary.

Out on the ground level track some very good looking locomotives were also enjoying the day with Chris Brown's 5 inch gauge GWR Manor class locomotive 7818 *Granville Manor* looking resplendent in BR Western Region colours and showing lots of fine detail; it looked just right with a chocolate and cream driving coach (photo 15). The 5 inch gauge Simplex owned by Chris Stone was enjoying the ground level track, making multiple circuits. In addition the 5 inch gauge South African 4-4-0 *Lawley* owned by Trefor Milns was making light work of the track (photo 16). Trefor kindly gave me a trip round and I can say with confidence that the track is an excellent ride for the passenger coaches. President, Tony Brown also enjoyed some track time with a 5 inch gauge Class 8 Shunter (photo 17).

Within the storage shed (photo 18) a good display of locomotives and other model engineering projects by



Don Gregg has Edward Thomas going well as he rounds the top curve on the elevated track.



The little well truck and casket built by Chris Ayres.



A 5 inch gauge Manor class, Granville Manor owned by Chris Brown coasts down the gradient.



Trefor Milns with his fine South African 4-4-2 locomotive, drifts through the cutting to the tunnel.



Club President, Tony Brown gives the Class 8 shunter a run round on the elevated track.



The front view of the substantial storage shed with ground level rail access.



This fine Neilson 4-2-2 in the Caledonian blue livery on display in the storage shed.



The classic lines of a BR Class 9F in 3½ inch gauge on display in the shed.

members was on show. Among the many locomotives was the 5 inch gauge 4-2-2 Neilson in Caledonian livery which looked to be an excellent example of the prototype (photo 19). A very nice 3½ inch gauge model of 9F *Evening Star* was another quality model (photo 20).

For the battery powered locomotives, a very useful charging system has been installed. By fixing the charging

unit at a higher level and connecting this to a set of bus bars, it is a simple matter to connect a battery to the bars and then just switch on.

In complete contrast to all the railway exhibits, the quarter scale model of a Bentley BR2 Rotary Radial Engine built by Peter Clarke was an excellent piece of work. I have seen this engine on show at the Midlands Exhibition and it never fails to draw admiring spectators (photo 21). A neatly arranged board provided



A superb example in quarter scale of a Bentley BR2 Rotary Radial built by P. Clarke.



22
The drivers eye view of the 4 inch scale McLaren.



23
Impressive scenery on the garden railway.



24
Don't they look a happy, smiling group? The club ladies who made all the super cakes and puddings for the buffet lunch.



25
Jill Shipman, wife of the very first club member receives a delicate orchid from Betty Thompson.

storage for all the rolling stock connecting draw bars and pins so members can easily find a suitable draw bar when they need one. To add even more interest on the day a 4

inch scale McLaren traction engine owned by Barry Buckley was in steam, showing off some excellent workmanship and steaming ability; again, a quality model (**photo 22**).

I mentioned above the club's extensive garden railway and here the members have constructed a large 32mm gauge railway with lots of interesting features together with a 45mm circuit for those members who operate on this scale. The typical houses on the layout are based on actual properties built near the Clogau Gold mine in Wales by the miners themselves. Apparently, when the miners asked the owners for better accommodation, the reply was: 'there is plenty of spoil dug out from the mine so use that and build it yourselves!' They did exactly that and the result, in model form, is shown on the railway. The active garden railway section has about 15 members within the main club and they enjoy plenty of running days. They also have a model of Scarborough Castle positioned on a hillside overlooking the railway because they wanted a castle in the landscape and this was one that could be modelled without too much difficulty (**photo 23**). To complete this great little railway they have a fine scale model of the Welshpool and Llanfair Railway station at Raven Square in Welshpool. I am indebted to Dave Grainger for all the information about the garden railway section of the club.

The time was just flying and located opposite to the main station was an open sided

marquee where members and guests were congregating. I soon found out why - because inside this marquee was a most sumptuous buffet which had been laid out by the ladies of the club. A large selection of sandwiches and tasty treats provided by an outside caterer were accompanied by a wonderful selection of homemade cakes and puddings, all made by the ladies (**photo 24**). It was lunch time and all the guests and members were soon filling plates and looking for somewhere to sit. It was a real party atmosphere and I have to say I don't think anyone went hungry. As the initial rush died down it fell to me to conduct the draw for an excellent range of prizes. Of course, there was much good natured banter hurled at me for not picking the right tickets or too many of the same number sequence but we got there in the end and I hope everyone who won a prize enjoyed the result. No doubt it provided the club with a nice little bonus for their funds. Following this, Betty Thompson made a nice little presentation of a very delicate orchid to Jill Shipman, the wife of Geoff Shipman (**photo 25**), the club's very first member; Geoff was there for the day and spent it catching up with many friends whom he had not seen for some time.

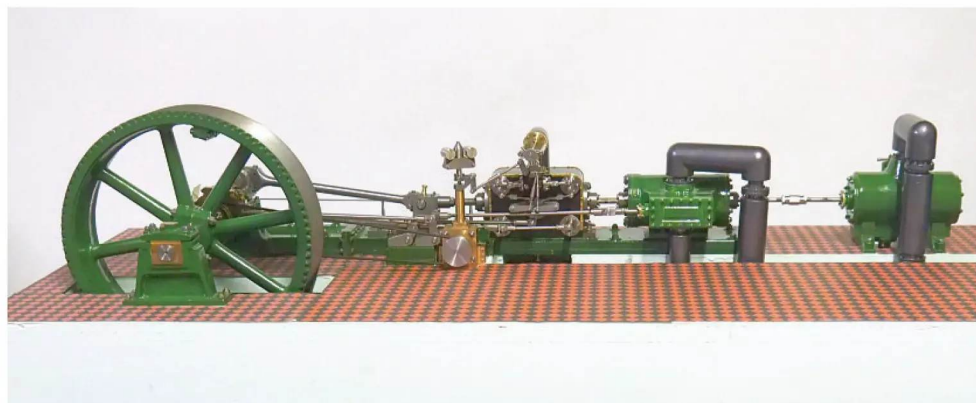
In concluding my notes on this special occasion for the Erewash Society I would like to thank all the members for their warm welcome and hospitality, particularly Tony Brown, Malcolm Kerr, Dave Richardson and John Ollerenshaw whose idea it was to invite me to pay the club a visit on this special Anniversary. It was superb and provided a great day out for my wife and me; we left with lots of great memories.

I hope the club continues to flourish because after all the work that the members there have put into the site, now is their time to really enjoy what they have. Thank you all.

ME

A Tandem Compound Mill Engine

PART 4



down with studs. Each end of the shaft is carried by a bronze bearing split horizontally; in full size these were in four parts and adjustable for wear in both vertical and horizontal planes but this isn't reproduced in the model. The bearings are supported in rectangular slots in the cast iron baseplate at the crank end and in an outer up-stand and these are provided with an oil reservoir and an oiling ring to bring the oil up from it.

The whole engine bed is in three parts: the bedplate (**fig 9**), slide (which also carries the governor) and the soleplate for the two cylinders. These three parts must align in all three planes and the dimensioning from three datum faces and the

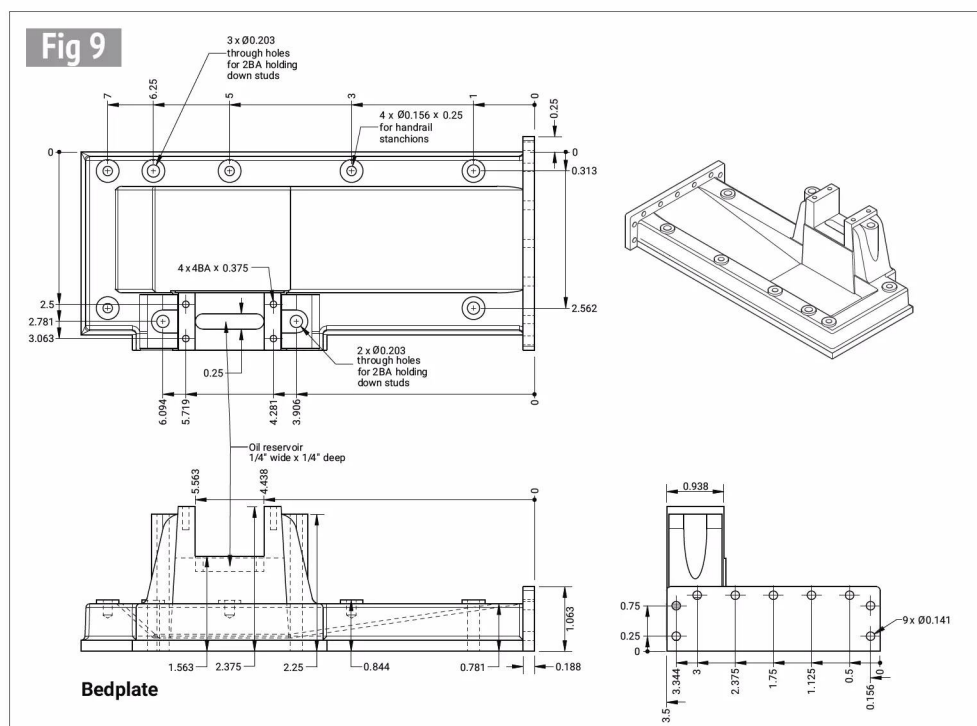
David Thomas builds Arnold Throp's model of a Corliss mill engine.



With the flywheel and crankshaft together, they need bearings and supports before we can make them rotate. The two main bearings are connected

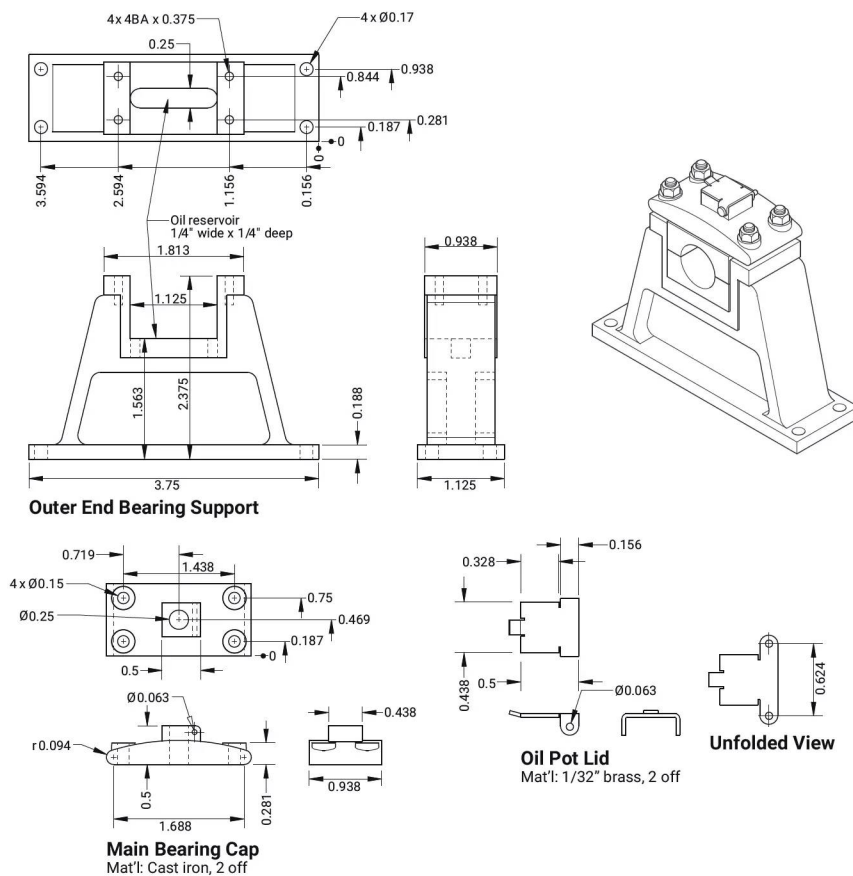
only by the engine bed and the foundations of the engine house which, in full size, were necessarily massive. For the model the base will be plywood or MDF with the castings held

Continued from p.463
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Bedplate drawing and shaded isometric view.

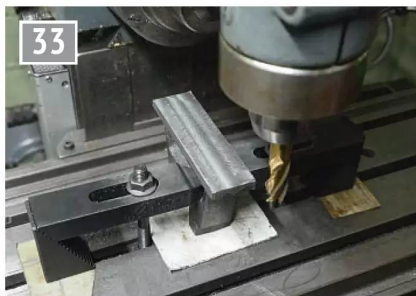
Fig 10



Outer end bearing and bearing cap drawing.



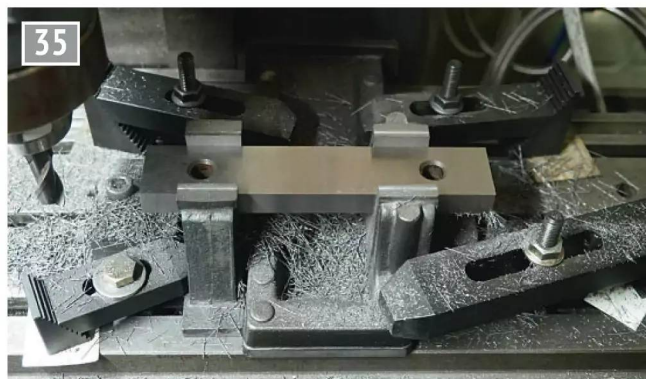
Machining the base of the bedplate. This is the datum for vertical dimensions.



Milling the underside and sides of the outer end bearing housing.



Set-up for machining main bearing housings.



A 1 1/8 inch parallel was 1.1250 inch by micrometer and made a good width gauge. Getting a shake-free sliding fit was a good feeling!



The bottom of each bearing housing needed an oil reservoir.



The base plate has holes for the 2BA holding-down studs and (as here) for the handrail stanchions.



Drilling the bolt holes in the rear flange. Careful measurement from the datums is vital as the holes in the mating flange on the slide have to align.



The bearing caps come cast as a pair. The bosses for the nuts and the tops of the oil pots were roughed out ...



... then used as a reference face to clean up the underside.

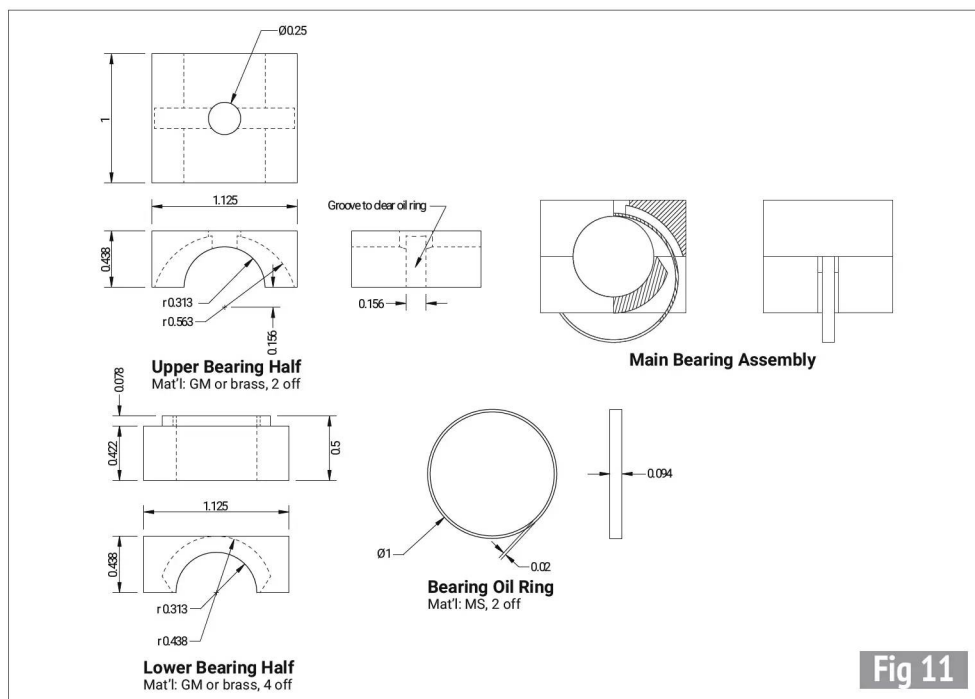
machining sequence are aimed at ensuring this. After a bit of careful measuring the initial set-up of the bedplate used

what will be the upper faces as the reference (photo 32) for the underside to be milled flat as the first datum. Some

clamp juggling was needed to give the cutter access to all the surface. At the same setting, the end face that will abut the end of the slide was machined with the side of an endmill to make the second datum. The outer edge of the casting probably wasn't intended to be machined and there was very little material to spare but that is what I did to provide the third datum face. Doing this removed the angle from the face and slightly spoiled the appearance but having a reference face for aligning the three plates seemed worth this. The base of the outer end bearing (fig 10) was treated similarly (photo 33) and then the two castings set up together to mill the bearing housings (photo 34). A 1.125 inch parallel made a handy gauge for the width of the slot (photo 35). The oil reservoirs underneath the bearings were milled in two stages, first with a slot drill (which had only just enough length held in the collet) to get rid of most of the material (photo 36) followed up by a long series 1/4 inch end mill to clean up. The holes for the handrail stanchions and engine holding down studs were drilled after facing off their bosses (photo 37). In the photo the

outside datum edge is visible and you can see that I've only taken off just enough metal for the face to be usable. The flange that meets the end of the slide has also been squared off to drawing and the fixing holes were drilled with the bedplate against an angle plate and the datum face set square to the mill table (photo 38).

The two bearing caps were provided as a pair. The first operation was to smooth the tops of the stud bosses (photo 39) to give a clean surface for supporting on parallels (photo 40). The base was milled flat then the parts flipped over again to bring the tops of the bosses and oil pots parallel to the base (photo 41). After separating the two caps and milling the sides to size, the edges of the oil pots were tidied up with a ball-ended endmill which only left a little filing to smooth off the curved tops and ends. The brass covers for the oil pots were shaped in the flat from sheet brass with a piercing saw and files and the holes drilled. The parts were folded using a piece of 7/16 inch square steel as a mandrel. For me these were tricky bits to make and there were two scrappers for two usable parts.



Main bearing drawing.



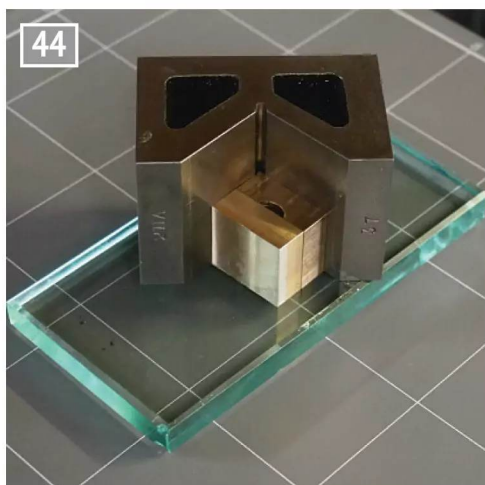
Going back to the top and facing off parallel to the now smooth base.



Whatever the original form of the bearing brasses they need to be squared up to size.

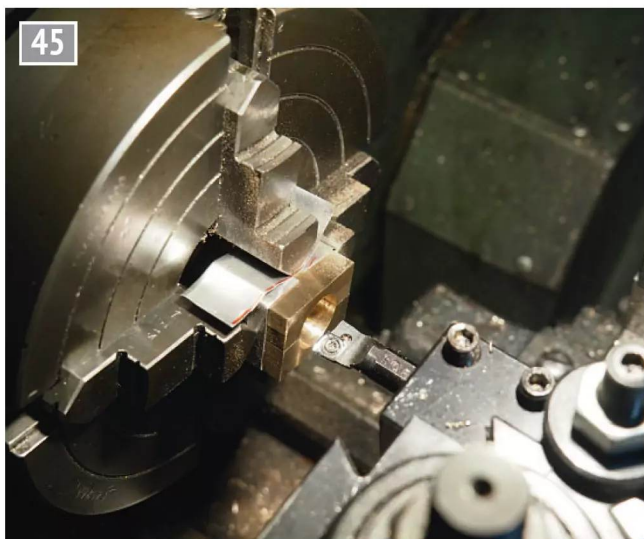


Recycling hoarded material is good but can lead to difficulties. Those half-round holes didn't make good places to start the drilling and boring.



The bearing halves were glued together with cyanoacrylate in a nest with a greased glass block as the base.

The bearings themselves (**fig 11**) are specified in bronze, which is certainly the correct choice, however the model is unlikely to run for all that many hours in total so brass might well be good enough. Once again I dived into the storage pile and found an old bronze clamp once used for holding dental flasks together while making dentures. Recycling is good and, in this case, brings memories of my late father-in-law who was a country dentist and, decades ago, had to do his own technical work. His practice premises provided a lot of interesting bits and pieces when we cleared them out. The bandsaw produced six rough blocks (two for top half bearings and four for the bottom) that needed smoothing off (**photos 42** and **43**). These were glued together in a nest formed from an angle plate and a glass block (a mixing plate from the bad old days when dental amalgam was mixed by hand) greased with petroleum jelly (**photo 44**). A boring bar failed to deal with the off-centre half-round hole, so I went to an under-size slot drill for starting the hole and finished the bore to size with a very sharp carbide tip (**photo 45**). In the initial set-up a parallel was put in place to resist drilling forces and showed no sign of coming loose so in photo 45 it has been removed. The upper bearing halves need a groove for the oil ring and **photo 46** shows a 4mm square HSS tool bit cutting one. I anticipated difficulty with such a wide cut, but the bronze machined well. Rather obviously I took photo 46 with the tool pointing the wrong way! In the lower parts of the bearing the clearance for oil rings is turned on the outside (**photo 47**). The oil rings themselves require simple turning and boring from mild steel stock (**photo 48**). **Photograph 49** shows the two sets of bearing parts which were interchangeable but ... just in case ... I marked them for location. The final operation on the bearings was to drill and tap for the 4BA cap studs



Then the bearing was bored to size. There is a plug gauge just out of shot.



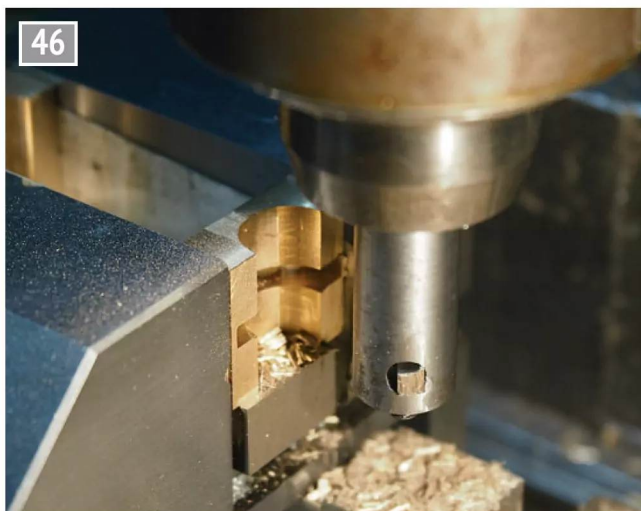
Then the clearance for the oil rings was turned on the other half of the bearings.



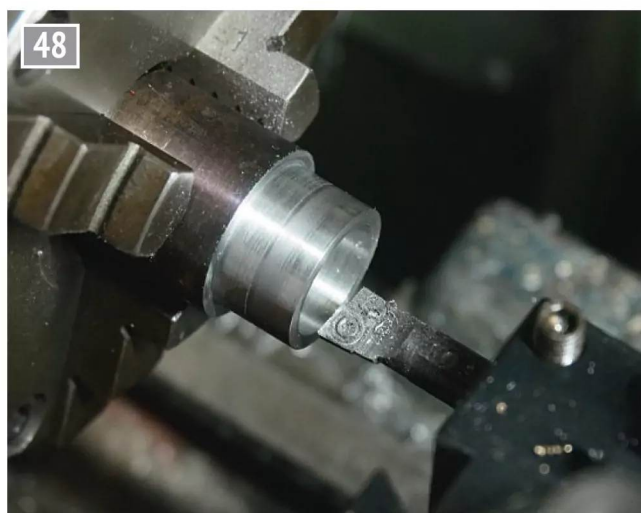
The sets of bearing bits came together to look like this. They are interchangeable but I marked them anyway in case of differences due to wear in the future,

(photo 50). In full size these oil rings were in two halves, hinged together, with shaped tabs and holes that locked

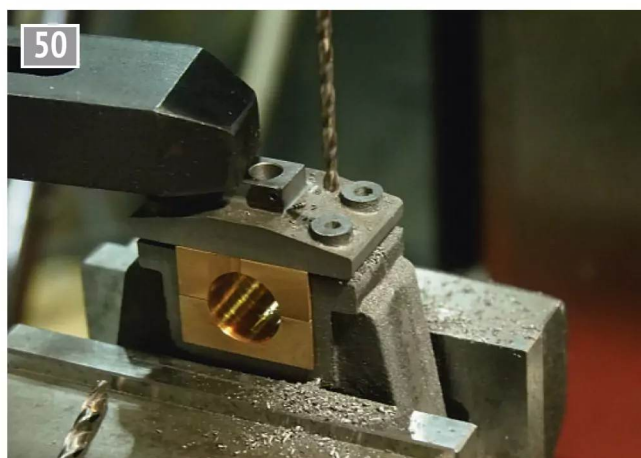
them together at the other ends. The tabs and holes had sides that were tapered in the thickness of the ring to lock



The other end of the 4mm square form tool was very sharp and did a very good job of machining out the groove for the oil ring.



The rings themselves required simple turning and boring from mild steel.



A long series drill was needed to clear the clamp to spot through for the cap studs.

together. It was obviously possible for a skilled man with a file to produce these when the rings were 2 inches wide -

but at 1/16 scale I didn't even try to draw them out!

● To be continued.

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The Development of Motor Cycle Engineering Before WWI

PART 2

Patrick Hendra, of Eastleigh Young Engineers, takes a look at the design of early motor cycles.



Continued from p.472
M.E.4752 September 20

Unfortunately for the Royal Enfield Sales gurus, their latest creation - the Model 201, designed in 1913/14 - was offered to a public, somewhat preoccupied by other matters, in early 1915 - oh dear! This was a dreadful pity because the 201 was way ahead of its time. Royal Enfield offered all chain drive - two speeds - a *free engine* - AND a kickstart. Royal Enfield, like almost all engineering manufacturers, were heavily involved in war production and faced difficulties in buying materials and components so they were in trouble by 1915. They were then forced by the Government to cease civilian motorcycle production completely in 1916.

Royal Enfield made motorcycles for the military but specialised in sidecar outfits. The open sidecar carried a Lewis machine gun and ammunition. The combination, as they were always called, carried a crew of two. Several manufacturers were similarly involved. Some combinations were even used as mini ambulances.

The Model 201 machine was announced anew and unaltered in 1920 when materials became available following the upheaval of the war. (This happened again after WWII - 1939 designs offered new in 1946.) After WW1, the industry did brilliantly even though exWD machines briefly flooded the market but it had to deal with inflation and then deflation (table 2). I suppose

Table 2

Year	1915	1916	1919	1921	1923	1925
£ current price	40	42	52	65	50	35
£ purchasing power	40	34	27	27	28	31

Prices of Royal Enfield 21/4h.p.

Purchasing power values were calculated using Bank of England value of money figures.

Ford Model T \$850 in 1908= £188. Royal Enfield produced their Autorette car in 1913 with a better specification than the Ford for 110 guineas (£115.50) - 2 seats and brakes on all 4 wheels!

UK Motorcycle total registrations **1907** 35000 increasing to 124000 by **1914**.

young men had their first taste of motorised transport in WW1 and liked what they saw. The ladies were not ignored - Royal Enfield introduced a ladies', dropped frame version in 1924, the 201A with an open frame and comprehensive weather protection. By this time, the RE201 had serious competitors but in the post-war slump of the later 1920s demand for cheaper forms of independent road transport and its competitive price (again, see table 2) kept it on sale unmodified until 1926 when a facelift was tried but failed.

SO - my rusty machine was built in 1924/25 to a pre-WWI design, a fascinating peek into engineering of more than a century ago. To put this in model engineering perspective - flying was the caper that then enthralled the popular journalist. Trains were doing the Ton (100mph) and British steam locomotive design was at its pinnacle. Gresley, Stanier and Maunsell were active at the time.

Most but not all car and motorcycle engineers in the WW1 period cut their teeth in the railway industry. However, their training was very amateurish and haphazard as will be obvious from the biographical articles on Marshall that have recently appeared in *Model Engineer*.

Let us look in detail at my trusty rusty steed in some detail to see what it tells us.

The motor

Most motorcycles and almost all cars of 1913 were side-valve four stroke e.g. the Ford Model T. Royal Enfield went for a two-stroke design (so did Velocette and Scott). The design was very different from



Inside the Royal Enfield engine.

Since the late 1920s almost all British motorcycles and small i.c. units have sported AMAL carburettors. The carburettor market was very diverse before this: B&B, Senspray, Amac and Binks were to be found. They amalgamated in 1929 and then traded as the Amalgamated Carburettor Company. Amalgamations such as this were common at that time e.g. the creation of ICI Chemicals in the mid 1920s or Auto Union in Germany a little later.

anything produced today. Its statistics are: bore 64mm by stroke 70mm, capacity 225cc and output 6bhp (photo 7).

A carburettor (B&B, a precursor but very similar to the later Amal design) mounted at the front of the engine (photo 8 and box 2) fed a charge of petrol/oil/air mixture into a sealed crankcase containing an open, built-up crankshaft similar to that of a four-stroke engine mounted between roller main bearings (fig 3). No lateral location was provided.

It was not unusual then for manufacturers to make their



The B&B carburettor on the front of the engine?



The crankshaft and piston drawing from Royal Enfield sales literature.

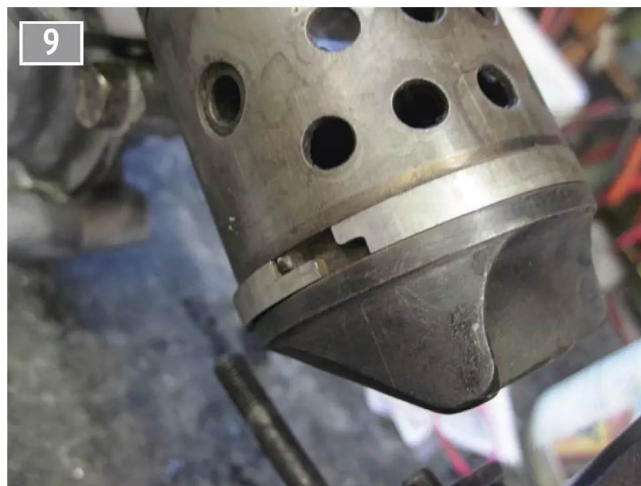
own roller main bearings. The big-end is again a roller bearing and the connecting rod is steel.

The piston is very odd. It is made from iron. I suspect that it is either mild steel or very fine grained cast iron. Around WWI, car, motorcycle and aero engineers were experimenting in changing the material used in pistons from iron to aluminium. The difficulty was that although Al has excellent thermal conduction characteristics, it is soft if pure. Aluminium alloys (then usually incorporating copper) are much harder and stronger but their development was in its infancy. Aluminium as a casting material was expensive until just before WWI when demand increased, forcing the price to unattractive levels again during the War. The prices then fell in the early 1920s and engine manufacturers rapidly switched from iron to aluminium pistons. The famous Norton Company were experimenting with aluminium pistons after WW1 (photo 9).

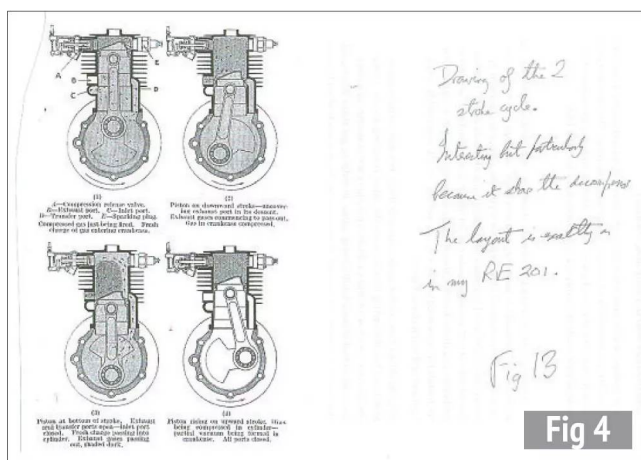
The walls of the Royal Enfield pistons are very thin and are punctured by numerous holes which seem to be there to enhance the lubrication of the piston/cylinder interface on the pressure side. The piston carries a tall deflector to steer the incoming charge and to efficiently drive out the exhaust gases. See fig 4 for a description taken from ref 4.

The single, pegged piston ring is almost square in cross-section and is very stiff so the seal against the cylinder is tight. The cast iron air-cooled cylinder is very sparsely finned and has no detachable cylinder head (photo 10). Since both the piston and the barrel are made of iron, their coefficients of expansion are similar and, I presume, the piston/barrel fit is tighter than is typical of air-cooled engines using aluminium pistons.

The deflector piston design was typical of the period. Flat pistons and 'loop' charging of the cylinder was invented by Adolphe Shnurlé in 1926 and used shortly afterwards in the German DKW RT 125cc. It later



Piston with its deflector.



The operation of the two stroke engine. Note the decompressor. Taken from ref. 4.

became the BSA Bantam after the design was transferred to the UK as part of WWII reparations.

To return to the main bearings: they are not of the now familiar commercial detachable ball or roller races. These became available only early in the 1910s and were in

short supply during WWI and were expensive until relatively recently. Ball and roller races were made by specialist manufacturers like SKEFCO and R&M because the balls and rollers had to be of identical diameters within about 0.0001 inch (2.5 micrometres) or the largest ball or roller took most of the load and the track failed. The error limit was set, of course, by the compressive modulus of the case-hardened steel.

Royal Enfield themselves machined outer tracks into relatively thin tubular sections (photo 11) closely supported outside by the aluminium crankcase castings. The inner tracks are part of the crankshaft. I presume that in this way the inherent flexibility of the outer tracks let Royal Enfield engineers accommodate slight errors in



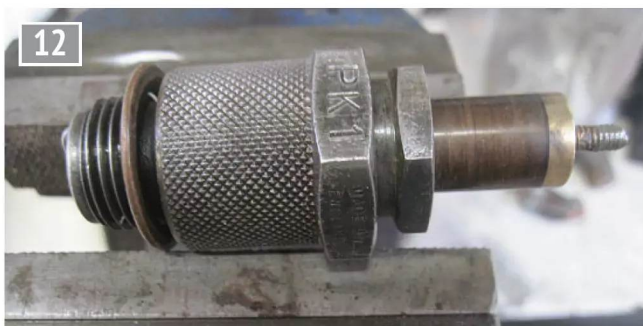
Frugally finned iron cylinder.

11



Crankshaft and main bearing inner.

12



KLG sparking plug assembled ...

13



...and dismantled. Note the mica insulation.

the diameter of the rollers. In fact, there are NO replaceable ball or roller races **anywhere** in the Model 201, as we shall see below.

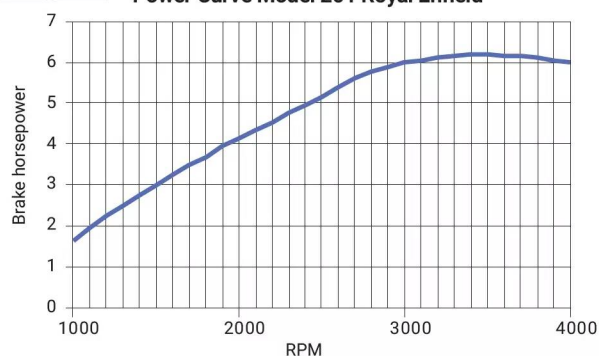
In modern two strokes, the crankcases are carefully designed to minimize the dead volume so that the suction is as efficient as possible and the compression of the charge beneath the piston before the transport ports open is as high

as possible. This way, high revs and great power per unit displacement can be obtained. Royal Enfield designers made little or no effort to minimize the crankcase dead volume.

Sealing the crankshaft to the crankcase was clearly a problem. Modern shaft seals simply did not exist so a contact set-up using a composite plastic material is used. Hang on - composite

Fig 5

Power Curve Model 201 Royal Enfield



Power curve-redrawn from ref 1 (part 1).

plastics at that time? Yes - 'Tufnol' sheet made from layers of cotton fabric and soaked in phenol formaldehyde polymer (Bakelite) was available. The sparking plug is at right angles to the cylinder axis and is very strange to modern eyes.

The sparking plug by KLG (photos 12 and 13) is of the detachable type, of 18mm thread size (currently most engines use 14mm plugs). The insulation is machined from thick sections of mica - a silicate mineral that consists of stacked parallel layers of atoms. I am fairly certain that the central electrode is made of nickel because it is weakly magnetic. For some reason unexplained, Mica insulation was favoured over ceramics because two-stroke engines were then said to run *very hot* - yet the finning is sparse? Above the piston is a steel detachable plug identically threaded to the plug hole - why? - to find top-dead-centre, of course!

The sparks are provided by a Model K1 Lucas magneto chain driven off the crankshaft at engine speed and is almost identical to the instruments fitted to British Bikes up until the 1960s.

Engine performance

In fig 5 I give a redrawn version of the power curve offered in ref 1 (part 1, M.E.4752, September 20). This yields a specific power output of around 7.5 bhp. per litre per 1000rpm. But you will note that significant power is available at 1000rpm and below. Modern

normally aspirated four stroke engines do 60% better than this. Some sophisticated racing two-strokes have generated more than 200bhp per litre at 13,000 rpm, for example in the 1968 racing season the Yamaha 125s were putting out 44bhp and their 250s generated 70!

One other reason for the poor power output offered in the early days of motoring was the need to keep the compression ratio down to 5:1 or less. Modern engines imbibe petrol of much higher quality than the stuff available around 1914 - today, the quality - the octane rating - is much higher than it was then - and as a result compression ratios above 10:1 are now routine. The quality of petrol significantly improved in the 1920s when tetraethyl lead was introduced allowing compression ratios to rise up to 7:1. The lead caused sickness particularly in children and has since been banned worldwide for use in motor vehicle fuel.

Transmission

Royal Enfield designers were at the forefront in 1913/14. They had recently patented a strange two-speed all-chain transmission system and it was obvious that the Model 201 would be an ideal application thus avoiding the need to buy in a commercial gearbox and its clutch.

The transmission system uses two primary drive chains both continuously driven by the crankshaft. The two engine

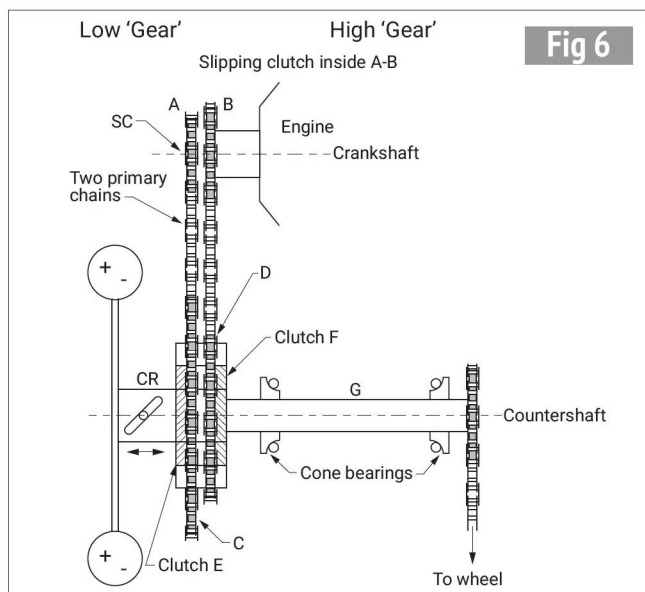


Fig 6

Simplified drawing of transmission.

sprockets are of different diameters and drive matching driven sprockets mounted on a counter-shaft behind the engine. The two chains are of similar length - 53 links of $\frac{1}{2}$ inch by .305 inch.

Hidden away inside the width of the driven sprockets is a pair of internal-expanding ring clutches, the rings being forced into the inner sprocket surfaces by a pedal operated mechanism.

The transmission is shown in a simplified form in **fig 6**.

The system uncovered is to be seen in **photo 14**.

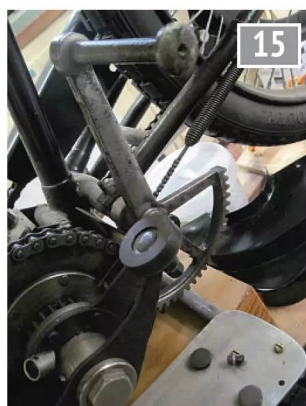
The two primary chain sprockets A and B are mounted on the engine crankshaft through a patented 'slipping clutch' SC (see fig 6). The

primary chains then drive the driven sprockets C and D continuously which are, in turn, mounted on a countershaft carried in cup and cone bearings G behind the engine. Sprockets C and D are selectively locked to the countershaft through a pair of foot operated metal to metal clutches E and F of the internal expanding type. If neither clutch is engaged the engine is in what we would now describe as 'neutral'.

Depressing the pedal operates a helical scroll system that moves the core of the countershaft CR in and out. This, in turn, forces one or other of the internal clutches to expand and 'lock' the selected sprocket to the countershaft.



Primary drive.



Kickstarter - 5 guineas extra!

The kickstarter is a segment of a gear that engages with a gear to the left of the sprockets. This is, in turn, fitted with a face type freewheel compressed by a spring. The kickstarter is completely exposed (**photo 15**).

The countershaft is, amazingly, mounted between two cup and cone ball bearings G - the type of bearing we all had in our bicycles years ago - remember how the uncaged balls used to fall out invariably in the dust?

The countershaft cups and cones are considerably larger than bicycle hub bearings. Although they are driven relatively fast - up to a half engine speed, they seem to be up to the job. All of the primary chains are on the near side. To adjust the primary chains a cylinder carrying the countershaft between the engine plates is off-centre. As the cylinder is rotated, the centre line of the countershaft moves. This, of course, alters

the meshing of the kickstarter gear.

The off-side has a drive sprocket on the countershaft, a drive chain and a rear sprocket. Because the system does not include a conventional clutch, engaging the drive can be a bit fierce so Royal Enfield incorporates a patent slipping clutch on the crankshaft (**photo 16**) - and a rubber cush drive in the rear wheel hub - the latter is still offered today!

Quite obviously, the engine would tend to stall so a huge exposed iron flywheel is fitted on the offside of the engine. This doesn't seem to be very healthy and safe but Moto Guzzi continued with exposed flywheels well after WW2.

It must be remembered that the Royal Enfield 21/4 was a 'lightweight', that is, an economy machine. Larger machines by 1914 were incorporating two and three speed countershaft gearboxes using constant mesh gears and hand gear changing. The 'positive stop' foot control - now often called 'sequential gear changing' - appeared in 1927 where Velocette used it to good effect in the Junior (350cc) TT race of that year.

●To be continued.

REFERENCES

- Ref 4** *The Book of the Royal Enfield Repairs and Maintenance 1922-1928*, 'RE Rider', Pitman's Motor Cyclist's Library.



The patent slipping clutch - inside the drive sprockets.

The Leufortin Project

PART 7

Ian Bayliss
presents
an internal
combustion G-scale
locomotive.



Continued from p.449
M.E.4752 September 20

The trials (and tribulations not over)

After now over three years of mostly enjoyable and satisfying work I am looking justifiably (well I think so) proudly at something I had designed and made, unpainted but ready to run. Just how wrong can you be? The truism of pride coming before a fall was roaring down the tracks at me and I was blissfully unawares.

Leufortin 1 goes up on blocks, fuel goes in, system primed by pulling starter with finger over exhaust, air filter oiled, fully charged batteries for receiver, servo checks completed and fully charged glow plug heater fitted. Pull the cord and it will start.

No! This engine would not start. Glow plug checked. Looked fine with bright white/orange glow from filament. Turned locomotive over and drained all fuel from carburettor, exhaust and crankcase having pumped the fuel from the tank (pumped? Sucked out with a 60ml syringe fitted with a bit of Tygon tubing, no less). This cycle went on for a couple of hours with no success. After a couple of days of the same, I finally took to the last resort as reported on the Internet by those more knowledgeable about nitro engines. Apparently, this 'hack' is normally used for engines that have had some life but have been out of service for a while. That is to pre-heat the engine with a heat gun or a hair dryer on maximum setting. Finally, the engine fired. It ran totally out of control - nothing would control it even

shutting the throttle down by the servo. It just ran wild with the centrifugal clutch fully engaged. Managed to stop it by a rag over the exhaust and pinching out the fuel line. In under two minutes, three years of dedicated work was in ruins. Flycranks were out of line (quartering? What quartering?) with bent crank pins, etc. bolts on the output shafting had vibrated very loose with two nuts off altogether, the forward /reverse lever handles had fallen off despite being locked with thread locking adhesive and the direction change lever frame bolts were out and the frame wrecked. The batteries had bounced out of a commercially sourced battery box and, having started on full charge, they were now flat.

The disaster had struck!

I walked away just a little devastated. It took a couple of days for reason to set back in. The model had been designed with the ability to be dismantled, so a detailed strip down, analysis of what had gone wrong and diagnosis were undertaken.

Working through the sub assemblies it was noted that anything that I had taken an educated chance upon and not over engineered had failed in some way. Fortunately much was salvageable. In the car world (comparing with the model car I have) cars have a very good sophisticated suspension system that provides a level of effective damping of the substantial vibrations set up by these engines in the structure. We

tend not to have this level of sophistication on our locomotives. Everywhere that I had some dependence on grub screws without other support had failed in some way. I should have heeded the collective wisdom from those who have succeeded in internal combustion in the garden railway field. That wisdom states that all should be cross pinned, extensive use of Philidas/locknuts and to be liberal with thread locking adhesives. Only some of these had I incorporated partially, because I knew I had to strip the model down to finally paint the thing.

The real disaster became apparent when I reached the tumbler forward/reverse mechanism and jackshaft assembly. Stripping out the tumbler yoke revealed that the idler gears had partially friction welded themselves to their respective solidly held steel shafts (they had to be hammered apart with a drift). The separating forces coupled with the torque magnification of this bit of the gear train were far higher than I had calculated for.

The gears being small ran faster than the surrounding shafting. The very point I had missed. I had taken the erroneous view that as this was at the slow end of the transmission, narrow gears without hubs running on fixed shafts with a lot of lubrication would all be okay.

All parts were bagged and tagged as they say and the really good fortune was that the main gearbox that had



First search for what went wrong after the disaster.



Disappointing task of stripping out the locomotive to find the real causes of the troubles.



Bagging and tagging all of the disassembled components and isolating salvageable parts.

pedantically been built and over engineered had suffered no apparent damage and still ran as a unit. The cab was okay as was the main chassis, and a lot of the other parts were salvaged.

Photograph 61 shows very little is wrong. Appearances are deceptive.

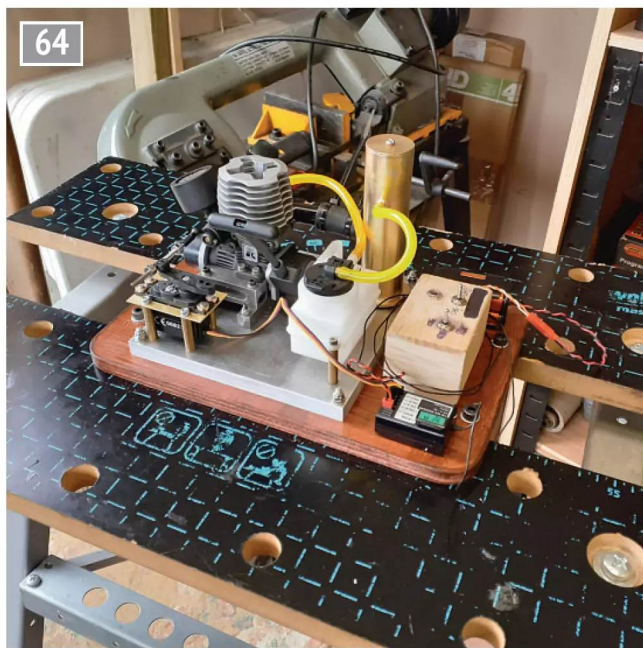
Photograph 62 – finally, the offender has been apprehended and out on the bench.

Photograph 63 - bagging and tagging as the forensic people like to say.

The re-build programme

It was apparent that a redesign of the damaged areas was necessary along with a whole mass of modifications that rocked (forgive the pun) the base principles I thought I had covered. Too many days and hours of frantic work followed on the 'drawing board'. Various decisions were taken at this stage from what had been learned. Firstly, to stop doing

all the easy bits first, just to feel good - a disciplined approach was needed to make the parts as the file turned them up. Secondly, to split up the difficult material and the easier items, bagging and tagging as I went. The decision was made that nothing would be left to chance if possible. The final transmission output would revert to the twin bevel solution (of 'Detritus' fame) for the forward/reverse, albeit without a clutch (relying on the centrifugal clutch at the engine bell housing). Thirdly, not sliding gear teeth along a lengthy face width gear but a bespoke sliding permanently engaged dog type coupling operated by a locking lever. This would dramatically reduce any imposed separating/torque forces on the control mechanism, maybe leaving the way open to servo control in the future. Everything that could be was now going to be keyed to its shaft including wheels and flycranks with just



Homebuilt test bed to try and find out how nitro engines behaved and how to set them up.

about everything running in ball bearings including now the only idler gear. It was not easy but some clarification can be found in the updated master arrangement drawings (see figs 1 and 2 in part 2 – ME4748, July 26).

Test beds and engines

I was not prepared to go through all this again with a wrecked model on my hands and a recalcitrant engine. All the collective wisdom for nitro engine commercial products tells the neophyte in this field like myself to use the factory settings to 'break-in' the engine from new. Believe this at your own peril or your model's peril. Run it rich - running lean overheats the engine and reduces its longevity and so on. True but this one was difficult to start and ran out of control. As it transpired the factory settings were not even remotely rich and the throttle idle gap was less than half what was required.

I therefore designed and built a robust 'test bed', at the insistence of my good lady, in order to set up and adjust both this engine and the one already purchased for the second locomotive. This is shown clamped with bespoke clamps

to the folding workbench (**photo 64**).

Some throttle linkages to fettle for use here on the test bed and on the final models were needed if only for the spherical connection. Visiting the model shop I managed a chat with one of their technical people. He said to never trust the factory settings on new modern engines. They can be incorrect and have just been assembled and not necessarily to the needed adjustments for the engine in question. Always check the break-in settings from the engine specifications and set your engine up to those. Good luck in finding consistent settings from the manufacturers and published data in the public domain. Even they proved to be questionable.

There are three critical adjustments and it is not my place as a non-expert to give any advice, just my own empirical findings. My engine was way out of adjustment from the factory. The three adjustments typical of modern engines are idle speed setting (by measurement of the throttle opening in the throat of the carburettor), high speed needle (HSN) setting and low speed needle (LSN) setting.

Having installed the engine



65
Completely new flycranks with keyways and the tooling to ensure all were identical.



66
Set up on the mill to accurately match crank pin drilling.



67
Shaping new flycranks.

on the test bed, the needle settings and idle speed throttle opening were reset. It started with difficulty in the end and ran, albeit badly. One problem partly out of the way - put aside to get on. A return to it was made whilst paint dried and other matters with the project attended to. It was as bad as ever. Even the settings given were far too lean on the LSN. Consequences: overheating, poor control by runaway, broken pull start cord (inboard knot melted due to the overheat), shattered big end bearing, bent con rod, piston caught in lip of porting, total seizure.

A little out of chronological order at this point but I had written a long detailed diatribe on the machinations, frustrations of nitro engines and the settings etc. As a

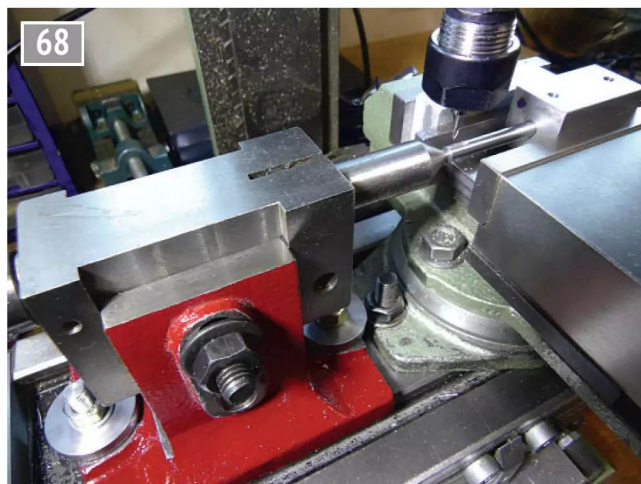
novice it is not my remit or experience to do so here or presume to advise others. There are some thoughts that need to be considered as broad brush strokes for those of a like mind about to embark on such a foolhardy 'mad professorial, off-grid' venture such as this one.

The apparent simplicity of modern nitro glow plug engines is deceptive. They are highly developed, high performance machines. They are capable of very high revolutions per minute, typically in the range 3,000 to 30,000 r.p.m. They are sensitive even to barometric pressure and humidity and to the variables available to the owner. They need careful breaking in, much like the highly tuned performance engines of the 12 inch to the foot motor sport world. To have ignored such has proven to be somewhat hard on the pocket. In short, no two engines, even of the same model, are the same. Ensure blue smokey exhaust, don't overheat. Nuff said?

That inevitability aside, the engine, even working after a fashion, at the time before the seizure of the first round was a huge relief and incentive to carry on with the changes to my model.

The first modifications to the salvage and first replacements

It had been decided this time around to paint the model as the second attempt progressed. Facing a rebuild and then another strip down to paint was not an option by now. The chassis frame was undamaged but needed some hole variations in the footplate flanges to accommodate the redesigned final drive arrangements. There were also some changes to the rear footplate holes. All the gearbox and transmission holes were opened to M3 so that Philidas locking nuts could be used, ensuring no loosening or loss. M2 were not available. A simple strip of bright mild steel (5mm thick x 16mm wide) from the old stock drawer



68
Sinking keyways in running axles for flycrank quartering.

was drilled with the existing holes each side of the changed holes and the new holes along its centreline by co-ordinate drilling on the mill - bolt in position, spot and drill through. The chassis is symmetrical so a matter of just turning it over ensures no left-hand or right-hand to be made. Ready for paint.

The wheels were broached with keyways this time. All new flycranks with heavier hubs were made with some tooling to ensure consistency. The same logical argument applies. I had tried to over-think all this as to how the fly cranks, now with keyways, and crank pins would match up. They in fact just have to be identical to each other. They were broached before shaping and drilling for the crank pins. Consistent drilling was achieved by putting them in a fixture in the mill vice with a keyway and a piece of shaft with a key and drilled and reamed for the crank pin by spotting through the fixture. This was all done with the X-Y table locked for a belt and braces safety net. Final shaping was in another little fixture - just a reamed shaft hole and a crank pin hole, fixed and clamped with an M6 socket cap screw and 4mm ground stock piece inserted through the crank pin hole, slot drilled down to a stop one side. Do all four. Move slot drill centre over requisite amount do the other side of all four (photos 65, 66 and 67). A new motor

and servo mounting plate had to be made along with a new but now narrow footplate/rear cab mount.

Fitting the flycranks with keys raises the problem of quartering. It is now totally reliant on the position of keyways cut into the axles. Using the same logic as with the flycranks themselves and of course the sharpening of end mills by us amateurs to Harold Hall's suggestions, it is in fact a fairly simple matter. A 6mm diameter reamed hole is put through the centre of a piece of square section mild steel. A couple of grub screws lock the axle in position, roughly centred, and we have the basis of fairly accurate quartering. With the fixture just described locked in the mill vice, one keyway is milled in one end. The fixture is turned one flat of the square and relocked in the vice without moving the axle in the block at all. Then the keyway is milled in the other end. I do use a rotary table tailstock for support. As long as the second axle is dealt with the same way, the quartering will be as accurate as the squareness of the original block and the machine tool in use. That is something which should have been checked at the very start of this little exercise (photo 68).

●To be continued.

Geoff Theasby
reports on
the latest news from the
clubs.



My electric locomotive, *Deborah*, and its driving trailer are now more or less complete, having been fitted with a sprung, quick-release chair (NOT an ejection seat!), horn, brake, emergency stop feature, front axle restraint and some marble slabs to aid traction. I have encountered a phrase in the model community, that the last 5% of a project takes 95% of the time, and I wholeheartedly agree. In this case, the model was built without any plans or drawings but it just 'grewed', as in auxesis, like *Topsy*. Materials were obtained *aus gefunden*, or to put it another way *objets trouvés*, over a period of about 5 years, in between writing this column, following my amateur radio pursuit and enjoying my retirement.

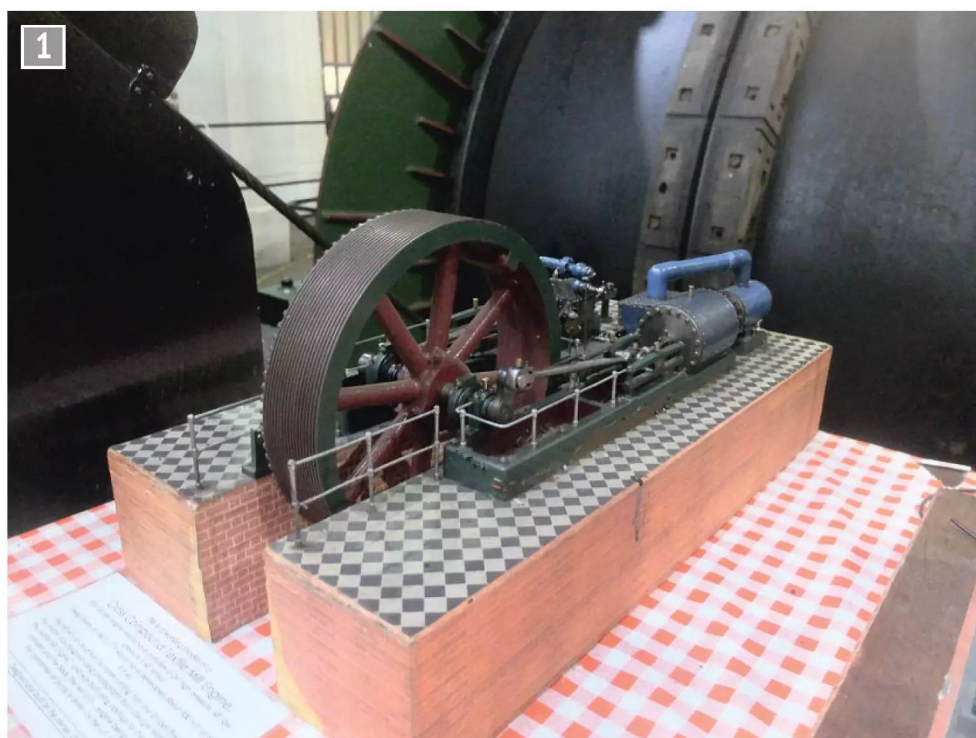
I do enjoy the occasional recommendation to watch videos suggested by newsletter readers and editors. So, for the first time in Club News, I offer my readers this: the Rolls Royce Silver Shadow as a rather expensive second hand car, the 'tops' in engineering.

The makers noticed a trend from chauffeur-driven to owner-driven, which was a revolution that sold more than any previous model. Not particularly fast but, as was said elsewhere, only your bank manager will catch you. The review car had service records for over 36,000 miles, which works out at £2.50 a mile. If you live in the countryside, this means your morning newspaper or milk is very costly. Compared with the Lexus L30, of a similar vintage, it is streets ahead, from the very tight shut lines on the openings, the efficient and beautifully engineered glove box catches and other dashboard switchgear. Despite the wholesale use of automation, the radio aerial is manually operated. The gearbox is a General Motors automatic but, instead of the mechanical linkage to the driver, RR have changed it to electric and selection is by a PRNDIL quadrant over the steering wheel boss. The seats are electric, operated by mini-joysticks in a recess at the bottom of the centre console. The hydraulic suspension is

a Citroën concept, improved of course by RR. This gives a feeling of disconnection with the road, and the steering is very vague, but the wheel needs only a fingertip to operate. Likewise, the brakes, now using discs, have taken over from the previous drums. Finally, even the clock is silent. www.youtube.com/watch?v=0ByTjy4D6E4

In this issue: a manual aerial, an hotel, dig this, poor Caledonian locomotives, a (Soviet?) crusher and unofficial locomotive names.

In August, we hied ourselves to **Papplewick Pumping Engine**, stopping off at the Bestwood Hotel, where Debs used to be the licensee. Bestwood winding house and engine, close by, is steamed a few hours each month but all the rest of the once-sprawling site had been demolished apart from the nearby dynamo house and the rest turned into a country park. We picked a glorious day, beautifully sunny and warm at Papplewick. Visitors were few, about ten in all. We got the guided tour of the decorated engines and the boilers, which are



Gerry Mason's cross compound.



Ezekiel's Transport spares: The book of Ezekiel, 1.1 et al.

steamed about six times a year. Our guide explained what a pierced plate on the flywheel was for, saying that single cylinder engines stop on Top Dead Centre and the plate is to move the engine by hand until it can start. (Well, no. 'Sometimes' the engine will so stop, and is 'barred' round as explained. It is not a regular occurrence, however.) Bestwood colliery was closed in 1967, the first in the UK to produce 1 million tons of coal, and had the fastest 'wind' at 30 mph, necessary as the deepest point was $\frac{1}{2}$ mile down. Some of the coal faces were 7 km away from the pit bottom. Debs tells me that it was said to be possible to walk below ground from Nottingham, all through South and West Yorkshire. I was overjoyed to find, in the shed housing the rescued Linby Colliery winder, some excellent steam engine models, including a very good cross compound by Gerry Mason (photo 1). Other full size machinery is on site, some only having a gazebo to protect them from the weather, and fund raising is ongoing. A miniature railway moves around the site, run by Chesterfield MES, but was not running that day. The 'big railway' station at Bestwood closed to passengers in 1931. I'm interested in these old coal mines because in a previous life I was responsible for the taxation of the miners in these pits and knew all the colliery names and

other details of the South Yorkshire & Nottinghamshire coalfields long before I ever visited them. These spare wheels are 'Gate Guardians' at the entrance to Bestwood Country Park (photo 2). The Linby Colliery winding engine has been transported here in pieces and has a shed to itself (photo 3). This is the 'works' of the Robey winder from Linby (photo 4). www.papplewickpumpingstation.org.uk

My attention has been drawn, following my item about the Caledonian '956' and Highland 'River' class locomotives in M.E.4749, by Angus McIntosh, of the **Caledonian Railway Association**, to the idea that the poor design of CME William Pickersgill's Class '956' 4-6-0 had serious shortcomings. In *Caledonian Railways of Great Britain* Steve Llanos of Sweat House Media writes: 'Steamindex (last accessed 23 August 2008) reports that these were considered to be failures. The editors quote from Atkins, P., *West Coast 4-6-0s at Work*, 1981, chapter 10 - *From 4-4-2 to 4-6-2 at St Rollox*, summarizing: 'Atkins considers that George Kerr was responsible for the design, especially the conjugated valve gear. Graeme [G.R.M.] Miller informed Atkins that the substitution of Stephenson link motion for the inside cylinder was due to the very high reciprocating mass of the derived gear. The derived



Linby colliery winding engine.



'The works' by Robey of Lincoln.

motion was modified with dashpots which led to an extraordinary sound. Atkins argues that in this final form the class was the only one to enter the LMS which combined long travel with long lap but the performance of the class was limited: 24,000 miles/year as against 32,000 miles for the class 60'. The Steamindex editors also

quote, with apparent delight, from E. S. Cox, *Chronicles of Steam*, about the physical and operational oddities of this design: 'The first time I found myself hauled by one of the '956' class of 3-cylinder 4-6-0's I could not believe what my ears told me was happening up front and when, in due course, this cacophony with its attendant ills was too



Miniature Volvo at Graves Park.

grievous to be borne due to the erratic behaviour of the conjugated gear, the effect of the introduction of a separate Stephenson valve gear for the inside cylinder having variable lead, together with retention of the outside Walschaerts valve gears having fixed lead, could only produce results at which the mind was bound to boggle'. As the conventional three-cylinder exhaust would be described as 'One-Two-Three-Four-Five-Six', they 'gave a more irregular exhaust beat of 'ONE-two-THREE-four-FIVE-six'.

On Track, August, from **Richmond Hill Live Steamers**, says that Peter Rock has built a 2 inch scale model of a Fowler road locomotive. A railway video filmed in Paraguay is recommended, with some hair-raising activity. The introduction is great, plenty of clag (black smoke), seemingly fast, terrible track and photogenic North British locomotives. Also this is the slowest 'express' in the world, meaning that anyone trying to end it all on the track would be likely to die of malnutrition before a train arrived. But spot

the sausages! In addition, the servicing or replacement of the track depends on whether the platelayers can find it in the undergrowth. www.youtube.com/watch?v=_wEAl5gxOBo The pan pipes background music is rather better than most of the melodies issuing forth from that instrument.

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

Stamford MES reports the building of three high sided passenger trucks for editor Joe Dobson to haul about. This design will not endanger any passengers who disregard the safety rules, as one gentleman did recently, slightly damaging the locomotive and riding car.

Daresbury Gazette, from **Warrington & District Model Engineers Society**, August, tells us that the generator shed and pavilion have been reroofed and I noted that the signals were powered by solar panels. Consideration of better sites depends mainly on the amount of shadow the panels can cope with.

W. www.wdmes.org.uk

In *Steamview*, August, from **Sydney Live Steam Locomotive**

Society, Craig Deacon writes on building a coal crusher. The society had taken delivery of a ton of good coal, from a benefactor, but it was intended for the 'Big Railway' so, after some deliberation, it was decided to build a coal crusher, to save teams of members spending all day hammering it into small pieces and getting sooty black, avoiding the use of child labour. Four iterations were necessary before arriving at a workable model. The cost had to be the absolute minimum - A\$ square root of 'mumble, mumble' - and the response from members was incredible. Scrap iron channel, a circular saw, flywheels (2), Audi brake disks and a 3-phase electric motor were somehow persuaded to allow themselves to become a coal crusher, filling a 10 litre bucket of small coal every 30 seconds. Simon Collier attempts a ground level driving seat, spanning the tender and the driving truck, to ease the strain to his back. Warwick Allison designed and calibrated a dynamometer load box.

W. www.sls.asn.au

Visiting Graves Park in Sheffield with Debs' family, we found a mini-Volvo, very suitable for an 'On the Road' piece. This was very popular - youngsters of all ages seem to like diggers, or 'back hoe loaders', as the inventor of the machines, Joseph Bamford, has it. The story of the JCB is fascinating and well recognised the world over. It is one of the three biggest manufacturers of such machinery on the world, founded after WWII, and even holds the world speed record for diesel vehicles (350 mph). But, back to Volvo, founded in 1954. Appropriately, I was wearing the Prancing Moose T-shirt (Google it). The story is amusing, not to say funny, as the Volvo company view is that it contravenes their copyright and they have told the maker to 'cease and desist' (**photo 5**).

Steam Whistle, from **Sheffield Society of Model & Experimental Engineers** informs us that Peter McBeath has died. There was standing room only at the funeral

and a well attended wake in Grindleford. Editor Mick Savage covers the future plans for the club site, like adding another footbridge to ease the congestion. The Society is a borderline case for VAT to apply and the financial types are pondering... Contact with HM Revenue and Customs is very slow, no surprise there. What other organisation could stay in business if it took weeks to resolve enquiries, answer letters and deal with anomalies? Totley tunnel, at the beginning of the Hope Valley line, is 130 years old this year. At its completion it was the second longest tunnel in the UK. Mike Peart refers to chalked information on old locomotives (think of Barry Scrapyard), which was preceded by unofficial additions to the locomotive 'Comet' in Victorian times. The GWR placed nameplates over the driving wheels with plenty of space for amendments. So, she became 'InCOMETax', a matter which was in the news at the time. Continuing in the vein of odd looking locomotives, try No. 8 on the Walkersville (Maryland) railway. It was cobbled up from bits and pieces, with a spare boiler pressed into service, in order to train drivers. See this video and marvel! www.youtube.com/watch?v=mKVUf25tCGw This also reminds me of the joke about *Flying Scotsman*. In its restoration, during the last Labour government, the powers that be decided a long nameplate was too expensive and some wag suggested they leave out the first letter of the name.

W. www.sheffieldmodelengineers.com
And finally, why do engineers confuse Halloween and Christmas? A: Because Oct. 31 = Dec. 25.

ME

CONTACT

geofftheasby@gmail.com

Club Diary

2 October 2024 – 6 November 2024

October

2 Bradford MES

Meeting: 'Bits and Pieces', 19:30, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999.

2 Leeds SMEE

Talk – Derek Rayner, 'South African Steam Safaris', Darrington Golf Club, 19:00. Contact: Judith Bellamy, jabellamy29@gmail.com

3 Cardiff MES

An evening with Tony Bird. Contact : secretary@cardiffmes.co.uk

3 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

4 Rochdale SMEE

Models Competition Night. Castleton Community Centre, 19:00. See www.facebook.com/

RochdaleModelEngineers

6 Bradford MES

Public Running Day. Members from 11:30, public from 13:30, whatever the weather, Northcliff. Contact: Russ Coppin, 07815 048999.

6 Guildford MES

Small Model Steam Engine Group, 14:00-17:00. See www.gmes.org.uk

10 Cardiff MES

Bring and buy. Contact : secretary@cardiffmes.co.uk

13 Cardiff MES

Open Day at Heath Park, Cardiff. Contact : secretary@cardiffmes.co.uk

13 Sutton MEC

Track Day from 13:00. Contact: Paul Harding, 0208 254 9749

16 Leeds SMEE

AGM, Darrington Golf Club, 19:00. Contact: Judith Bellamy, jabellamy29@gmail.com

17-20 Midlands Model

Engineering Exhibition

Warwickshire Events Centre, See www.meridienneexhibitions.co.uk

18 Rochdale SMEE

Annual General Meeting. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

20 Guildford MES

Open day, 14:00-17:00. See www.gmes.org.uk

24 Sutton MEC

Afternoon run from 13:00. Contact: Paul Harding, 0208 254 9749

26 Cardiff MES

Steam up and family day at Heath Park, Cardiff. Contact : secretary@cardiffmes.co.uk

27 Westland and Yeovil MES

Track running day 11 :00. Contact : Michael Callaghan, 01935 473003

31 Guildford MES

Open day, 10:00-13:00. See www.gmes.org.uk

November

1 Rochdale SMEE

Talk – 'Re-building the Ellenroad Beam Engine'. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

2/3 Halesworth and District MES

LOWMEX 2024, East Coast College, Lowestoft. See www.lowmex.co.uk

6 Bradford MES

Meeting: Autumn Auction 19:30, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999. Note: Only Members may bid on lots.

6 Leeds SMEE

Jumble sale, Darrington Golf Club, 19:00. Contact: Judith Bellamy, jabellamy29@gmail.com

NEXT ISSUE

Beam Engine

Mitch Barnes restores a beautifully made ME beam engine to its former glory.

Brushless Motors

Jon Freeman explains how brushless DC motors provide a more efficient and reliable drive for electric locomotives.

Leufortin

Ian Bayliss brings the construction of his internal combustion locomotive to a successful conclusion.

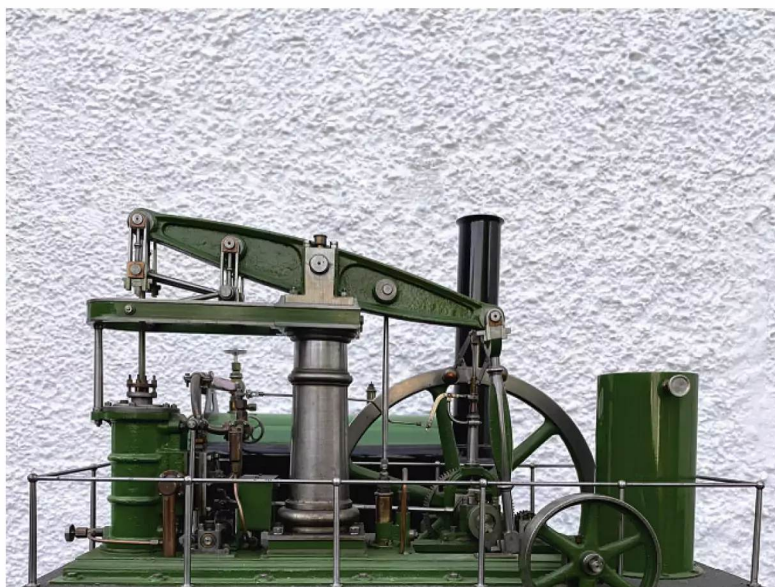
Pannier Tank

Gerald Martyn begins the construction of his 3½ inch gauge GWR pannier tank by fitting the horns to the frames.

Mill Engine

David Thomas gets to work on the valve gear for his Corliss mill engine.

Content may be subject to change.



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5 INCH GAUGE POLLY VI 2-6-0
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3 1/2 INCH GAUGE LMS "PRINCESS ROYAL" PACIFIC
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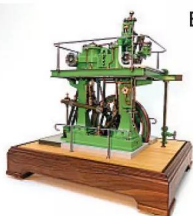
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Approx length 80"

- | | | | |
|---|----------------------------|---------------------------------|-----------------------------|
| • Stainless steel motion | • Choice of liveries | • Piston Valves | • Superheater |
| • Boiler feed by axle pump, injector, hand pump | • Painted and ready-to-run | • Walschaerts valve gear | • Reverser |
| • Etched brass body with rivet detail | • Coal-fired live steam | • Drain cocks | Approx Dimensions: |
| • 4 Safety valves | • 5" gauge | • Mechanical Lubricator | • (L) 80"x (W) 10"x (H) 14" |
| | • 4 Cylinder | • Silver soldered copper boiler | • Weight: 116 kg |

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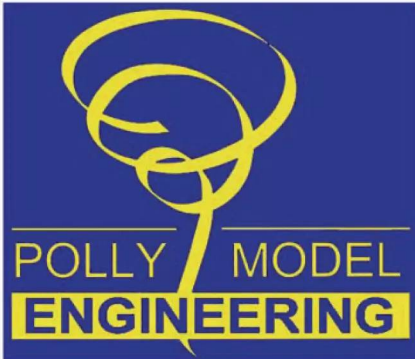
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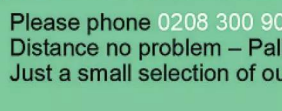
Norton Deep throat No.6DB fly-press 12" throat x 9" height £950 +++ FLYPRESS PUNCHES AVAILABLE



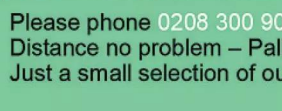
Smart and Brown Sabel lathe £950



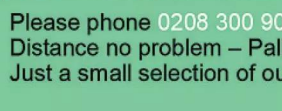
Neat cut and soluble cutting oils £10 each + oil available



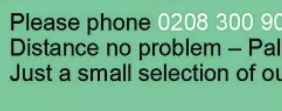
Milling cutters, drill bits, chasers, DOC cutters etc.



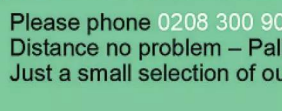
JET GH1440 7" x 40" lathe straight from art college in nice order £5750



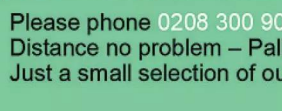
Myford ML10 lathe £1650



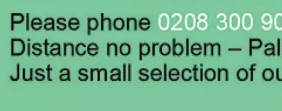
Harrison M300 lathe £3950



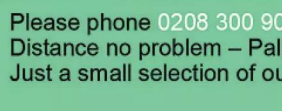
Schaublin 70 lathe + chucks and collets, two tailstocks, complete £12000



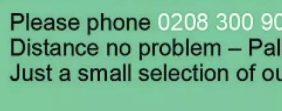
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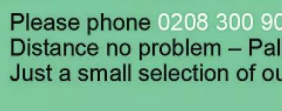
Myford Super 7 lathe £3450



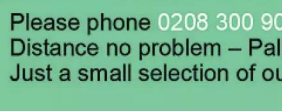
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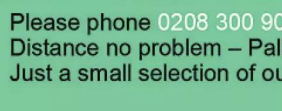
Tripos 240v switch £90



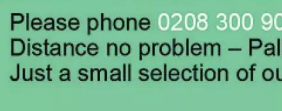
Fixed steadies for: Colchester Triumph, VS2500, Mascot, VS2000, Mastiff available!



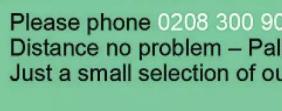
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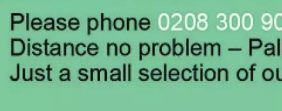
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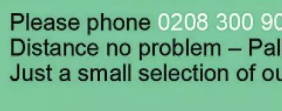
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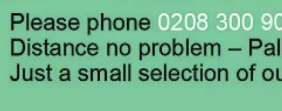
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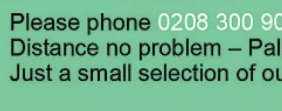
Charles spinning lathe 7" centre height x 24" centres £1950



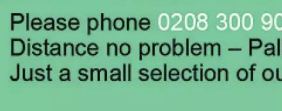
Boxford AUD Mk111 5" x 22", rare imperial gearbox, power cross feed, Gripnu 3 jaw, Dickson tool post, DRO + inverter, nice machine! £4250



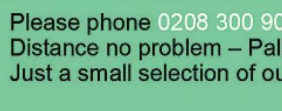
Sharp MK11 H-V milling machine + Mitsubishi inverter £1650



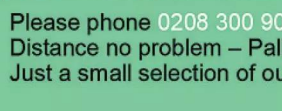
Transwave 1.5HP converter £325 5HP converter £525



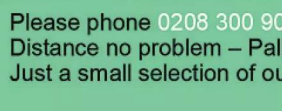
Myford Connoisseur centre lathe + Tesla inverter, DRO, stand, tooling £9750



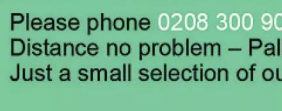
Colchester Bantam 2000 lathe (long bed) metric leadscrew, Dickson post £4950



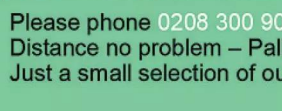
Stanier precision vice 55mm jaw New / New Zealand £195



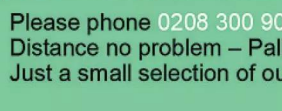
Myford 254 PLUS IMP. 240V, rare D-13 model, Immaculate example! £7,250



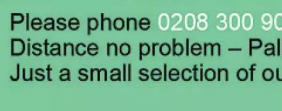
Harrison L5, M250 M300 / Colchester Student 11200 / 1800 lathe change wheels + A&S 1ES + MYFORD CHANGE WHEELS!



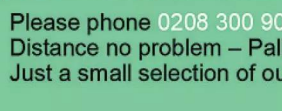
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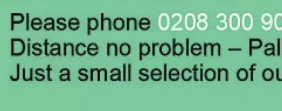
Wolf-Jahn lathe + collets + two tailstocks just in! £3250



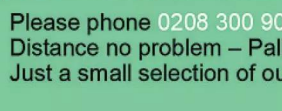
Chester Cub 630 6" x 30" centres chucks, steadies hardly used £2950



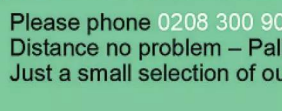
Trugrip collets metric £35 Imperial £30, Marico 2820 £15 each, Myford collets from £20



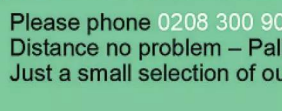
Creuson Morrisflex 240V 8" polisher buffers £825 each



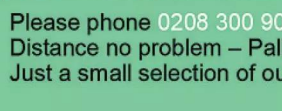
Myford bridge & rifle felts £6.75



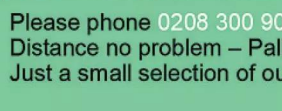
Myford Super 7 lathe £3450



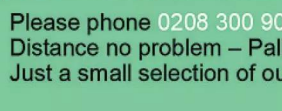
Myford VMB Mill + Chucks & stand 240V £2750 Just arrived!



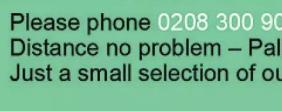
Arboga Mill / Drill ER collet chuck 2 speed 3PH motor £1250



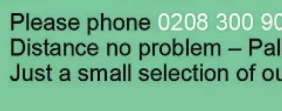
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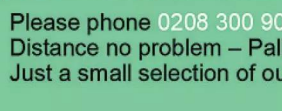
Myford Super 7B lathe £3450



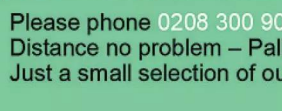
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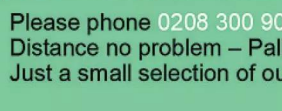
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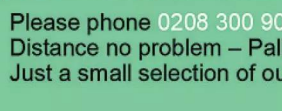
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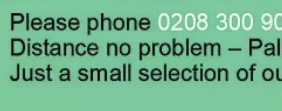
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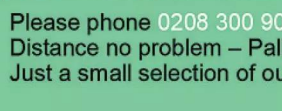
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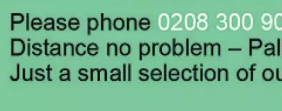
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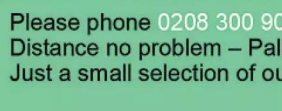
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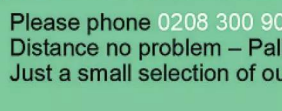
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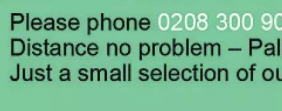
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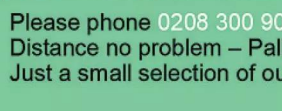
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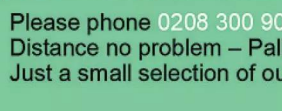
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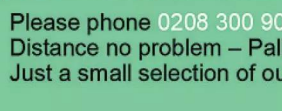
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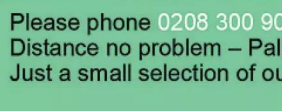
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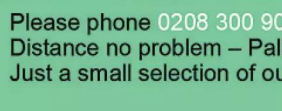
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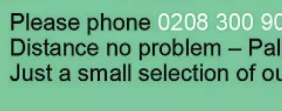
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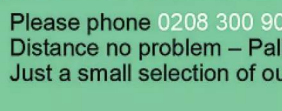
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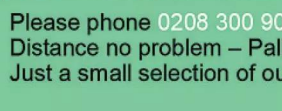
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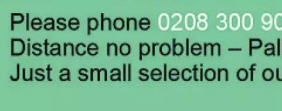
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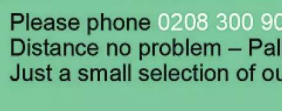
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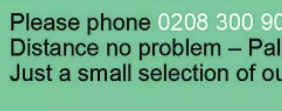
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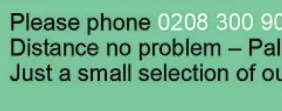
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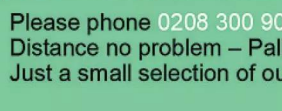
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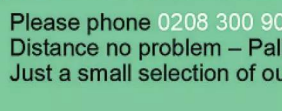
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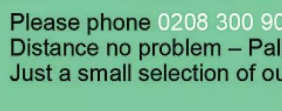
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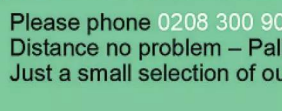
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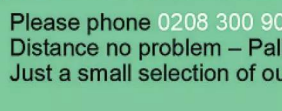
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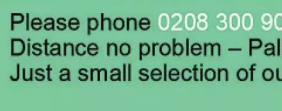
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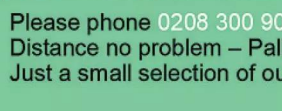
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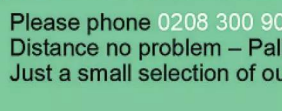
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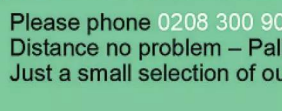
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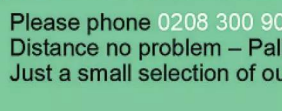
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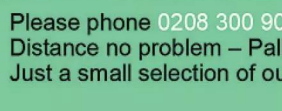
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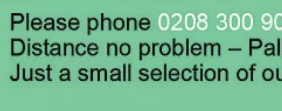
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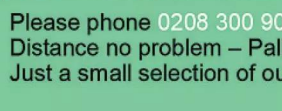
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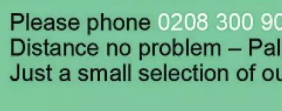
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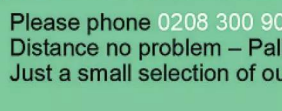
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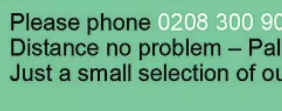
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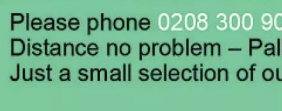
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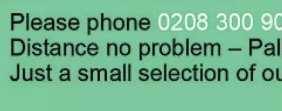
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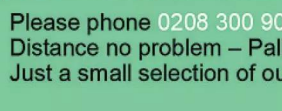
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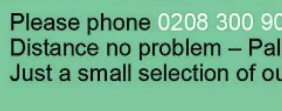
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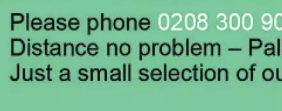
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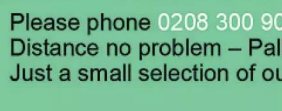
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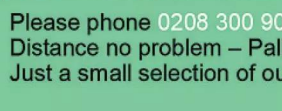
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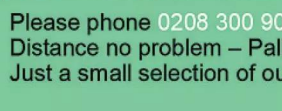
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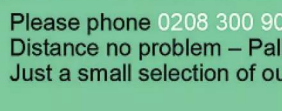
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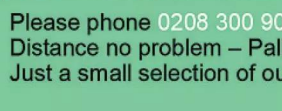
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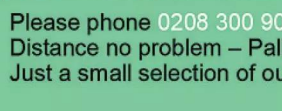
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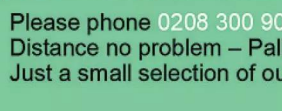
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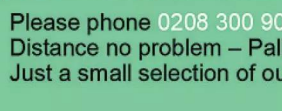
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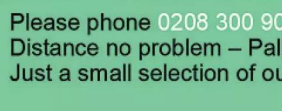
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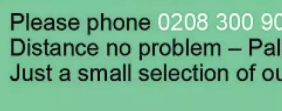
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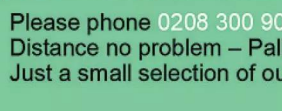
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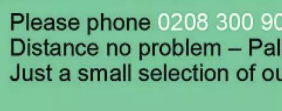
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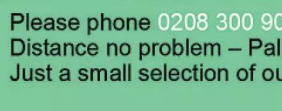
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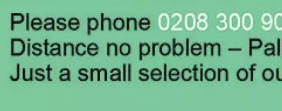
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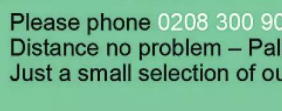
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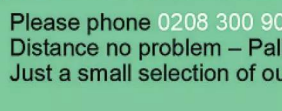
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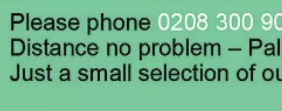
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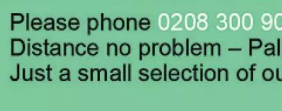
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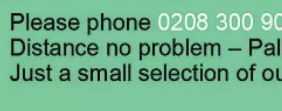
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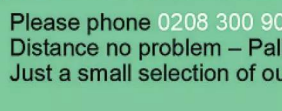
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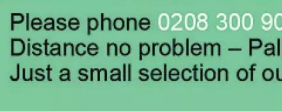
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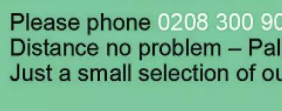
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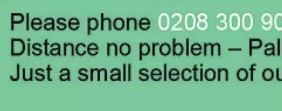
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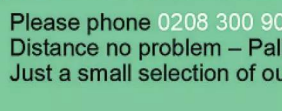
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