THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 221 No. 4589 • 22 June - 5 July 2018

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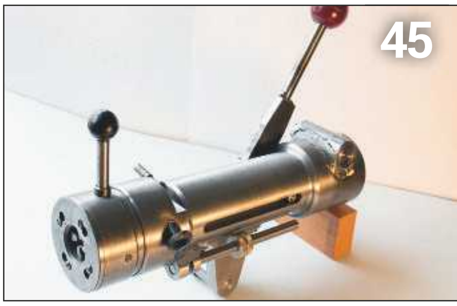

IN THIS ISSUE

Vol. 221 No. 4589 22 June - 5 July 2018

ON THE COVER...

Ballan Baker's Thompson K1 MacCailin Mor *and Geoff Moore's LNER B1* Impala, *on parade for a photo-op at Gilling. (Photograph: Doug Hewson.)*

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Steam Tug *Kerne*

The Steam Tug Kerne Preservation Society Ltd has been awarded 'The Queens Award for Voluntary Service' in the Queen's Honours List, published on 2nd June 2018. This is an MBE equivalent and the highest award given to a voluntary group. It is the first time a historic vessel preservation group has been honoured in this way.

The award was created in 2002 by the Queen to celebrate the anniversary of her Coronation and recognises excellence in voluntary activity carried out by groups in the community.

The assessment process for the award was conducted on behalf of the Queen by Captain Hugh Daglish LVO JP DL Royal Navy ex Commander of HMY (Britannia) and His Honour Judge John Roberts DL. The award citation honours the rescue and preservation of *Kerne*, one of Britain's oldest operational steamships.

The Queens award is recognition of the work of the group over the last 47 years. Their members' dedication has been an example of what can be achieved for the benefit of the nation's maritime heritage and is enjoyed by many thousands of people who have seen *Kerne* steaming to events and come aboard to learn about a living ship of the *Titanic* era.

Chris Heyes and Paul Kirkbride attended Buckingham Palace on Tuesday 5th June for a Royal Garden Party and The Lord Lieutenant of Merseyside is to make a presentation on board *Kerne* at a later date.

Bedford Gala

The Bedford Model Engineering Society are again holding their annual rally (now known as The Gala) at their Summerfields Miniature Railways site at Haynes, just south of Bedford. The actual dates are Friday 31st August through Sunday 2nd September. Originally conceived as a Visitors' Rally for 7¼, 5 and 3½ inch gauge locomotives, all gauges from 7¼ inch down to 32mm can now be accommodated and are welcome, as are traction engines and other model road vehicles.

There are spaces available for caravans and camping. Early arrivals and later departures can be accepted for anyone wishing to stay longer than the allotted three days. Full details and booking arrangements may be obtained by email to gala@bedfordmes.co.uk and will be detailed on the BMES website and Facebook pages.

Tony Webster

It is with sadness we report the recent passing of Tony Webster. Tony made a significant contribution to the magazine beginning in June 1991 when he first introduced his series on building the Durham & North Yorkshire traction engine in 2 inch scale. He had come to model engineering relatively late but was attracted to traction engines, and particularly the designs of John Haining, having worked in agricultural engineering professionally. He rallied the D&NY engine extensively for many years. In June 1995 he started a construction series entitled *Titan 10-20,* again an agricultural machine but this time kerosene fuelled. This tractor won him a Gold Medal at the Model Engineer Exhibition and was a popular series. On deciding he would like something bigger to run about the rally field, Tony commenced the design and construction of a 3 inch scale Fowler steam lorry and described its construction over 17 parts. Tony, always keen to pass on his knowledge and experience, continued to contribute to Postbag until his recent illness.

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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FALCOR A Beginner's Locomotive in 32mm Gauge

PART 5

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

Continued from p. 763, M.E. 4587 25th May 2018

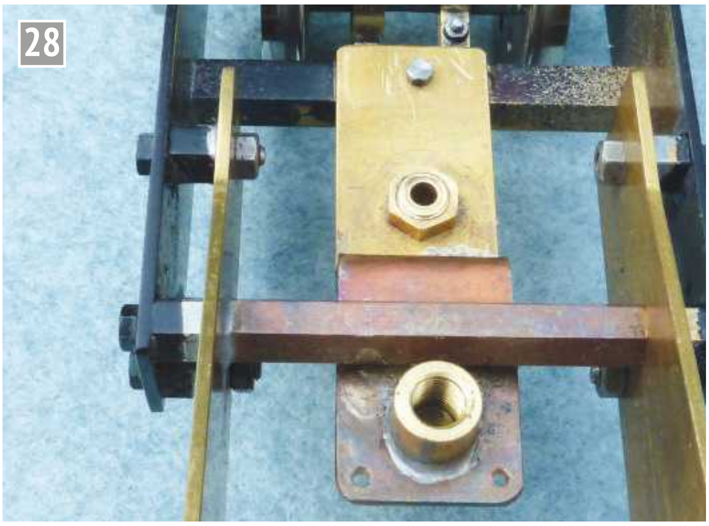
Main wheels and front bogie (figs 32-40)

The four main driving wheels and axles came from Roundhouse. They are a nominal 1½ inches or 38mm diameter (measured over the flanges) and are bored out for a ¼ inch axle. They are clamped via a grubscrew. On this locomotive I wanted to try for a few more wheels than a basic 0-4-0 arrangement, so this engine was made as a 4-4-0.

The front bogie attaches to the locomotive by means of a suspension bracket attached to the front of the frames (**photo 28**, **figs 32** to **34**). A location arm then connects the bogie to the locomotive at this bracket (**photo 29**, **fig 35**).

The bogie is sprung and the rear pair of wheels on that bogie can swivel up and down, so all four of the bogie wheels have a chance of staying on the track. Also, each of the bogie wheels is loose on its axle. Is this good railway practice? I do not know but the engine has not yet managed to derail any of its wheels when travelling over the points, most of which are Peco 38 inch radius. This includes one set of points which is home-made and a non-standard 30 inch radius; I wanted this one to match the curved track which is 30 inch radius.

When I put a central spring on the front bogie I did not know how much weight to put on it, so I borrowed a pair of kitchen scales of the same type as our own. Then, with a bit of 'guesstimation' the spring tension was set to put about 2.7 pounds weight on the front assembly and about 5 pounds on the four driving wheels. I balanced the locomotive on two short lengths of track. These were placed on each of the scales to spread the weight. So far, the weight balance seems to be very stable. Possibly someone with more



28

Front bogie mounting bracket.

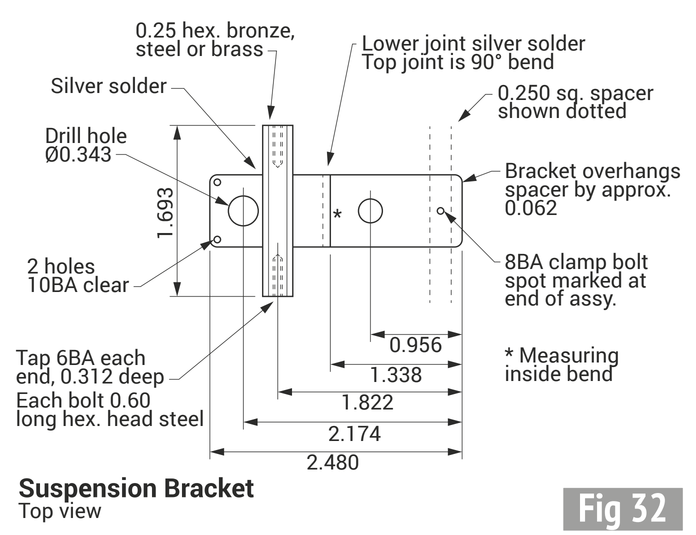
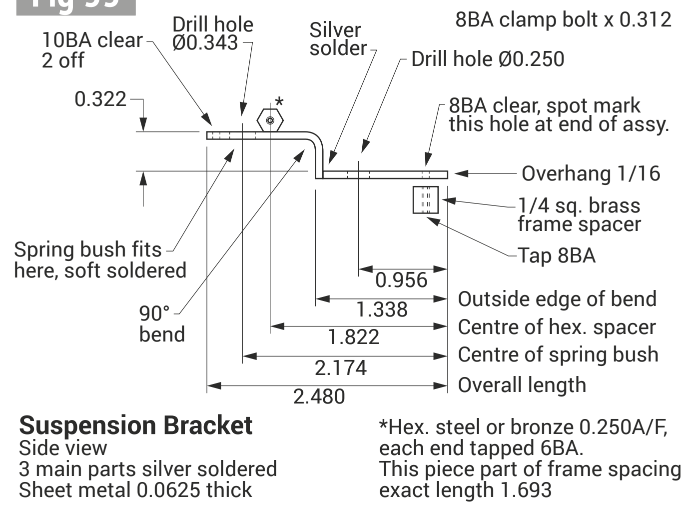


Fig 32

Fig 33



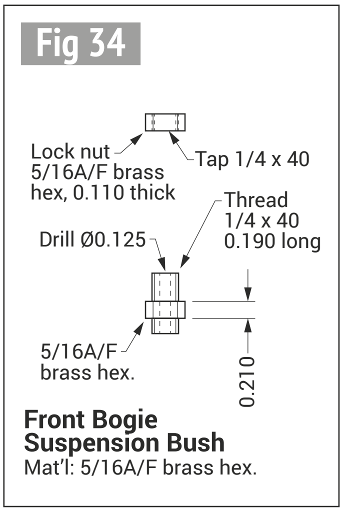
railway experience can tell me if the weight balance would be better set differently?

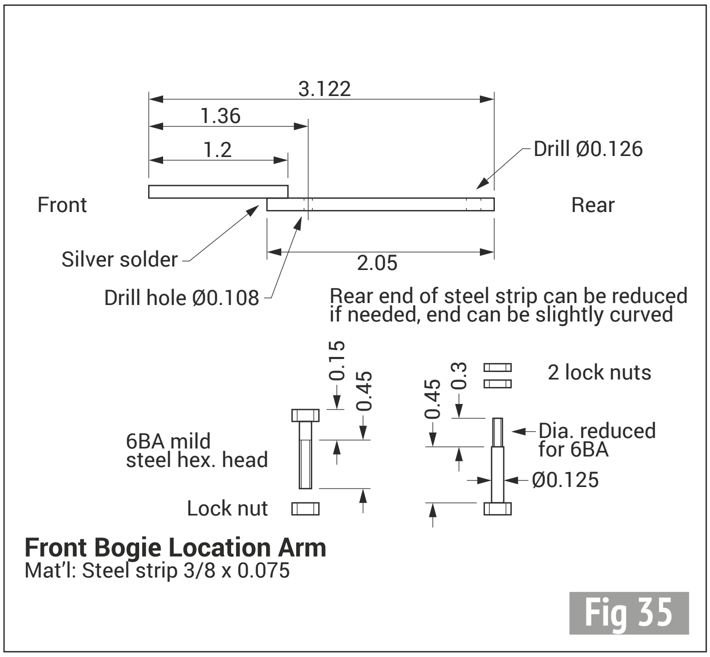
The central spring was set to give the necessary tension by making the long threaded bolt too long by about half an inch. With the locomotive on the kitchen scales the bolt was slowly screwed downwards to compress the spring until the balance 'felt right'. The excess length was slowly removed from the thread until the bolt could be tightened down hard without needing a lock-nut (**photo 30**, **fig 36**).

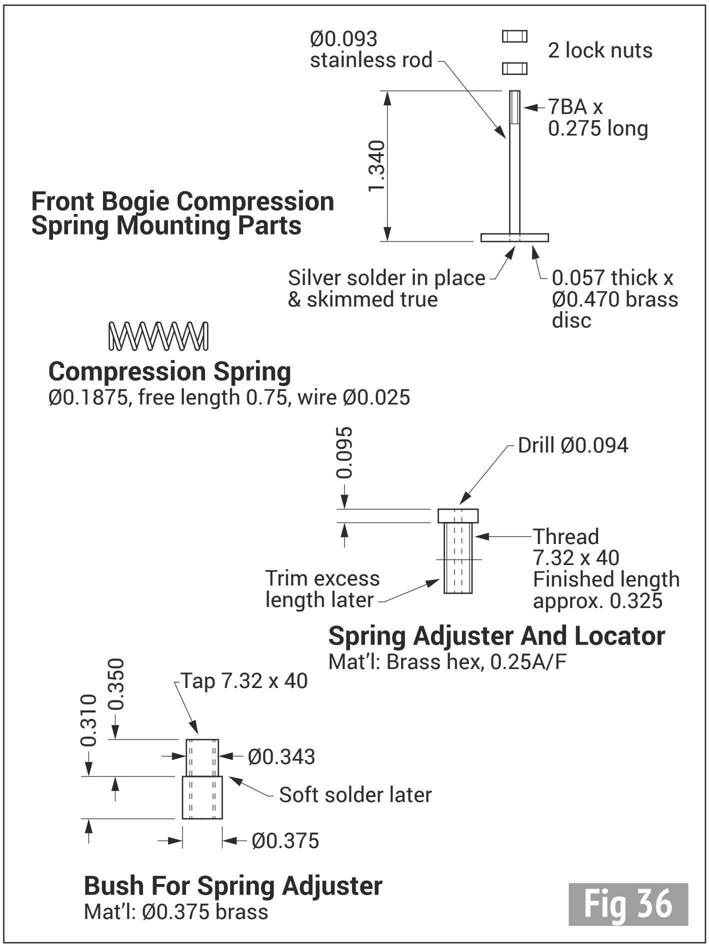
The main component of the bogie (**photos 31** and **32**) is 5⁄16 inch square brass bar. The front axle support is formed from 5⁄16 inch bronze rod bored out for the 1⁄8 inch axle (**fig 37**). Each wheel is loose on its axle. The rear axle support (**fig 38**) is slightly smaller diameter bronze rod with a length of 4BA threaded rod silver soldered in the middle. This allows the rear pair of bogie wheels to swivel up and down. Is it needed? Would it be better as a solid set of four wheels? The loose

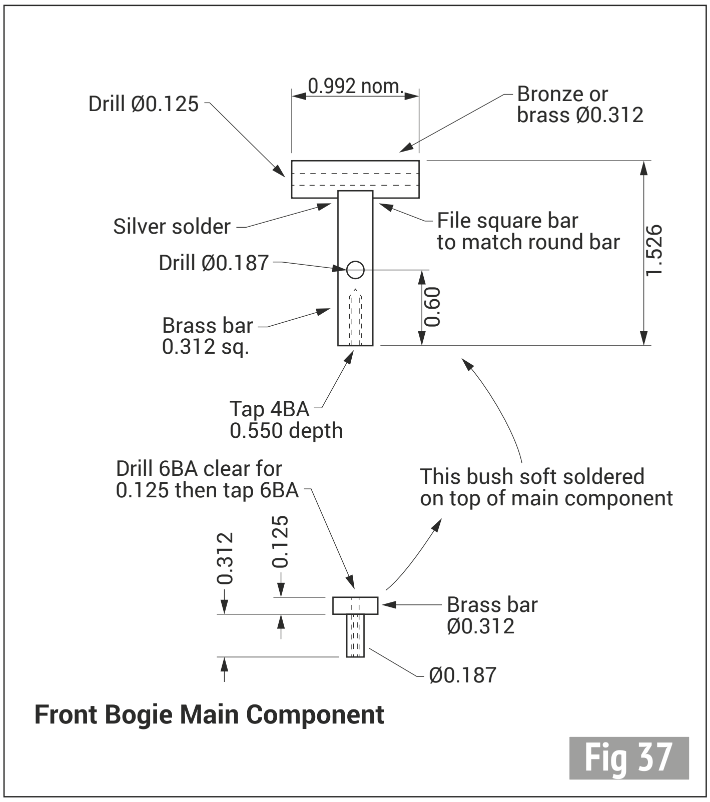
Front bogie complete, with location arm.

Compression spring.









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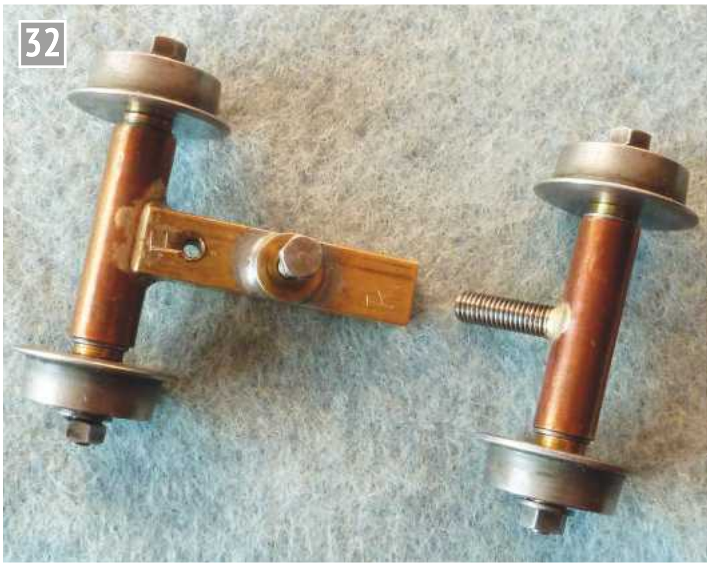
Front bogie minus location arm.

32



Front bogie, axle unscrewed.

rear axle certainly makes sure all four wheels stay solidly in contact with the track. It has not yet derailed, even with me driving over small twigs, leaves and pebbles.

The location arm to join the bogie onto the locomotive 'looked right', not from any science, although I am sure there will be exact sizes and ratios for all the lengths. I based my ideas on things I used to make with Meccano 60 years ago. The two bearing holes, one at each end of the location arm, definitely do not make a tight interference fit for the bearing pins.

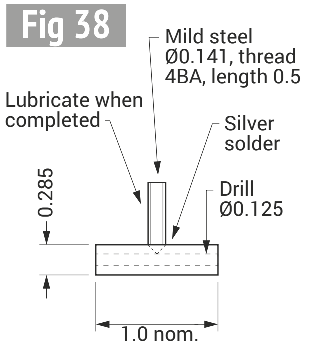
There is enough slack to allow the front end of the bogie to twist up, down and sideways by about 5° - obviously the rear wheels can tilt by a lot more. Another experiment one day is to swap the actual wheels for some which are slightly larger. The four currently fitted are 20mm over the flanges.

With a bit of judicious filing it would be possible to fit 22mm wheels. The front end of the location arm is continued forward and fits above a small section of brass angle attached to the rear of the front buffer beam (**fig 39**). This prevents the whole assembly from being pushed too far downward by the suspension spring and there are two end-stops for this angle as well. Without these extras it was very easy for the suspension spring to become hooked under the location arm.

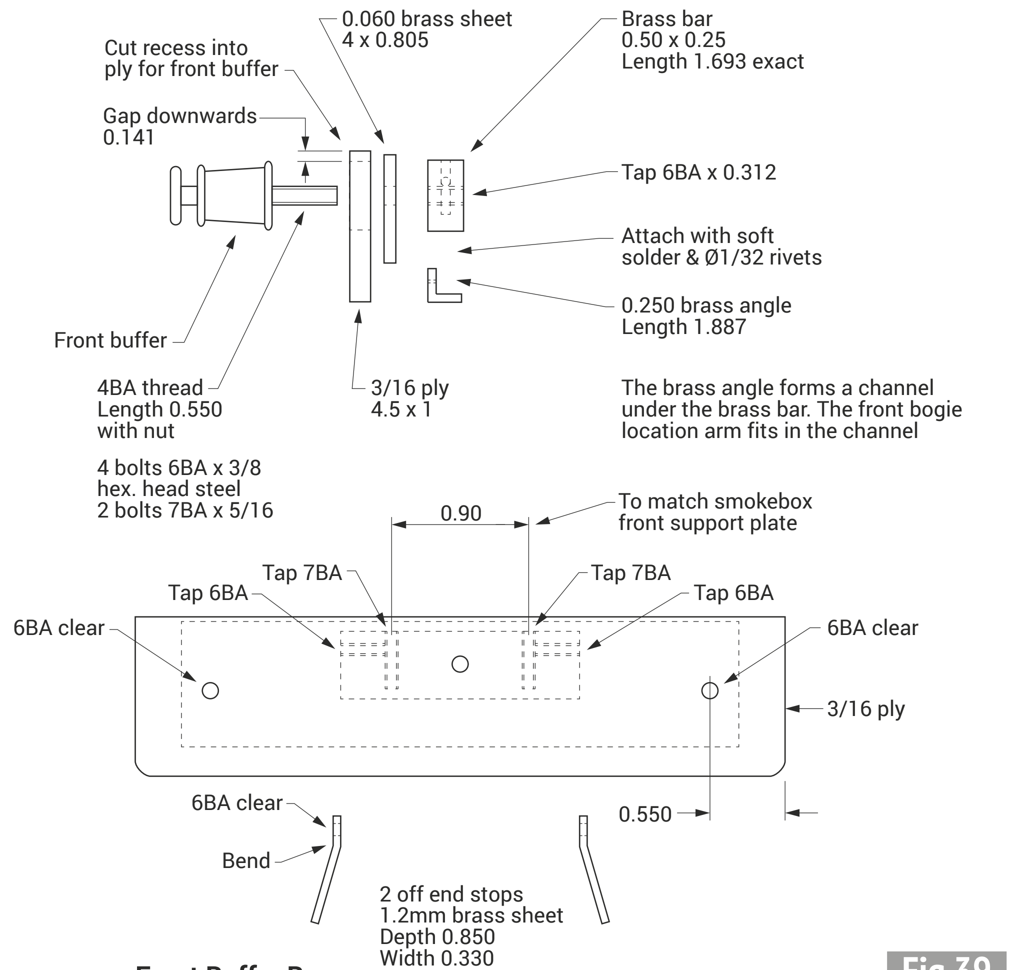
●To be continued.

NEXT TIME
We discuss flange clearances and take a look at an alternative two wheel bogie before moving on to the chimney, smokebox and valve gear.

Fig 38



Front Bogie Rear Axle Swivel
Mat'l: Bronze or brass



Front Buffer Beam

Fig 39

PART 16

Lathes and more for Beginners

Graham Sadler starts work on the toolpost.

Continued from p.853
M.E. 4588, 8 June 2018

A simple toolpost

It's now time for us to do something better than the Myford tool post clamp system. There are many, many designs available for a tool post for the lathe, both home-built and purchased. The simplest is a block of steel with a deep groove in it into which a tool can be bolted. The problem with this type is that it is little better than the original Myford clamp as packing pieces are still needed to bring the tool to centre height and each tool will need a different set. Some of these have two or even four slots, called a 4-way post. I find this type dangerous due to the tools sticking out all over.

There are a number of commercial versions known as 'quick change' tool posts, so called because all the tools are mounted in an individual holder which is locked to the body with an eccentric or cam action. However, these are expensive when you are eventually going to have 10-20 tool holders. In addition, for me, they are not good due to the clutter on the top of the main block (in some forms) and the increased overhang of the tool beyond the end of the support platform of the top slide. This increases flexibility in our lightweight machines. I do however have one for my big Colchester lathe, (photograph 6 shown in *M.E.*4576, 22nd December, page 16, along with my earlier mark 3 version of this tool post) where the clutter is not so important due to the size of the machine.

Many home-produced tool post designs need complex milling, often with dovetail cutters (requiring great accuracy, repeated for each holder) with a lot of material needing to be removed. This would not be easy without a miller and some good experience of using it. This tool post can be made just on the lathe while accuracy of repeatable cutting is surprisingly good considering the simplicity of the location of the tool holders. These are simple bars of 12 x 20mm material with 10mm slots along their length, with a 3mm diameter location pin.

Milling the slot in the fly cutter (posed photograph).

One of its advantages is that, when in use, it can be used to set the top slide parallel with a good level of accuracy. Others are that the post may be set in a fixed repeatable position or able to freely rotate with the ability for the tool to be positioned a lot further out, for light cuts on those nasty jobs which crop up with alarming frequency! All tools are set to centre height off the machine with a simple setting jig and still need shim packing but the time to set a tool to centre height is under a minute.

The machining is complex in places and will take a while so there's a lot of learning with this project! So that I could detail this project for you, I made a second post to fit on a replacement for the top slide. With a DRO I found I wasn't using the top slide for anything other than screw cutting and short tapers so in future the set-up photographs will show this highly rigid tool post mounting rather than the top slide - so it will be a little different from your situation. The tool post was on display at the Doncaster show in May.

Preliminaries

Before we start making the tool post, two useful bits of kit will be needed. These are the wobbler discussed briefly earlier, used to centre work in the four jaw chuck, and a fly cutter. Your version will be a different design to mine, which was made during teacher training years ago. I won't be giving wobbler constructional details as the method of production is identical to the pump centre we made for tapping (*M.E.*4582, 16th March, pages 443-4) - in fact the design of the device is the same, except that the centre needs to be 200mm longer, the body can be longer to accommodate a bore which is about 25mm deeper and the reduced end of the body will have a deep centre drilled hole. We will deal with its use later but my advice is to make it before starting on the dirty cast iron machining.

It's strange how things work out and how the workshop can surprise you. On another job, I had just tapped a big hole using the pump centre. The next operation was a four jaw chuck job, centred on a punch mark. I picked up my wobbler and didn't fit the tailstock centre as the drill chuck would be needed next. I just put the wobbler in the pump centre and fixed it in place with the double spring. It was then that the penny dropped! If you have made the pump centre, to convert it into a wobbler all that is needed is a rod about 200mm long, with a point on one end and a centre in the other!

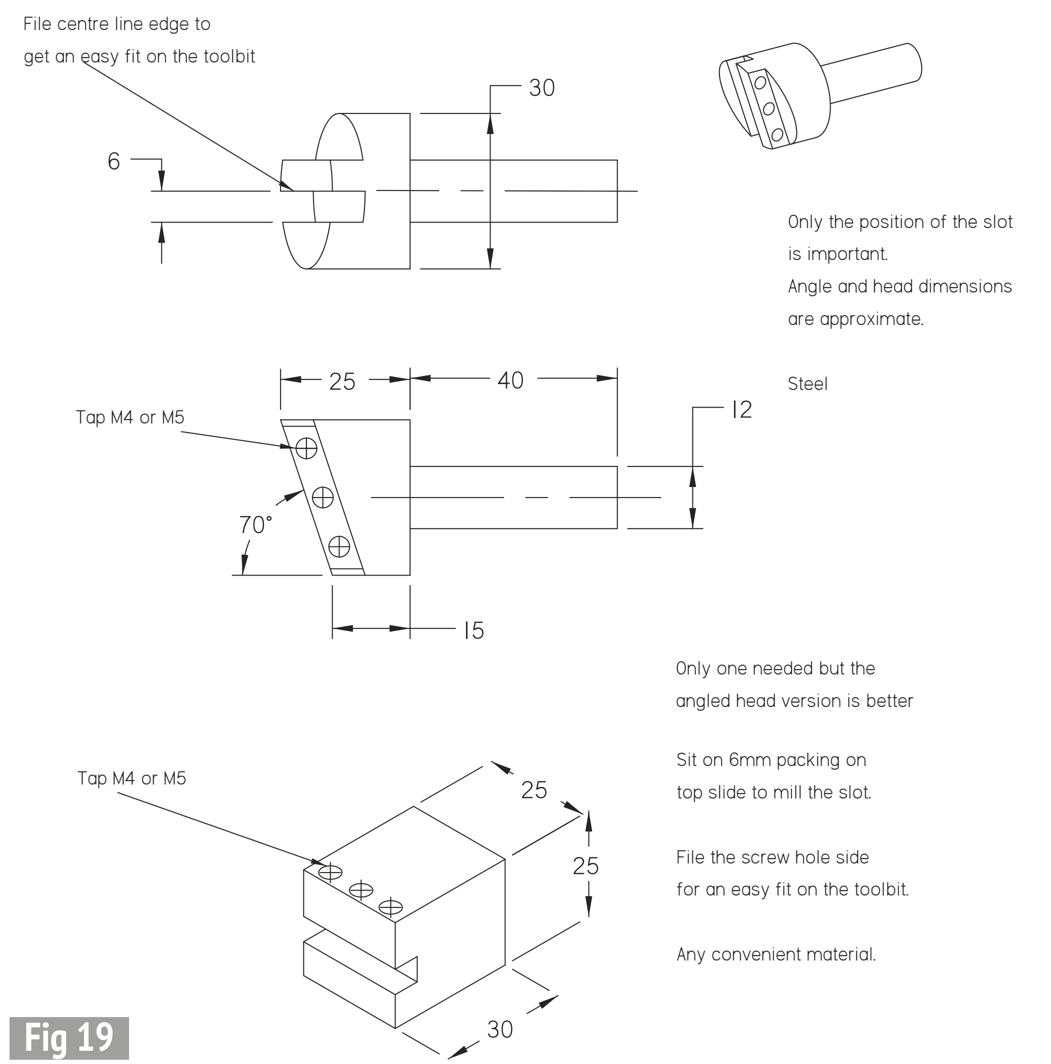


Fig 19

Making a fly cutter

A second bit of kit will be a fly cutter (**fig 19**). This will be very useful when you get a milling machine and has a lot of uses on the lathe. It's called a fly cutter because that's what the chips do - fly all over the place! Always use eye protection when using this simple and effective device. If you haven't purchased one and want to make it, start with a cob end of steel about 30mm diameter and 65mm long. It needs a vertical slide to manufacture. I did devise a top slide only method but it was ridiculously complex and still needed handwork.

The best alternative is to mill a slot in a block of material for a short 8mm or preferably 6mm round nose tool bit held with grub screws, using the four jaw to hold it. Keep the swept diameter just big enough to fully cut both sides of the work or the spindle speed will have to be dropped. Another alternative could be to use 20mm square material with a round tool bit but at the moment we haven't covered how to grind these – special holders are needed. I won't give any instructions for this type of fly cutter (I used to use one like this a lot) as it depends on your lump of material and the dimensions of the work to be cut. For the tool post you'll be cutting a piece about 70mm square.

To cut the HSS blank shorter after forming the cutting end, grind a groove all round, put it in the vice with a cloth over it to catch flying chips and give it a sharp whack with a hammer using a thin piece of plywood as a shock absorber.

If using a vertical slide, start by turning the shank, then mount on the slide clamping into the Tee slot, as shown in the posed photograph (**photo 71**). Set the slide at a 20 degree angle then mill the end to produce the overall angle. Mount the 6mm cutter and just get it to touch down on the top of the blank then lift the slide 15mm so that the bottom edge of the cuter is on the centreline of the body, mill the groove in two or more cuts to 6mm deep, lift the slide 12mm (6mm for the cutter and 6mm for the width of the central bar) and produce the step for the screws. Finally, grind a cutter, but do note that it is a LEFT-hand knife tool not right-hand as we made before.

An eBay search for a 'fly cutter' will show many sets of three at about £22 - but why have three?

●To be continued.

Next time we will make use of our newly-made fly cutter to start work on the toolpost.

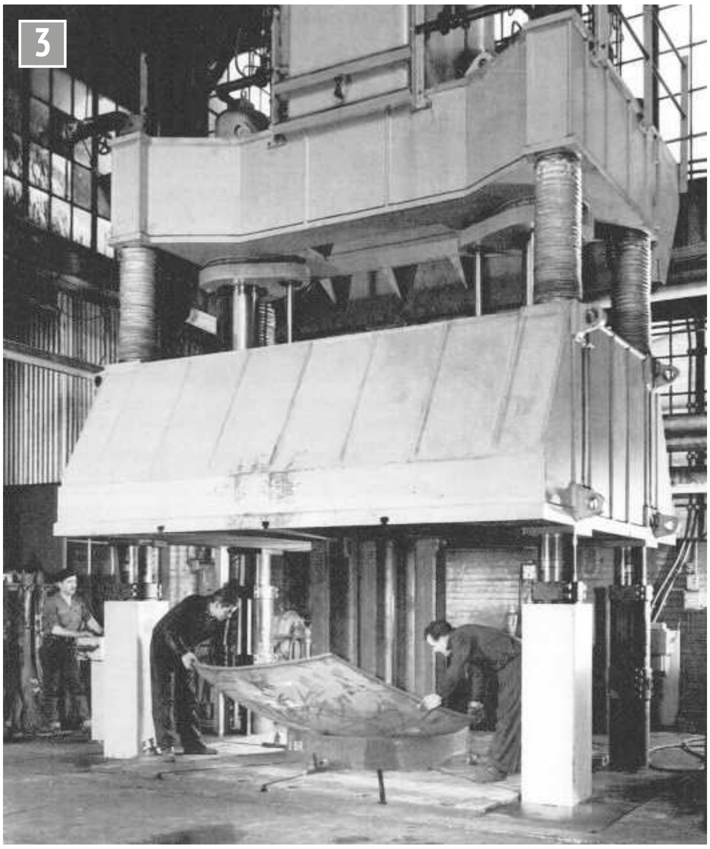
More Shipbuilding in the Thames PART 2

Days of Iron Men and Iron Ships

James Wells looks back at the days when wrought iron was 'king'.

Continued from p.769
M.E. 4587, 25 May 2018

Having seen the advertisement for the book *Rivet Lad* by Alan McEwen I was reminded that, despite the well-known industrial north, it seems to be that now almost forgotten is that the south, including London, also had a considerable heavy industry.



A 500 ton press.

Thames industry joins WW2

Having at least survived the Great Depression when several of the larger shipyards had permanently closed, thanks to the London Docks the Thames Industry still had enough existing infrastructure to play a significant part in WW2. The Admiralty had decided that although a couple of new battleships might be useful, the coming naval war - as in World War 1 - would likely be fought out between small surface vessels and German submarines.

After considerable experience from the earliest days of steam, the Admiralty was concentrating on the 'Admiralty Three Drum Boiler' as the most practical design compromise. Any existing ship with other boiler designs would be converted to the three drum at future major refits. This was to be a wise decision for in the various naval battles the 'three drum' was to prove highly reliable and standardisation meant that most personnel would be familiar with almost any ship fitted with these boilers.

The major Thames contribution was to produce, in heavy steel plate, the high pressure steam drums required for naval boilers. Although such steam drums had originally been produced by forging from solid billets, and end caps riveted on, the more modern practice was to roll up a heavy plate and to butt weld the two edges and ends together.

The welding itself was both impressive and unimpressive. The welding wire was as thick as a man´s thumb and would weld the two plate edges together in one pass but as the whole welding pass was covered by a flux powder from a nearby hopper, only the occasional spark was seen. The heat from welding fused the powder into strips of what appeared to be crude glass.

Another Admiralty decision was also to affect the Thames Industries and this involved smaller warships. Steam turbines drove the larger ships and required specialist machinery for manufacture, which didn´t exist on the Thames. By using high pressure steam piston engines the various parts and spares for these engines could be readily sub-contracted to non-specialised industry that possessed suitable machinery. If steam turbines required specialist long term training, Reservists and Hostilities Only would be familiar with piston engines.

Apart from the vast numbers and variety of marine equipment required for a wartime effort, there were other requirements. In the same SE London area was a company that produced large propellers. The sight of several tons of molten bronze being poured into a large mould was impressive enough but the sheer skill of a Moulder required to set out such a mould with slow moving and subtle curves for producing a large bronze casting still amazes me. This same company would survive on into the 1970s and, during post WW2 years, continue to make propellers for the various 'Empress' merchant ships amongst others.

One other legend about Thames industries concerned armour plate. By the outbreak of WW2 the Admiralty and the Army seem to have compromised on 'Homogenous Soft' armour plate. This had a number of advantages beginning with being readily rolled by any steel works that had heavyweight rolls and thereafter not requiring any further heat treatment. The same armour plate could be rolled, folded, welded and cut by the usual oxy-acetylene methods.

Homogenous Soft armour didn't have the same impact resistance as German 'Hard Face' but for any ship that had taken action damage of the lighter kind, a comparatively small dockside workforce could affect repairs. Where shell fire had gone through the plate producing internal 'petalling' around the shell hole, this was ox-acetylene-cut off, ground flat and, using special arc welding rods, similar armour patches welded over the outside of the shell hole.

Until the last days of the Thames docks there were still available small launches carrying steel plates, oxy-acetylene and welding equipment to make any repairs to any ship that had sustained any kind of damage; in peace time usually caused by heavy weather.

By using high pressure steam piston engines the various parts and spares for these engines could be readily sub-contracted to non-specialised industry that possessed suitable machinery. If steam turbines required specialist long term training, Reservists and Hostilities Only would be familiar with piston engines.

A now deceased uncle, who served at El Alamein, did tell me that a British tank damaged by shell fire could be patched and back in action within hours. Whole rows of damaged vehicles would be lined up with the notice on each: 'you may strip this vehicle' - and each with a book in the cab detailing which parts as spares had been removed.

Sunset on the Thames

Post WW2, Thames industries, by possessing heavy equipment, was able to survive amid a declining ship repair commitment by diversifying to supply the oil and chemical industries. As the world increasingly moved away from coal to oil based fuels, Thames Industry increasingly supplied a whole range of large vessels for refining crude oil. Some of the vessels were large with one such being 110ft in length but on arrival at the site was erected in less than two hours.

Moving such large components was usually contracted to Pickfords Ltd. One driver was very proud of his towing vehicle telling me that it had 16 forward gears and about half that for reversing. When a heavy vessel was moved onto the public highway it was followed by the local council repair gangs to check highway lighting and for cracked drains.

Large but comparatively lighter vessels could be railroaded down to the river and towed to the destination but there were few destinations with access to the sea or a river. One such was the then Windscale Nuclear Power Station and forms almost the last part of the Thames Industry story.

Possessing the heavy machinery to originally roll up and form armour plate meant that the Thames Industries were able to take a considerable part in the most modern and least known part of its history during the nuclear age. The steel plate rolling mills were finally able to produce the large stainless steel plates required by the nuclear industries and these were to be turned into the reactor shells and heat exchangers by Thames Industries.

Stainless steel was a material cordially loathed by the workforce as being hard to forge, form, cut, machine, grind and weld. With the usual Carbon based steels a minor mistake could probably be corrected in ways not possible with SS.

Such were the initial problems with welding SS that the Boffins from Aldermaston had to be called in. I´m not sure if this aspect is still covered by the Official Secrets Act but the problem was solved by special 'stabilised' welding rods. The saying at the time was '*if you can weld stainless steel you can weld anything'*.

As a material, SS was much over-rated and one small aspect of almost the last gasp of Thames side boatbuilding comes to mind. A missionary company needed a couple of small boats for use on the River Congo. The usual steel boats had been reasonably successful but needed regular painting as protection against corrosion. It was thought that an initially more expensive SS boat would survive longer without the need for regular painting. Sadly, in the stagnant waters of the Congo, the SS boat corroded more rapidly than unpainted mild steel. As SS doesn't readily hold paint I never did find out what was the final answer. The 1962 Cuban Missile Crisis also played a part in the history

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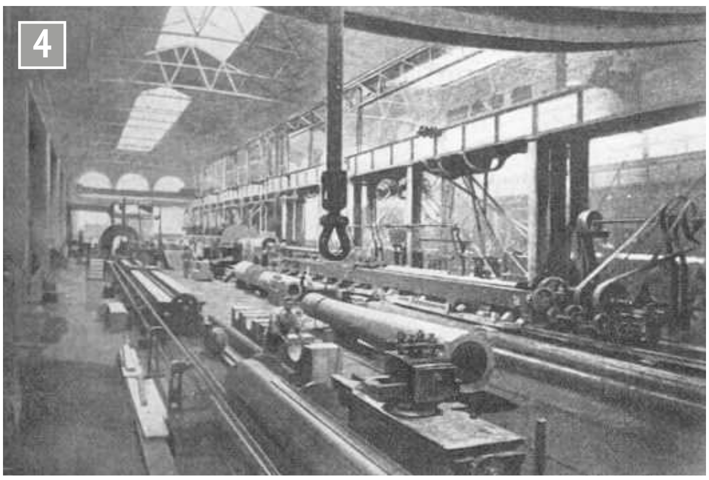


The gun boring shop.

of the Thames with notices posted in all the usual places: *'An impending nuclear war will not be accepted as an excuse for absenteeism'.*

In the 1960s, the then Prime Minister, Harold Wilson, as part of an export drive, had arranged considerable Russian credit on British banks. A result of this was one of the more memorable incidents of my own days in Thames Industry. A Russian contract required some 2 inch diameter stainless steel round bars to be accurately rolled up into approximately 6 foot diameter rings. This was done and the dimensions subsequently carefully checked as being satisfactory by the Foreman, Senior Foreman and the Inspection Office. A few days later a party of about 12 dour Russians turned up. One Russian carefully checked the dimensions then a second and a third Russian did the same, all in the presence of the Senior Inspector. All the talking was done by one Russian, the rest keeping up a dour silence, all refusing even an offer of tea.

Having satisfied themselves in triplicate, the Russians picked up the rings and the scrap left over from rolling the rings, carefully collected all the drawings and took everything away to an unmarked lorry parked outside the rolling shop.

Nobody ever seemed to find out just what was the intended use of the rings but the incident became almost a yard joke as the one Russian word everybody seemed to remember was 'Niet'.

In these days of computer and laser controlled equipment I still have to admire the generations that produced very large and heavy steelwork to the highest standards with frequently only hand tools and methods. It was a privilege knowing them and I learned a lot.

In retrospect...

In many ways the former SE London Docks was almost the personification of the British as a whole, both men and women. There is no doubt that the Thames industrial scene had always been a tough area, with attitudes fuelled by constant fears of unemployment. A man could be almost completely worn out by his middle forties, a woman could be a widow within a few years of marriage and with small children to care for.

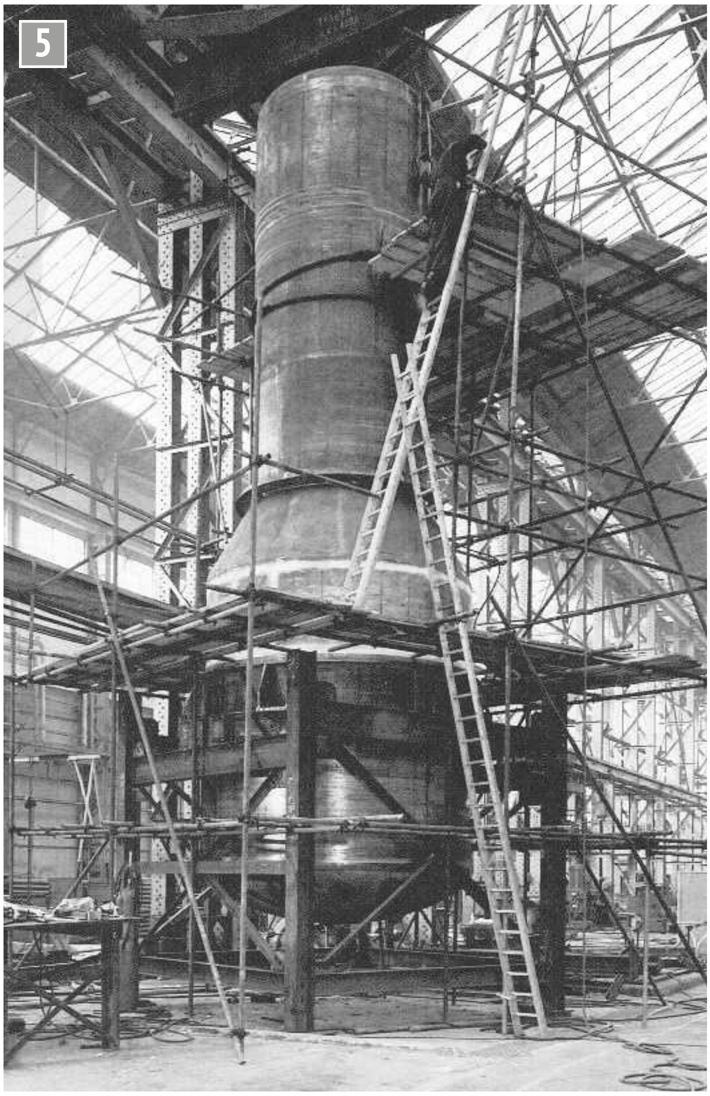
There was also the question of mortality. One foreman that I´d been speaking to during the morning tea break died suddenly at midday the same day. Within days a hard pressed widow had Notice to Quit and was trying to sell some prize pigeons.

Saturday night brawls with police after the pubs closed were regular occurrences but despite the considerable numbers of men who'd served in the 7th and 14th Armies and, as later arms amnesties were to prove, had smuggled large quantities of arms back to the UK, none of these same arms were ever used in the brawls. However violent a Dock strike became, nobody seems to have considered resorting to firearms; rather an enviable record.

In many ways, the hard life of SE London and Thames Industry showed the worst and perhaps the best of the industrial working classes as tenacious survivors. Arguably the Thames was the pioneering shipbuilding and industrial area and at least parts of it survived until the complete collapse of British Industry in the 20th Century. Sadly most of the people are now gone as well and we shall not see their like again but their memories and experiences will live on - for a while at least.

In this centenary year of the beginnings of women's Suffrage I thought that I would also give a little mental effort to recalling some fond memories of those same Thames women who stood so stoically and loyally alongside their menfolk through two world wars and the aftermath.

It was a result of women's Suffrage that was to leave a legacy that would survive even the final closure of



A new era: The Windscale Separator.

the Thames Industries. Governments soon woke up to the fact that there were a considerable number of potential new votes around. As most of the women worked in shops, stores and other such businesses, and with the early closing day usually being Thursday, Polling Day rapidly became an established Thursday institution.

On Thursday Polling Days, the women would finish work early, remove the usual head scarf and wearing their best hat, troop off to the Polling station to cast their votes.

Then there was the great dockside flour mill which kept SE London fed, even during the Blitz. Several generations of young women would leave school and find employment at the flour mill. They would then find partners, have families and in due course, their own daughters would eventually find a job at the same flour mill after leaving school.

Perhaps my favourite memory, though, has to be the Thames women and the tomato dock. Outside this dock was a sharp bend in the road and periodically a heavily laden lorry would shed a few boxes of tomatoes, the loss of which was covered by Insurance. As the boxes fell off the lorry, scattering the tomatoes, hordes of women would erupt from nearby buildings with their bags and buckets to collect the tomatoes.

Women power was definitely on the march though as a generation later there seemed to be a whole new breed of woman around – though when collecting the tomatoes, they were feeling them first.

ME

Designing Model Boilers Or, The Truth About Model Boilers

PART 3

Martin Johnson explains what really happens inside model boilers.

Continued from p.772
M.E. 4587, 25 May 2018

There are several 'constants' or parameters that the program requires to calculate boiler performance, each of which we'll discuss below.

Grate loading

> ...we work our fires harder than normal in big engines and we waste a greater proportion of the heat generated. – E.C. Martin, M.E.3423

Without some reasonable estimate of a realistic grate loading no calculations of heat production, gas flow, flow regime or heat transfer can commence.

The power output from a boiler clearly depends on how much fuel is put into it. However, with coal firing there is a limit to how much coal can be fed into a given grate; in full size rail practice it was reckoned that 100 to 120lb/sq.ft/hr could be fed before clinkering was likely to take place on express engines and approximately 50lb/sq.ft/hr was a more usual figure for freight work or shunting. There are no equivalent values for miniature practice, where one might expect a much thinner fire and hence lower grate loading. Busbridge (**ref 7**) estimated that his tests could have been continued to higher grate loadings.

I tabulated the results of various locomotive efficiency trials from pre-1967 to 2007 on engines from 3½ inch to 7¼ inch gauge. Some 360 individual runs were tabulated. I also collated as many design details as possible for some 30 locomotives across the same range of gauges. I was then able to calculate grate loading data for 114 runs on various designs.

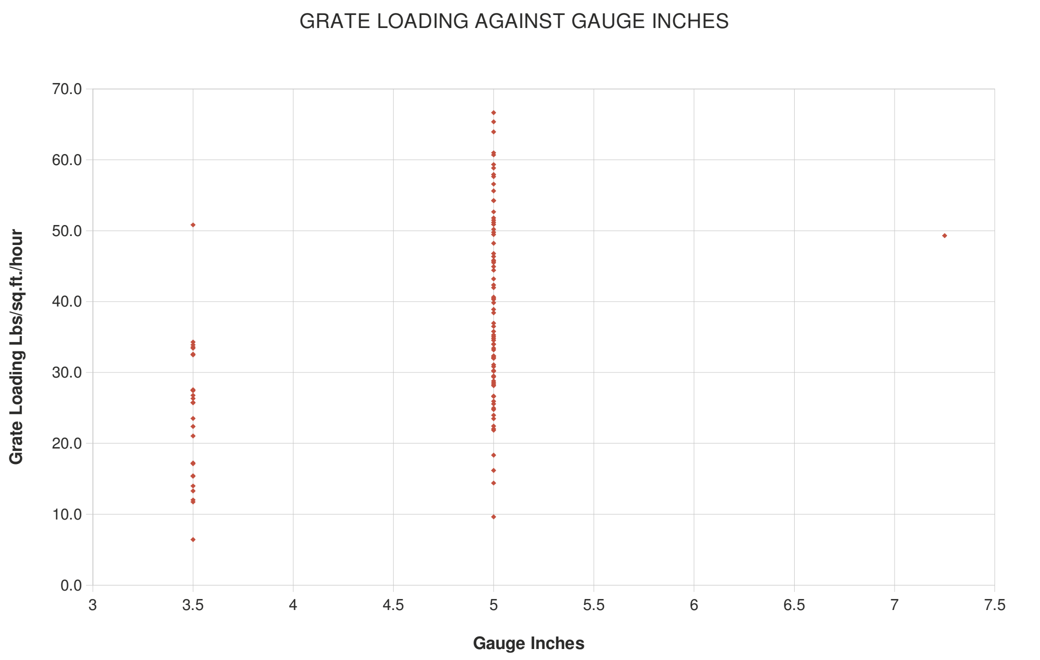
I tried analysing this data set of 114 runs in various ways. Initially, I looked at a cumulative frequency graph which showed a reasonable Gaussian distribution with a median result of 33.4lb/sq.ft/hr and an upper quartile value of 45.5lb/sq.ft/hr. However, the data are heavily skewed toward 5 inch gauge locomotives, mostly of main line outline.

One might expect a rising trend in grate loading with size, which is true, as **fig 6** shows. There is, of course an extra point not shown on the graph at 56.5 inch gauge and 100 – 120lb/sq.ft/hr, which indicates that a curve of grate loading against gauge must flatten off from the trend shown in fig 6. Clearly, we do not work our miniature engines harder than full size!

Some additional data can be found in **ref 8**, in which a *Rob Roy* was worked at 42.2lb/sq.ft/hr. The author reported that three adults were being hauled and estimated the fire was being worked too hard. 3.75lb of water was evaporated in this test. J. Busbridge (ref 7) estimated that during his tests on a 3.5 inch gauge *Brittania* boiler, the peak recorded firing rate of 20lb/sq.ft/hr could have been easily exceeded.

For road use, a test on a full size Sentinel S6 steam waggon was reported in *The Commercial Motor* on 6th January 1950. This used the usual Sentinel test route over Horseshoe Pass. 62.5 miles were covered in 3hrs. 2mins. using 4cwt. 13lb of coal on a grate of 3.28sq.ft, hauling a gross load of 23tons 12cwt. This gives an average grate loading of 46.3lb/sq.ft/hr; as outlined above, one might expect a higher loading on

Fig 6



a thicker full size fire and a considerably higher value at peak loading.

I also tried a more sophisticated analysis of grate loading against Draw Bar Horse Power developed per unit area of grate (a measure of how hard the locomotive is working compared to its grate size). However, the data showed very poor correlation, which was probably masked by the important variable 'driver skill'. This is not surprising given a 20:1 spread in measured locomotive efficiency over the various trials.

Several factors might affect the value for grate loading deduced from the above analysis:

- The data is based on a competition where the object is to use as little coal as possible.
- According to the competition rules, coal used during 'waiting time' before the competitive run is debited against the competitor's allowance.
- Coal may be lost 'overboard' during the excitement of competition.
- The power output and hence boiler demand on a miniature locomotive is limited by the adhesive weight of the miniature, which in turn would limit the required grate loading. This would not apply to a road vehicle, where wheel slip is virtually unknown.

Based on all the above considerations, I estimate that a design loading of 40lb/sq.ft/hr would be reasonable for 5 inch and 7¼ inch gauge and perhaps 20 to 25lb/sq.ft/hr as a more conservative value for smaller miniatures. There is not sufficient data to conclude much about larger boilers, except that the grate loading can be higher than 40 lb/sq.ft/hr. For my own project of a boiler with a grate of just over 1 square foot, a value of 50lb/sq.ft/hr looks reasonable. So, grate loadings in miniatures are not proportional to scale^3, mainly due to overscale fire thickness, but the grate loading per unit area is significantly less than full size.

It may be that grate loading should really be related to cubic volume of firebed, so that lb/hour/**cubic foot** of firebed would be quasi constant. In full size practice, I have seen fire thickness typically from 4 to 8 inches so, based on full size values, 100 lb/sq.ft/hr would be equivalent to about 200lb/cubic.ft/hr. In miniatures, we have a much thinner fire – a maximum of 1½ – 2 inches in a 3½ inch gauge *Brittania*, for example. So, based on 200lb/**cubic.ft**/hr and 1½ to 2 inch fire thickness, grate loading would be 25 - 33 lb/sq.ft/hr on a 3½ inch gauge *Brittania* and around 50lb/sq.ft/hr on a deep firebox 5 inch gauge miniature. **Figure 7** shows these estimates to be reasonable but somewhat higher than observed figures, which might be expected as they are based on the thickest possible fire.

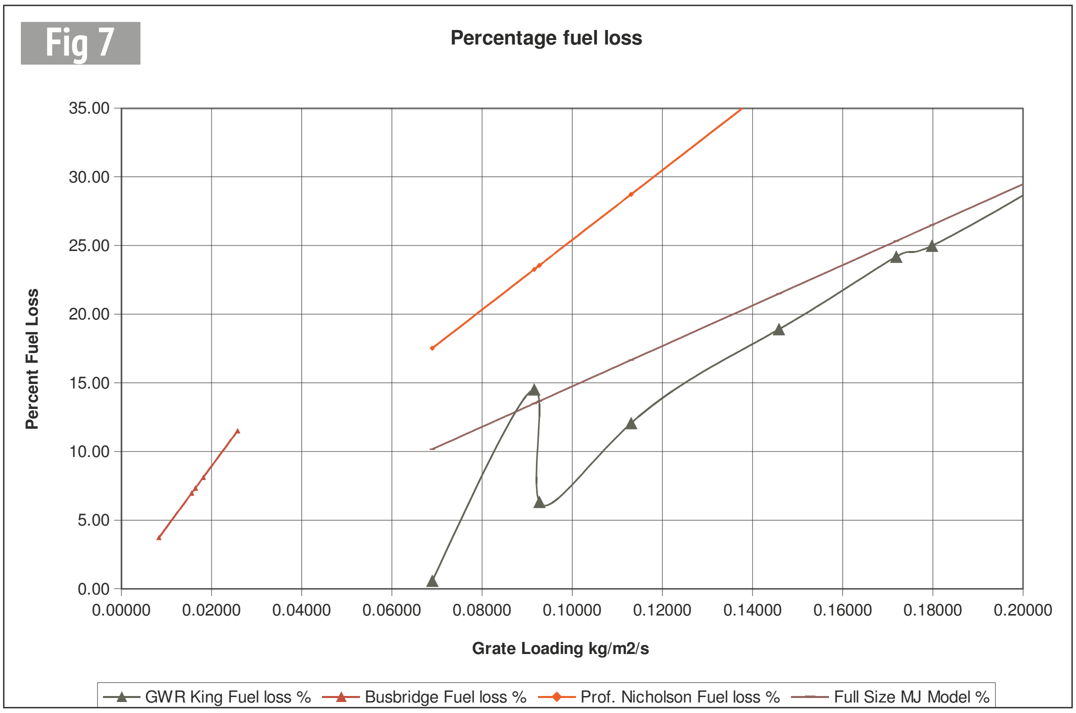
A plea for more data
If anybody can help with leading boiler dimensions, particularly grate size, for the following designs I would be very grateful:
5 inch gauge *Brittania*, 3½ inch and 5 inch gauge *Maid of Kent*, 5 inch gauge *Merchant Navy*, 5 inch and 3½ inch gauge *Netta*, 5 inch gauge *Springbok*, or indeed any locomotive for which IMLEC style data exists.
Replies to Martin Johnson 1 on the *Model Engineer* forum, please.

Coal lost before combustion

A remarkably large amount of coal is lost before combustion. This is probably due to the fierce draught through the fire carrying small coal particles away. The upward velocity through a full-size fire is some 7m/s (15mph) which is quite a stiff wind and able to carry small coal particles away. The velocity through a miniature firebed is around ⅓ of the full-size value.

I have been able to infer values for fuel loss from Busbridge's tests. I also have S.O. Ell's summary of testing on a King class locomotive and Professor Nicholson published a formula for predicting fuel loss in full-size. All of these results and prediction methods are shown in fig 7, which shows:

- Professor Nicholson's method gives a proportional rise in percentage fuel loss with grate loading. However, Nicholson's constants predict a much higher rate of fuel loss than Ell measured.
- I have fitted a Nicholson type law to Ell's data, which is shown as 'Full Size MJ Model', which roughly approximates to the measured data.
- The fuel loss for a miniature is much higher in proportion to grate loading than for full size, as shown by the much steeper line through fuel losses inferred from Busbridge's data.



I have also tried plotting fuel loss against air flow through the grate, reasoning that it is air flow that carries the fuel away. However, it seems there are other factors affecting fuel loss and I am investigating the effects of coal particle size and retention time within the boiler. In the interim, the following relationship which I have used to correlate Busbridge's data is an approximation to performance in miniatures:

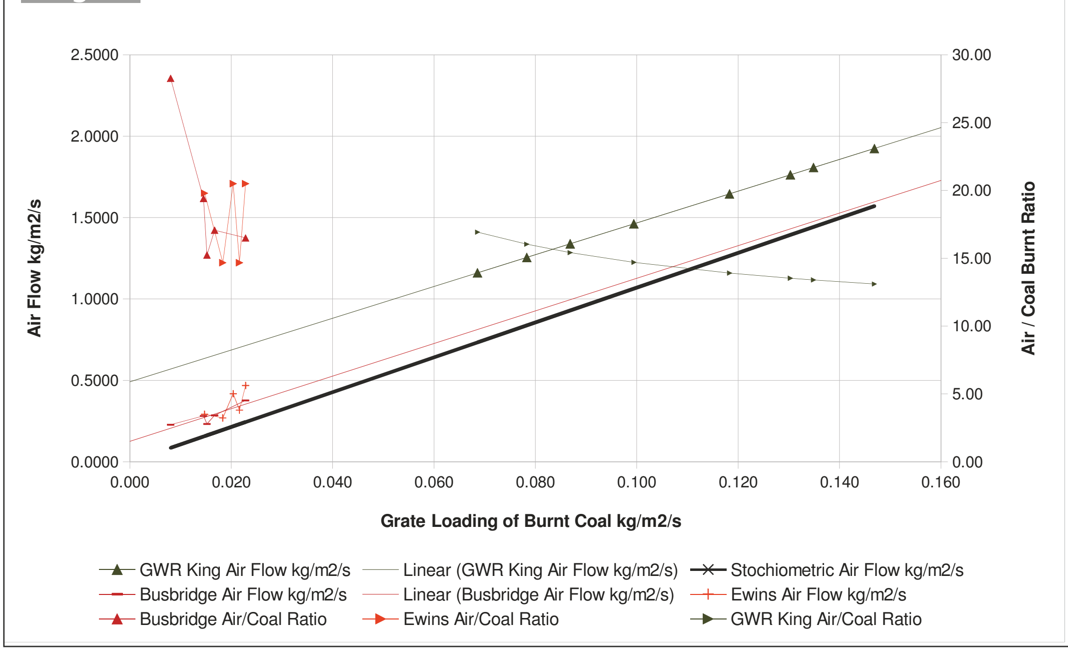
Coal Lost =
Grate Loading x 445

where:
Coal Lost = Coal lost before combustion as percentage of total coal fired [%]
Grate Loading = Coal fired per unit area per unit time [kg/m²/s]

Air ratio

> Might closing the dampers when pulling hard reduce the excess air and still be sufficient to maintain the fire? - Don Broadley, M.E.4558

Fig 8



The amount of air reaching the fire governs combustion temperature, quantity of flue gas passing through the boiler and the quantity of heat ejected with the flue gas and is therefore an important variable in boiler performance. The quantity of air drawn in can be directly deduced from analyses of flue gas as made by Busbridge, Ewins and many workers in full size. **Figure 8** shows miniature data from Busbridge and Ewins along with full size data from a GWR King by Ell. The grate loading on the X axis is based on coal burned, not total coal fired.

The full-size data shows a linear relationship between air demand and grate loading. The gradient of the relationship is about 90% of the stoichiometric air demand but there is a significant air demand at zero grate loading. I have shown the line of stoichiometric air flow, based on a good quality anthracite, which is a rather steeper line than that calculated by Ell; I do not know the reason for the discrepancy. This zero intercept means that the air ratio (mass of air / mass of coal) tends asymptotically toward the stoichiometric value at high grate loadings. Thus changing the air flow must imply a change in combustion rate, so fiddling with dampers is not an option – at least in terms of steady state operation.

The miniature data shows similar trends, with the gradient of Busbridge's air flow data being about 93% of the stoichiometric value but the zero grate load air demand is only a quarter of the full-size value. This means that the miniature air to coal ratio tends toward a stoichiometric air ratio at much lower grate loadings. Ewins's results show much scatter but fall in a similar area.

Once again, there are clearly other effects that distinguish full size and miniature work; particle size, fire depth, grate geometry, edge effects around the grate are all possible influences. I intend to undertake further theoretical investigations to see if a universal law for miniatures and full-size can be developed. In the meantime, the air flow through a miniature grate can be calculated from:

Air Flow = 0.126 + 0.93 x Stoichiometric Air Ratio x Coal Burned on Grate

where:
Air Flow = Air flow through grate [kg/m^2/s]

Stoichiometric Air Ratio = Theoretical mass of air to burn unit mass of coal

Coal Burned on Grate = Total coal fired less coal not burnt [kg/m^2/s]

Areas are the grate area.

Other 'constants'

There are several other constants in the program that need some explanation or justification:

- Fuel burnt above the grate. Not all the fuel is burnt on the grate; volatiles and light coal particles will burn in the firebox volume. In the analyses I have allowed for 10% of the burned fuel to be burned above the grate within the firebox. Combustion is assumed to cease in the tubes or flues.
- Combustion efficiency. From analysis of published tests, typical combustion efficiencies of 97.5% are appropriate to miniatures, giving carbon dioxide values between 0.5 and 1%.
- Absorption coefficient of flue gas. This is a measure of the thickness of the 'fog' of combustion gases and determines the ability of infra-red radiation to pass through or be absorbed by the combustion gas. Work on combustion gases from forest fires and house fires has given absorption coefficients of around 0.8. I have found that 0.9 seems to work well for both miniatures and full-size practice; the higher value is probably due to greater solids content in the flame of a forced draught coal fire.
- Dryness fraction of steam. Analysis of Busbridge's superheater test results show that the steam must have been dry before entering the superheater. It may well be that a boiler can generate virtually dry steam but Busbridge's boiler was set up on a bench. I would expect significant water carry over from a boiler travelling over imperfect track. For consistency, I have used a dryness fraction leaving the boiler of 99.9%. The program is then calculating a maximum estimate of superheat temperature.

●To be continued.

NEXT TIME
We will look at the analysis of a typical locomotive design.

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8. (8.8) Williams, N. 'Trials of a Rob Roy' *Model Engineer* M.E.3442

PART 16

Technologie sans Frontières

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

Continued from p.778
M.E. 4587, 25 May 2018

'The Nord, the Midi, Paris-Lyons-Mediterranean, the Ouest and the Est have adopted six coupled types... The Baden lines are worked by these engines... It was for these lines, indeed, that I designed the first of the six-coupled types. The Gotthard expresses are worked by four-cylinder compounds of the same type built at Winterthur; Roumania has also ordered some twenty engines of the same general type... The locomotive drawings were made by the Société Alsacienne de Constructions Mécaniques (S.A.C.M.) and the engines were built at their works at Belfort.' ***Alfred de Glehn to Charles Rous Martin*** (ref 1**).**

81

Paris-Orléans Railway mixed traffic 4-6-0 Ser. 1701-20.

The P-O Railway 1701-1725, mixed traffic and 4001-84, express passenger 4-6-0s of 1903

By the final decade of the nineteenth century the Paris-Orléans Railway had a substantial if somewhat antiquated fleet of mixed traffic locomotives mostly owing their origins to Fourquenot with elaborations upon a theme by his successor, Ernest Polonceau. The appointment of E. Solacroup in 1899 rapidly extinguished the Fourquenot tradition. His enthusiasm for de Glehn's work was established immediately upon his appointment with the introduction of the 25, Midi-based *Grand Chocolat* 4-4-0s, which, as if to impress his new regime on the world, he numbered 1-25 in the P.O. running lists.

This allegiance to the de Glehn model was reiterated when, in 1900, he ordered twenty-five 4-6-0s for the Limoges to Montauban line where traffic patterns entailed frequently starting and stopping heavy trains. The new locomotives were unadulterated copies of the Nord machines commissioned two years previously, even retaining the wrap-round smokebox casing which was being supplanted by the American drumhead style elsewhere (**photo 81**). The first nine were built by S.A.C.M. (builder's nos. 5192-5200, 1900).

The P. O. six-coupled mixed traffic locomotives entered service at the same time as that railway's Atlantics, locomotives that were again heavily indebted to the Nord Atlantics. When the P. O. decided to follow the same path as the Ouest in developing an express passenger version of the mixed traffic 4-6-0, it merely affected a transformation of the Atlantics by substituting six 6 foot $\frac{3}{4}$ inch (1.85m) driving wheels for four 6 foot $8\frac{1}{4}$ inch (2.04m) wheels. Excepting the changes necessary to accommodate this alteration every other feature of the 4-4-2 was transposed including the same $14\frac{1}{4}$, $23\frac{5}{8}$ x $25\frac{1}{4}$ inch (360mm, 600mm x 640mm) cylinders.

S.A.C.M. was responsible for the first of the class and built the majority thereafter

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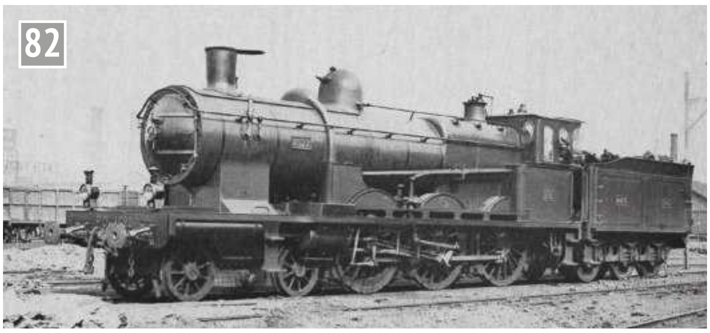


P.O. 4022, S.A.C.M. 1905.

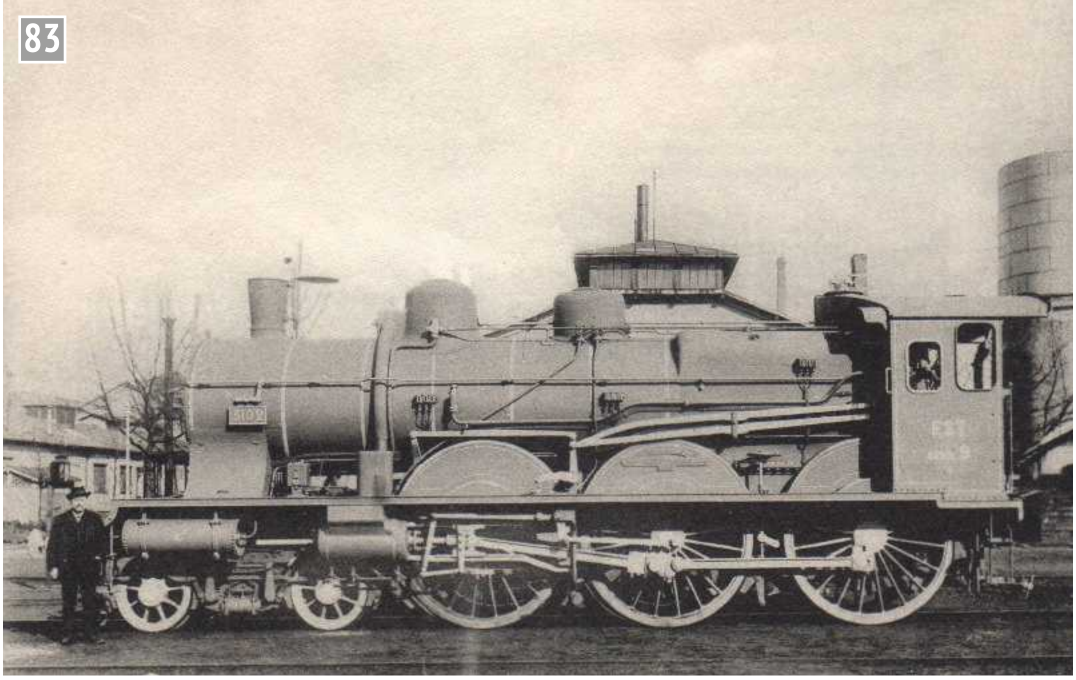
(**photo 82**). They delivered nine units in 1900, P.O. 4001-9 (S.A.C.M. 5192-00) followed by 1903, P.O. 4010-15 (S.A.C.M. 5401-6) in 1903 and 4016-44 in 1905, (S.A.C.M. 5401-6 and 5464-78). The only other builder was Schneider who, in 1908, constructed a further twenty, P.O. 4045-64 (Schneider 2919-38).

The Est express passenger traffic 4-6-0, 3101-2, 1903

The Est was also finding the Achilles heel of the Atlantics and in 1903 it copied the Orléans in adapting the overall characteristics of the Atlantic to the superior adhesion of its mixed traffic 4-6-0 chassis to produce the first of its own six-coupled express passenger locomotives. The driving wheels retained the Atlantic's diameter of 2.090mm (6 feet 10¼ inches) giving the Est machines the largest drivers of any of the French 4-6-0s, despite the argument that the move to a six-coupled wheelbase was motivated by the desire to increase adhesion. The first two (Est 3101-2) were built at Épernay in 1903 (Épernay works nos. 448-9). These machines (**photo 83**) were followed by a further 43 (Est 3103-46), all built at Épernay and entering service in 1906. Whereas the initial two had compensated slide valves the second series had piston valves (**photo 84**). There were ultimately to be 280 of the class, the later ones with cylinders 390 x 590 x 680mm compared to the original 340 x 540 x 660mm. Superheating was introduced in 1908 with numbers 3147-8. The majority were built at the Épernay works but Maffei produced 20 in 1911 and Batignolles supplied 50, the last to be built, in 1925 after a building hiatus of 13 years.

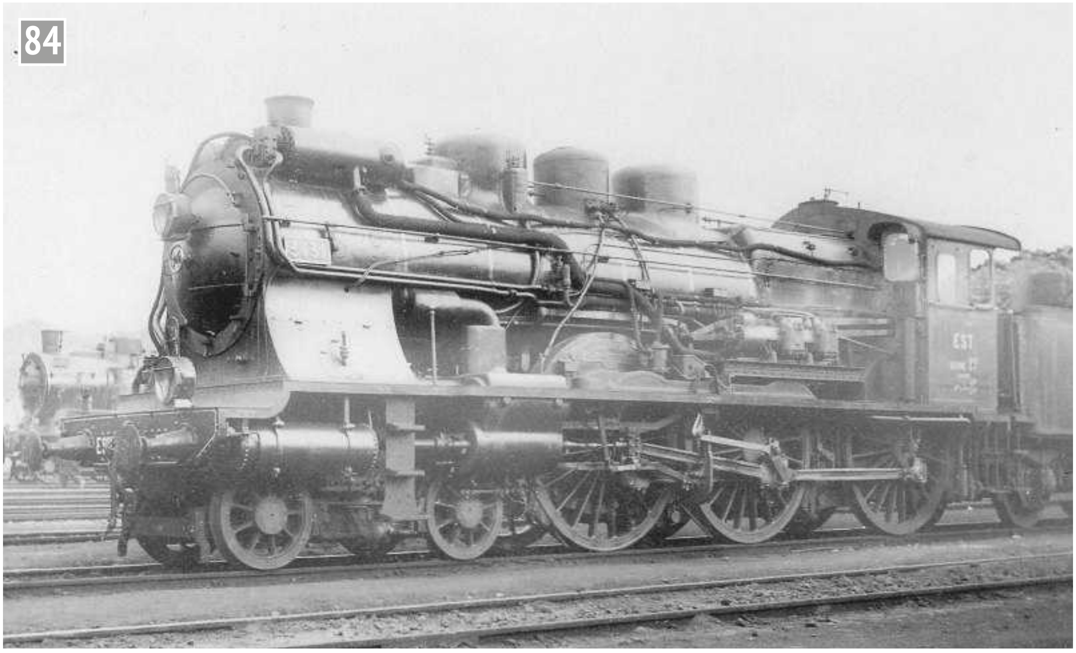
Chapelon regarded the Est locomotives as representing the ultimate development of the French 4-6-0 (**ref 1**). This view is shared by John van Riemsdijk who pointed out (**ref 2**) that these were the most numerous and the most powerful of French 4-6-0 locomotives. He adds that:

83



Est 3102. 2.090m wheels, the largest used for a 4-6-0 in France.

84



Est 3131, the piston valve version of the 2.90m driving wheel 4-6-0. The French enthusiasm for clarity above the running plate has clearly been mortally wounded by this time.

There was continual development of this design, which proved so effective that the Est never designed a Pacific. In fact these 4-6-0s could hold their own in any comparisons with French pre-Chapelon Pacifics, except those of the Nord. They could run 600 ton trains at 60mph on the level already in the 1920s and when the Chapelon example led to a modest degree of alteration their power was increased by 35% for a given combustion rate.

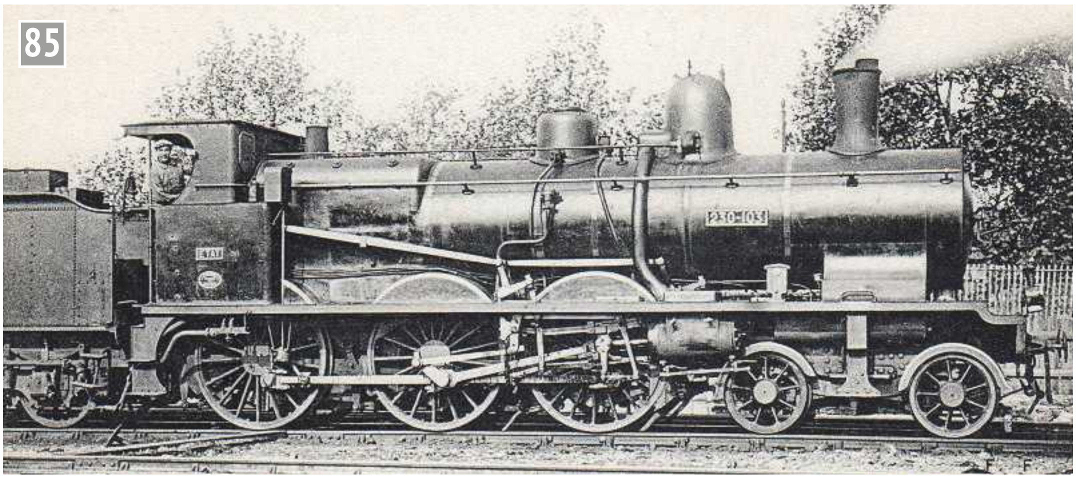
Their final manifestation came with the post Second World War, rubber-tyred Paris-Strasbourg *Rapides,* for which they were streamlined (unfortunately!). The coaches of the *Rapides* ran on ten-wheeled bogies, massively increasing the rolling resistance of the train but, as van Riemsdijk records, the locomotives in this service we capable of 2,200 cylinder horsepower with outstanding rates of evaporation, despite a high superheat temperature of 410 degrees.

The État, mixed traffic 4-6-0 3701-10 of 1897 and the express passenger 4-6-0 3477-86, 1908

The assimilation by the French Railway operating companies of the essential de Glehn-S.A.C.M. design from the *Grand Chocolats* through to the express 4-6-0 epitomizes their willingness to adopt a template that had proved successful outside their own regional boundaries. This greatly favoured the manufacturing process, lowering the marginal costs of production by allowing the builders to use the same basic drawings, foundry patterns and boiler pressing blocks for multiple productions across a range of classes of locomotive and a variety of customers. Paradoxically, this does not seem to have given firms such as S.A.C.M., who originated the de Glehn designs, any over-riding competitive advantage. Rather, the railway companies appear to have insisted that designs be freely passed between potential suppliers. To the invariably impoverished État, France's only state-owned railway, a locomotive whose design and a sizable proportion of its production costs had been absorbed by previous customers had strong attractions.

Following the example of its neighbour the P.O., it first took up the 1897 Nord 3121 form of 4-6-0 traffic locomotive, ordering ten machines that were identical to the S.A.C.M. design from Five-Lille who completed the batch in 1901 (F. L. 3167-76. État 3701-10). Cail added another twenty in 1902, État 3711-30 (C. 2559-78). Four years elapsed before ten more entered service, built by Five-Lille, État 3731-40 (F. L. 3339-48). The final 15 were not built until 1909, when Schneider completed 230.041-55 numbered under the newly introduced État scheme which included a description of the wheel arrangement.

To meet its express passenger needs the État had successive dalliances with Nord *Grande Chocolats*, P.L.M. style 'windcutters' and American Baldwin built 4-4-0s. In 1905 it acquired ten Orléans Atlantics and the Orléans large wheel 4-6-0 was also to provide the model to meet more general traffic needs. In most respects the État 4-6-0 was dimensionally identical to the Orléans variant, 1.85m driving wheels, cylinders 360mm, 600mm x 640mm and a boiler of the same diameter with the same heating surface but, mysteriously, one less tube (Serve). The main departure was a metre added to the wheelbase, 7.5m to 8.5m, which moved the trailing rear axle to the rear of the firebox, improving the ashpan layout. At the same time the weight was very slightly reduced to 75.1 tons total compared to the P. O. 75.3 tons and 53.1 tons compared to 54.6 tons adhesive. The first ten, built by Five-Lille (F.L. 3477-86) entered service in 1908, Cail secured the second batch of twenty (C. 2940-59) and Five-Lille completed the series in 1909. Eventually, the État was to have 55 mixed traffic (**photo 85**) and 167 express passenger 4-6-0 locomotives (**ref 3**).



État 230-103, mixed traffic locomotive.

● To be continued.

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2. J. T. van Riemsdijk, *The Compound Locomotive*, p. 90.
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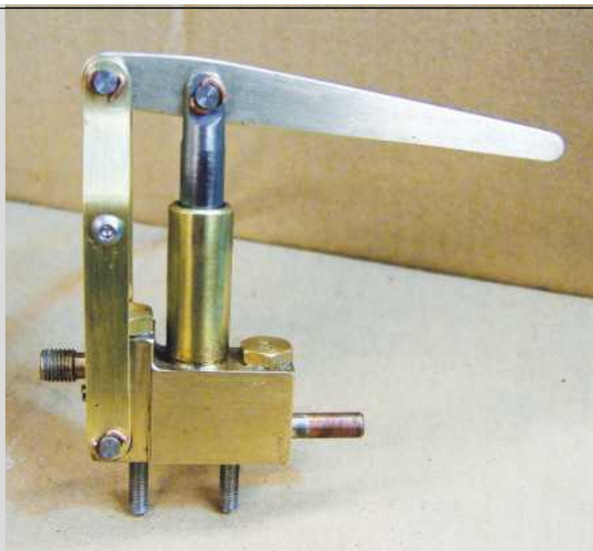
ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT IS
E NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE

- **Vertical Boiler**
  Martin Gearing completes the hand feed pump for the boiler.
- **Meccano**
  Henk-Jan de Ruiter explores the history of Meccano.
- **Bolton Museum**
  Graham Gardner pays a visit to the Bolton Steam Museum.
- **Injectors**
  Rhys Owen explores the history of injectors and takes a look at the principles upon which they work.
- **Barclay Well Tanks**
  Terence Holland assembles the dome cover from the parts previously made and goes on to look at the smokebox.



Content may be subject to change.

ON SALE 6 JULY 2018

Photographing Locomotives and Wagons

PART 1

Doug Hewson assures us that photographs of miniature locomotives can look just like the real thing.

For some time now, I have been looking at some of the photographs in various magazines and wondering if anyone, apart from me, has ever stopped to think about this. Where do you normally take a lineside shot of a locomotive from? Is it from way above the engine giving a sky view of the locomotive, or is it taken from about sleeper level giving a worm's eye view of the locomotive?

I have seen many an article written in *Model Engineer* fairly recently which is quite an interesting article in itself but then it is ruined by the photographs which people have taken. Some of them are taken at such a low angle which to my mind just ruins them. I don't know whether this is to try and accentuate the 'bigness' of the engine, or what, but it certainly doesn't work for me. I have seen articles where one nearly has to stand on one's head to get a proper view of the picture and then that doesn't look right either.

I suppose there is then the classic Model Engineering shot looking down on the engine from human height, which to me also looks very wrong. It just belittles the engine and the work which has undoubtedly been bestowed on the building if it. When someone has spent twenty years or more building a locomotive then it would be very nice to show it off to its full potential. Even when I was building my BR standard 4MT I always used to look around to see where the best angle was for taking a photograph from, even though the locomotive was on the bench.

The next thing to look at is the background and see what might be in the way as you never know what might creep in there. We used to have some blue 5 gallon plastic drums and wherever I seemed to want to take a photograph one of those would appear in it somewhere! This was especially relevant around our locomotive shed where we used to gather a lot of clutter for some reason. If you can arrange to have another locomotive or a wagon or two in the background your photographs will look all the better.

Don't worry about not taking the full photograph either. I have taken numerous photographs where the whole subject is not quite covered - in fact it is sometimes impossible the get the whole subject in.

Then - where is the sun?! I was always told the cameraman had to take photographs with his back to the sun. That might have been the case when we had the good old Ilford 127 camera but not these days. Witness the numerous photographs taken when we were kids, trying to squint into the camera and saying cheese or putting one's hands in front of one's face to shield it and then getting told off for doing it. It would have been far better to take pictures slightly to one side. We run a ground level railway which has four separated goods yards and therefore there is always somewhere to take a photograph, wherever the sun happens to be. Furthermore, we have added signals (yes 63 of them!) and telegraph poles which immediately give the railway some height. Some of the poles only have four pots on them but it makes such a big difference to the overall look of the railway. In fact, it makes it look like a proper railway (**photo 1**).

You can see here what a difference the signals and telegraph poles make even with the telegraph poles too close together! Notice also the wooden level crossing where a footpath crosses the line. This not only adds to a very nice little scene but the first thing I noticed, when driving on a ground level track at night, is all the different sounds that the railway makes. So, one can easily tell exactly where one is on the railway. Another aid is a small tripod. I have one which is just 4 inches high. This means that if you calculate the height to eye level (where the centre of the camera lens is) then it is just about right for taking most photographs of 5 inch gauge locomotives.

●To be continued.

1

The late Derek Bray (Ron Bray's son!) going around the railway just passing Chinley Junction signal box with his dad's GCR Pom-Pom *and a short goods train. I took this photograph to just show the overall view of the Junction.*

This is Nick Harrison's Britannia *on shed on our railway which I took the first time it came here, However, doesn't it look so much better like this (right) without all the clutter in the background?*

This is another photograph I was told not to take. Yes, it is taken directly into the sun taken first thing one Sunday morning at Gilling. I just spotted this photo opportunity as I was wandering across the yard and stopped to take the photograph. It is Peter Robinson's Freshford Manor *waiting for a parcels train to be coupled up. However, it is a great help that I have a view finder which lets down on the back of the camera. A distinct asset for taking photographs such as this.*

These were taken on shed at one of our steaming 'do's and once again this shows all the engines on arrival but the one on the right, to me, looks far better even though there isn't as much locomotive in there for one's 'money'.

Now, isn't this just a lovely job? It is Keith Pardey's A4 taking coal before going off shed to take the Flying Scotsman at Gilling. Keith is looking on, and I think it is his grandson or nephew about to drive the engine. This was just to show that you can take photographs of things other than locomotives going fast! Who would have thought that a photograph of something as mundane as an engine taking coal could be so interesting? Well, I thought was anyway. This is one of the locomotives at Gilling with working vacuum brake. A great friend of mine, Albert Green, drove this engine for ten years on the GN main Line before his retirement and is mentioned in Peter Townend's book 'Top Shed'.

This is just a few of the engines awaiting their duties at Gilling. This was meant to show the correct angle for taking this kind of photograph.

This is Martin Wyatt's BR Class 2, also at Gilling.

Another photograph taken at Gilling but this time I could just have done without someone opening the car tailgate behind, which I had not noticed until the photographs were downloaded (or uploaded at home - I never do know which is the correct way to say that!). At least it is a proper black and partly scruffy 9F. I thought it was just wonderful.

Some more nice engines at Gilling. Here we have Michael Heavens's Cockington Manor, Ted Goode's pannier tank, Ballan Baker's MacCailin Mor and Geoff Moore's proper LNER B1. Impala and MacCailin Mor are two more locomotives with working vacuum brakes. You can perhaps see now why we do not allow any freelance engines or narrow gauge engines at these events. They just would not fit with anything here. I thought that the driving trucks in the background here would not detract from the scene too much in this case but I could just have done without the rail ends in the turntable pit. I don't suppose you can have everything!

Now, several things occurred here. This is Ballan Baker's Y4 back on home ground once more. I purposely stood Elizabeth Cooling's engine in the background but then didn't see the brazing hearth standing there. I suppose it wasn't big enough really. That is just one more thing which keeps cropping up in photographs around our locomotive shed.

Now, I just thought I would slip this photo in. It is Erimus Yard at Gilling at the beginning of the day with some of the staff gathering ready for action. Thomas Whitbread is on the far right (in the distance!) and is the yardmaster for a couple of hours there. He has been with me in the yards at Gilling since he was seven years old. There is no problem with co-opting recruits here. I think it is because of what we do at Gilling where most people can join in and work a shunting pole. And, as someone once said to me, yes and we can lend you the shunting pole. Seven and eight year olds are very welcome!

Improving Wiring Reliability in Models

PART 1

David Tompkins explains how to make permanent and robust electrical connections.

The first model – an HST125.

I started to build electrically powered models for two reasons; the first was because I wanted something different to steam powered locomotives and the second was to have models that could provide instant motive power for club public passenger haulage. These could form a useful back-up for steam locomotives that have lengthy start-up times and are prone to failures when hauling.

The first model (**photo 1**) was based on the HST125 as its whole weight is on driven axles thus maximising traction effort for passenger hauling. After 12 years the locomotive is still successfully hauling passengers. The second model (**photo 2**) is a steam outline locomotive, again with all axles being driven. The Bayer-Garrett K1 was the prototype in mind and, with a little licence taken with the boiler, the batteries were easily installed.

Moving away from locomotives my third model was the half sized 1901 Oldsmobile Curved Dash car (see *M.E.*4583, *M.E.*4585 and *M.E.*4587).

All three models are dependent upon wiring, to a greater or lesser extent, for both the power connections to the battery and also to the ancillary electrical parts.

Over the years of working on electromechanical equipment I learnt that the cost of a single unreliable connection could be eye wateringly expensive. (Consider the cost of a warrantee service technician call to fix a duff wiring joint on some equipment on a drilling platform in the North Sea!) So, on our modelling level the cost may not be so high but in terms of dealing with a failure in the field and having to strip down a locomotive or whatever model it is not a happy situation.

It is easy to imagine the situation where one has just spent months or years completing the mechanical parts of a model and can almost taste the actual running of the project. The temptation to rush through the 'electric string' part is high. Spend as much detailed effort on the wiring as you would on the mechanics; it will pay off in the long run.

Document your circuits in a simple manner; no need for drawing office standards just clear hand sketches will be adequate should you ever need to revisit the wiring in the future.

Copper cable

For general connection purposes there are four main practical contenders. In order of conductivity we have gold, silver, copper and aluminium.

Specialised applications are where one will find gold and silver. Their cost outweighs their lower resistivity in general purpose use. Copper and aluminium are the most widely used conductors, with aluminium normally excluded in our modelling applications due to the inability to solder it easily and non-availability in suitable insulated sizes.

What are the attractions of copper? It has high conductivity, can be easily drawn into fine wires and can be easily soft soldered.

Multi-strand, PVC insulated cable is the typical connection cable ranging from 7/0.2 through 16/0.2, 24/0.2, 2.5mm² to 10.0mm² cable. (7/0.2 wire consists of 7 strands of 0.2 diameter wire etc. etc.) I would not recommend under any

The second model – a steam outline locomotive based on a Bayer-Garrett K1.

circumstance the use of single strand insulated cable such as is used in telephone wiring - the reason will become clear in a moment.

If you have attempted to manipulate copper you will have discovered that it is very ductile in the annealed state but quickly work hardens when bent. So copper wire will work harden when bent but the use of small diameter strands minimises this effect as the bend radius to wire diameter ratio is maximised in any given installation. You will see that a single strand, for the same bend radius, will have a much greater work hardening effect.

The work hardening due to bending will lead to fatigue failure if repeated, i.e. a broken wire. To keep the work hardening to a minimum the bend radius, to which the wire is subjected, should be kept to a maximum.

Aside from the insulation provided by the PVC sleeve around the wire, the plastic coating also assists in maximising the bend radius of the wire within the cable.

The following consideration of various connection processes will highlight how they affect the bending of the wire.

Connection methods

There are a limited number of connection methods that are usually found in model engineering because they are inexpensive and easily sourced.

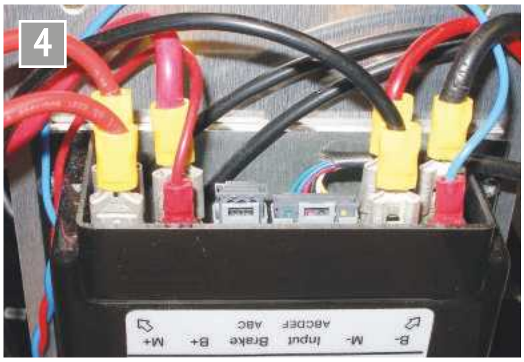
IDC (Insulation Displacement Connector) comes to us from high volume electronics manufacture, typically found in computers.

Crimp terminals, connector inserts and ferrules are all fitted to cables using crimping tools specific in type and size.

A very widely used connecting process is soft soldering, easily done with copper wire.

Screw terminal strips, commonly known as chocolate blocks due to their appearance, are widely available and inexpensive.

An insulation displacement connector.



An insulation displacement connector in use (gray connector in centre).

Adjustable wire stripper.

Ratchet crimp tool.

IDC

The use of IDC's in the models I have built has been limited to one very specific application; that is the connection of the control components to the mother board of the motor controllers.

Photograph 3 shows a connector that has not been attached to any cables and **photo 4** illustrates an IDC loaded with cable and plugged into a motor controller.

Upon inspecting photo 3 you will see at the top is a series of holes into which cables are plugged. Below the holes contacts with slots in them are visible.

By compressing the top and bottom together the cables are forced into the crocodile mouthed contacts where the cable insulation is displaced and the wires are pressed into a gas tight connection with the contacts. A gas tight joint with the contact is important for long term reliability; ingress of contaminants is limited thus preventing corrosion that will lead to a bad joint. Because of this connection method the cable size used is critical and should be matched to the connector. I would be surprised if an IDC used in models required anything other than 7/0.2 cable.

As the cable sleeve is supported by the holes in the upper part of the connector the wires are not subjected to bending at their weak point, i.e. the junction at the end of the sleeve. The lack of bending means that the work hardening and chance of subsequent fatigue failure at this point is minimised.

Connector inserts and crimp terminals

Virtually everything electrical these days has connector inserts and crimp terminals, so the technology is well developed.

Before we look at the details though I will side track to cable end stripping.

Photograph 5 shows my preferred wire stripper. The reasons are that it is not too critical on cutting jaw adjustment, necessary to prevent cutting of the wire stands within the cable, it can strip cables in a tight installation as it grasps the cable close to the stripped section and it has an adjustable end stop for repeated stripping of ends.

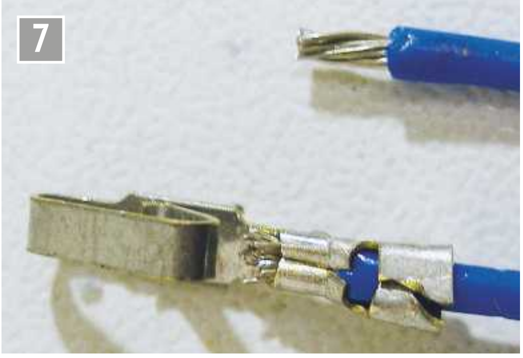
The stripper in the picture has served me for many years and this type are widely available at a sensible price.

I would strongly advise against using the strippers which employ jaws with sharpened triangles coming together. Whilst they will strip cables successfully there is a great danger, if they are not correctly adjusted for the cable size, of cutting through some of the wire strands and so weakening the joint to be made.

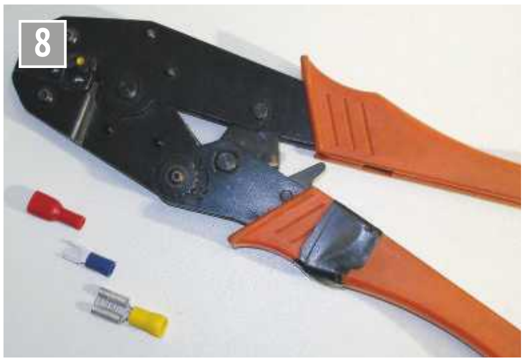
Dealing with connector inserts first; the components and tools associated with the process are shown in **photo 6**. There is the crimping tool, a small insert and a larger insert.

The smaller insert is the type widely used in connectors on radio control equipment whereas the larger one is associated with PCB connections with wider and larger connector bodies.

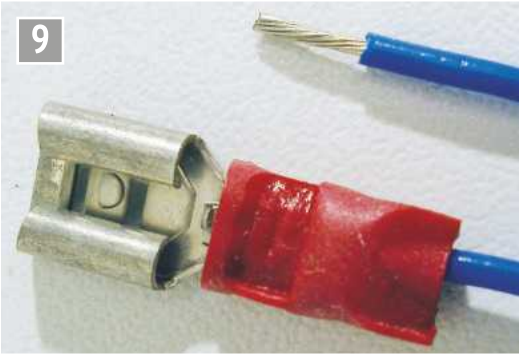
Being a professional standard crimp tool its price is astronomic – in the region of £200 – however ratchet types to fit these crimps are available for much less than even the cost of a tipped lathe tool.



A prepared end and a crimped connection.



Another ratchet crimp tool and a variety of crimp connectors.



An example of an insulated crimp.

A crimp tool for closing eyelet crimps.

Ratchet crimping tools are necessary if you want reliable crimping. The only method of crimp quality control is by making a crimp and destructively testing i.e. by attempting to pull the cable out of the crimp. Failure of the cable or the crimp should occur before the parting of the cable from the crimp.

By preventing the ratchet crimp tool from opening until a pre-set closing force has been reached one can achieve repeatable crimping. Cheap 'plier' type crimping tools do not offer this repeatability and so under-crimping and failure can occur. Throw them in the bin.

Photograph 7 shows the prepared cable end (note how short the stripped section is) and an insert crimped in place. You will note that the right-hand end of the insert is crimped over the cable insulation. Again, the sleeve is at the point of potential bending not the stripped wire core.

Insulated crimp terminals are more likely to be used in joints that carry higher currents. There are various types that can connect to blades, screw terminal blocks by means of eyelets, or forks or just pins. The insulation around the terminal provides the bending limitation on the wires of the cable, so reducing the potential of fatigue failure.

Three colours of insulating sleeves are commonly found, red, blue and yellow. A quick internet search will identify the colour for terminating any particular cable size.

The earlier photo 4 shows this type of crimp installed.

Repeatable crimp methods apply with these terminals and so in **photo 8** a ratchet tool and the three colours of insulation sleeves may be seen. This particular tool has given years of service and the crimping force can be adjusted when necessary. Quality should be tested in the same manner as described in the insert crimp section.

An example of an insulated crimp is shown in **photo 9** along with the correctly stripped cable end.

With cables larger in copper cross section than can be handled by even the yellow crimp terminal, such as battery and motor supply connections, one has to use uninsulated crimps. **Photograph 10** shows, again, a ratchet crimping tool and a typical eyelet crimp.

Marked on the side of the ratchet are the various sizes of cable that may be crimped and again the quality test method of crimps should be applied here.

Because the crimps are uninsulated we would have a potential cable inner wire bending point at the start of the cable insulation – a fatigue point for the wire. To deal with this it is simplest to install some heat shrink tubing over the end of the crimp and the start of the cable insulation (don't forget to put the tubing on the cable before crimping).

Finally, in the crimping tale we have the small ferrule with an insulated receiving cup. In addition to the bending support given by the cup, any stray wire of the core that escapes being inserted into the ferrule tube has less chance of shorting out with an adjacent ferruled cable end.

There are small uninsulated ferrules available but these will not provide the bending support given by the receiving cup of the former ferrule.

You will note that the crimp tool shown in **photo 11**, alongside a couple of ferrules, is not the ratchet type that I have been promoting so far. It is not necessary as these ferrules are used in situations where the cable is connected to a screw type terminal. Provided that the ferrule is retained adequately enough to resist parting with a light tug it will be firmly held on the wire when the screw terminal is tightened.

The ferrules shown are for different size cables and the crimp tool has different sized positions to deal with a range of sizes. Whilst on the subject of ferrule sizes; they are colour coded but unfortunately there are different codes dependent upon the country in which they are used. You will need to check, although my experience is that exact matching of ferrule to cable, as long as it can fit into the tube, is not totally necessary.

A further benefit one can obtain with ferrules is that two or more cables can be crimped in a ferrule together for a screw terminal position without the hassle of one wire popping out when tightening the terminal screw.

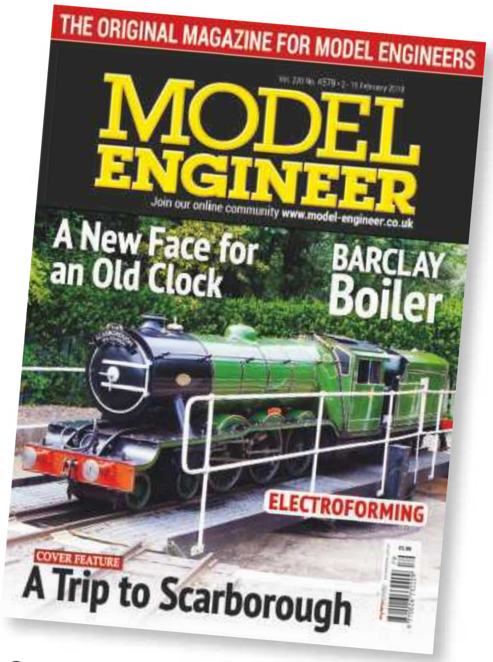
●To be continued.

Next time I will go on to discuss solder connections.

A non-ratchet crimp tool suitable for screw terminals.

MODEL ENGINEER

Incorporating Mechanics, English Mechanics and Ships & Ship Models



INDEX TO VOLUME 220

December 2017 to June 2018

SMOKE RINGS INDEX

POSTBAG INDEX

PART 19

A CNC Beginner's Experience

Slightly more complex CNC machining with a Sieg KX3

Peter King's continuing narrative of a CNC learner driver; a few lessons learned during 'hands-on' operations.

Continued from p.787
M.E. 4587, 25 May 2018

I hope the advice that follows, in the form of a series of short articles, is helpful to those starting out with CNC in the workshop. I aim to assist in understanding any problems and lead you, eventually, to satisfactory operation of your CNC machinery.

Having got over my sundry computer problems and finally got everything to work as it should, I had done a considerable amount of plain '2D' production that had 'backed up' in the meantime. The plain 2D work being jobs machined from one side of a blank piece of plate only – and all being finished by a simple profiling operation. Having learned to 'walk', whilst not ready to 'run', I felt able to move on to slightly more difficult work than drilling/ pocketing/ profiling jobs from plate steel. This was doing work on both sides of a plate; now there are several 'reefs' in the course here. Most of the times with a job like this you will require work on one side to be in register with the other side and within a close tolerance. This requirement needs arrangements to be made right at the start of proceedings.

The first and most fiddly way, where the end product cannot have any extra holes in it *and* is not going to be profiled, is one which means very careful setting of stops to position the work parallel to the axis of the machine table and very accurate centring of the blank on XY zero. There is a catch here – do check that the piece of plate is actually square as otherwise, when you turn the plate over, it is going to be true on the X axis and out on the Y axis by whatever offset is caused by an out of square side. Having checked, then when you turn the job over there is not a register problem caused by the inaccurate positioning – see below. Do remember that the *.dxf file for the reverse side **MUST** be inverted to register with what is now on the underside of the job - no, I didn't first time. I was tired and naughty words were said!

However there are traps galore and much thought has to be applied in order to get everything right! After the machining of the first side out of the workpiece, due to Cut2D having centred the desired job on the plate (because the CNC machine will cut to its set centres), the now profiled job itself is accurately centred on X/Y zero and the axis of Z (and if you have programmed for shim thin locator tabs, is still just held by the first set of clamps). Now comes the fiddly bit; by whatever means securely clamp the finished bit to the table - without moving it - and remove the first set of clamps and break the tabs to lift the waste. Now clamp two wide stops against the job on one X and one Y side to establish a datum. You can now remove the secondary clamp, waste and the job. Because the job was centred and the second job must be likewise, inverting, say, right to left, it will now ensure that for the new job's X/Y, zero is still in the centre of the workpiece. You can now clamp this fresh side against the stops. Therefore the next programme can be run and both sides are in register! All, this is, **ONLY** if you inverted the job the right way! I suggest that you read the above shenanigans several times until you are quite sure what you are going to do.

Before setting up a job such as described above, I lightly clamp a straight edge along the X axis, clear of the centreline by a suitable distance to accommodate a job. This is then checked with a DTI and jogged until true; clamps holding it are then tightened.

Where working with a blank with little leeway for profiling, I often carefully measure the actual width of the workpiece and then very lightly scribe a short line with a height gauge along the centreline. Then I lightly scribe across the centre on the length and make a *very* small centre punch dimple at the crossing – sometimes this can be somewhere that is going to be machined away in a later operation. This arrangement helps to get the work centred in both X and Y, as a centre finder mounted in the mandrel can pick up the central dimple when the table is adjusted by jogging. Then remember to zero both X and Y so that the program and the machine now have a datum to work from. The alternative is to mount a DTI in the mandrel and run the table to and fro and adjust the workpiece until parallel to the table axis. It is easier, however, to have a straight edge.

The next stage is to clamp the centred workpiece in place and against the straight edge then add a minimum of three stops – two against the edge nearest to you and one at an end. These provide a datum to hold the work against and allow you to then remove the straight edge if necessary to make room for further clamps, whilst preserving the centring.

Consideration of all the above shows that if the stops and zero positioning are not accurate, then the register of features on one side would not agree with the register on the other. For the jobs I was doing, a misalignment up to 0.001 inch or so would not matter (plate work for mounting Baker valve gear) but is best avoided as that is better practice.

●To be continued.

Quarter Scale Bentley BR2 Rotary Aero Engine

PART 1

Mick Knights begins the description of why and how he built his quarter scale aero engine.

1

The nine cylinder radial.

Having now completed several I/C engines, two of which have been featured in *Model Engineer*, it's always a bit of a dilemma deciding which engine to tackle next. Now that I'm fully retired I tend to spend the winter months in my shed working on whatever the current project happens to be, while waiting for the return of warmer weather so I can resume my outdoor pursuits. This does of course mean I tend to complete an engine every twelve to eighteen months. The last engine I built was a nine-cylinder radial to an established design, which I entered in the 2014 MEX and which took just under the twelve months to complete (**photo 1**).

Any follow-on project always needs to be a little more challenging than its predecessor, either by scale or by the machining challenges involved as, to my mind, there's not a lot of point in building an engine that's easier or more straightforward than the one you've just finished. I'm a bit restricted by the size of billet I can comfortably machine, which in turn dictates the size of engine I can tackle, as my lathe is a Super 7 and the milling machine is a bench mounted Sieg mill/drill. I do have the benefit of my little KX1 CNC milling machine, which some readers may remember from my other builds that have been published in *Model Engineer*.

I do tend to favour vintage aero engines, as I find it interesting to understand and then replicate the technologies, which at the time were ground breaking and on the cutting edge.

I had seen some examples of rotary engines and started to explore the possibilities of this being the next project. The difference between rotary and radial aero engines is quite simple; a radial has a static crankcase and rotating crankshaft but with a rotary engine the crankcase actually rotates around a static crankshaft. The reason for this, at the time of the first world war, was that the specialist materials that could withstand the intense heat and be cooled only by air flowing past just hadn't been invented. With a rotating crankcase though the engine could be cooled by the displaced air rushing around it. Another good reason for a rotary engine was a bit more practical, as there just wasn't any available space in the air frame for a straight multi cylinder engine. The Bentley BR2 was the engine that powered the Sopwith *Camel*.

By WW2 specialist alloys had been developed capable of withstanding the intense heat generated from a multi cylinder power plant and so the radial engine came to prominence.

It wasn't until I saw a splendid example of The Bentley BR2 at the 2014 MEX that I finally decided what the next project would actually be (**photo 2**).

First off, I bought the L. K. Blackmore BR2 build, which comes in book form. I do take my hat off to the engineers who first tackle a particular type of scale model engine when their only source of reference is the full-size version coupled with any original drawings that are available and then transpose all the dimensions to their chosen scale. Even if you don't intend building this particular engine the book itself is well worth a read as the author does tackle the build using mainly home-made cutters and basic machine set-ups, which were his only real option at the time of construction. There is also an interesting illustrated archive section with the air ministry operating manual for the engine and at £16 it won't exactly break the bank. L. K. Blackmore deservedly won The Duke of Edinburgh Challenge Trophy for his engine at the Model Engineer Exhibition 1981.

It is of course completely possible to build the engine using the plans laid out in the book, which many have successfully achieved in the past, although a few more elevations and sectional drawings would make the machine set-ups, machining processes and the workings of the engine easier to understand; after all, not many model engineers would be familiar with this particular style of I/C engine.

The last engine I completed, the nine-cylinder radial, was to the Hodgson design available from Ageless Engines. The plans for that engine are CAD generated and although there were times when I had to stop and really think individual machining processes through, the plans were very clear and easy to understand.

There are also plans for the BR2 available from Ageless Engines and, although not exactly cheap, I decided to purchase these as well.

The Hodgson plans, as I expected they would be, are very clear and concise, although a lot of the external details are not sympathetic to the original engine. However, they are a bit easier to produce in a basic home workshop, while the internal mechanical components are, to my mind, a far better proposition both for machining and eventual running.

The BR2 that inspired me (photo by Neil Wyatt).

It's fair to say that the Hodgson package, along with step by step build notes, does contain all the required information regarding the suppliers of the sundry items needed to construct his version of the engine but the preferred suppliers are all located in the States. The package also contains full plans for all the jigs and fixtures that might be needed to aid the machining processes. I will have to leave it to individual engineers to decide which of these pieces of tooling would be required to produce the engine in their own workshops.

The route I would take had now been established. All the internal workings would be to the Hodgson plans as they are fully dimensioned with different elevations and sectional views where required, while the external details would, for the most part, follow the Blackmore plans. This to my mind would incorporate the best features of both engines. That's not to say that this build would be an easy option, especially with my limited machine capacity, and as we progress this will become self-evident but on the other hand I still enjoy a machining challenge.

Now I fully appreciate this hybrid approach is not the one many model engineers tackling this engine would adopt but I sincerely hope by the time we reach the end of the build that most will feel this to be a faithful reproduction of a classic engine with most of the original external features, but with smoother internal workings and modern electronics, along with a few embellishments of my own (**photos 3** and **4**).

The ignition system I intend to use will not be the twin contact breakers of the original, which simultaneously send a synchronised spark to each of the spark plugs in the cylinder head, but via a Hall sensor reacting to nine magnets set in a rotating Tufnol disc, which sends the pulse of current to a CDI module, sourced

Rear view of completed engine.

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The business end.

from 'cncengines.com' in the States. This CDI unit replaces the twin coils that would be required if contact breakers were employed. This dual HT lead CDI unit is a bit of an experiment (**photo 5**) as I asked Roy at CNC engines for two independent CDI units which would react to the same pulse from the Hall sensor; each unit would then send the current to one of a pair of terminals on the rotating slip ring. (Don't worry if this all sounds a bit Greek at the moment, as hopefully I'll be able to explain the electronics as the build progresses.) Roy tells me that this CDI unit has one spark coil with an isolated secondary winding. The high voltage current will travel down one of the spark plug leads, through one spark plug, through the cylinder head to the second spark plug and then return via the other spark plug H/T lead and back to the coil, thus firing both plugs simultaneously. This of course means that, unlike the standard CDI unit, this one doesn't require a separate earth connection. I've taken Roy's word for all this as electronics has never been my strong suit.

So as far as the ignition is concerned I have taken what I hope will turn out to be an easier option and I trust all this theory will make more sense when we reach the appropriate stage of the build. If readers have any questions regarding CDI ignition systems you'll find Roy at cncengines.com is very approachable. For any engineers who enjoy the electrical side of their model making then the twin contact breaker approach should prove interesting although I understand from Roy that anecdotally even Lee Hodgson had trouble synchronizing the two sets of manual contact breakers on his version of the engine and L. K. Blackmore also used dummy magnetos on his prize-winning engine.

On the subject of the twin spark plugs, during the build several of my friends have asked me why there are two plugs per cylinder and I've had to confess that I have no idea. That's until I was talking to another acquaintance who reckoned it was because the volume of the combustion chamber is quite spacious and two plugs would deliver a stronger catalyst for the combustion. This sounds plausible but I suspect if this isn't the case the real reason will no doubt appear in the *Model Engineer* forum or the letters page quite soon after this piece is published.

Whichever approach to building this engine is chosen by individual model engineers it will definitely present some interesting machining situations, some of which will definitely push the envelope of the smaller and modestly equipped workshop and this, to my mind, is all part of the fun.

The two separate sets of plans for this engine are slightly different in scale so corresponding parts such as the cylinders and crankcase are not directly interchangeable without modifying some dimensions. This in itself doesn't present any real problems as the Blackmore components will only apply to the external features, some of which I've had to redesign due to the route I've chosen to adopt.

The materials and costs involved for this engine are considerable. I have become increasingly disillusioned of late with specialist suppliers of stock material to the model engineering fraternity, after having to wait some four months for the delivery of materials to be completed for this project. Even then, in a couple of cases, the wrong grade was supplied while the correct free cutting grade was invoiced. There are of course some billets that, because of their sheer size, have to be sourced from these outlets as the big commercial boys aren't at all interested in our modest one-off requirements but for bar and flat stock there are some very good online suppliers that don't have a minimum order requirement. These are now increasingly my first port of call as their prices, material quality and delivery are, in my experience, unbeatable. I will be mentioning individual suppliers when I tackle components where I have used their services.

Another online source for individual items of material that has proved worthwhile of late is to tap into the search engine for choice 'offcuts' and the material required. This brings up a variety of options with eBay usually supplying the greatest number of responses. The range of sizes and materials of course varies daily but if your requirement is a couple of weeks down the line then this can be a good option. By way of an illustration, I needed a billet of 30mm thick Tufnol for the ignition slip ring for this engine, but the smallest size available was in one-foot squares, with a price tag of around the £80 mark plus delivery. I even approached the manufacturers directly hoping they might have offcuts available but my enquiry apparently didn't even warrant a reply, so I kept looking online, until one evening there was a four-inch square block of

30mm thick Tufnol for sale on the aforementioned well-known auction site for a buy-it-now price of £25 including p&p. When saving money where you can is important, perseverance sometimes pays off. I use the same approach for sheet brass and aluminium, where usually the prices from this online source knock spots off quotes from suppliers. I've even had a piece of brass plate for the timing gear sent from Germany, which proved considerably cheaper than sourcing it from stock holders here in the UK. In some ways I'm glad I haven't kept an accurate record for the cost of material and sundry items for this build, as I'm sure the grand total would be eye watering if laid out in one go.

I was unfortunately several weeks into this project before our editor persuaded me to document the build, which resulted in the majority of the cylinder head machining process not being supported by photographs. I hope this will not prove problematic as the cylinder head machining is complex and time consuming but a step by step approach to the sequence of machining operations is covered in depth in both the Blackmore and Hodgson plans, although both adopt a slightly different approach. I machined the majority of the cylinder head on the CNC mill, which was a completely different approach again.

I hope that some of the machining processes that are documented in this build will help readers tackle different aspects of their own individual projects but of course this comes with the *caveat* that the machining envelopes of hobby, and indeed industrial machine tools should never exceed the manufacturers' operating recommendations. A hint of things to come perhaps!

The recommended machine requirements for the Bentley BR2 in the Ageless Engine plans are the same as the nine-cylinder radial I produced - that is, a lathe with a nine-inch swing and a Bridgeport type milling machine. I didn't experience any real problems constructing the radial engine using my modest machines but this particular engine did in fact take me to the limits of my machine's capacity, so any engineer contemplating this build would be well advised to check their own machine's limitations before ordering any expensive material. With the Hodgson version of the BR2 there are a couple of instances where a lathe with the nine-inch swing specified would have been a definite advantage. I do suggest an alternative approach to these operations using a conventional milling machine and rotary table but this approach does entail a great deal of machining time.

Carrying on from my previous builds I will again be relying for the manufacture of several key components on my little KX1 CNC milling machine which I've had for nine years and is now an indispensable part of my workshop. I would hope by now that any readers that are interested in embracing CNC machining for projects in their own workshops will have taken the plunge and will be familiar with the Mach3 control I use and its conversational programming 'Wizards'. So, this time round, I'll be explaining a couple of useful G-codes that some engineers might not be aware of but, when used in conjunction with Wizard or hand-written programs, can transform the program's potential just by the addition of a couple of extra lines of programming. I appreciate that many readers find pages of G-code confusing or just plain unnecessary when used in conjunction with model engineering. This is a position I fully understand, so rest assured I will only be using the very minimum of G-code required to demonstrate the aspect of programming I'm explaining.

There is a lot of machining and bench work to get through so if your workshop, like mine, is a little on the small side and will only house smaller machine tools, then perhaps you should allow eighteen months to a couple of years to machine and assemble this particular engine. The end result though will hopefully be an impressive looking bit of kit. As with previous builds, I do tend to write up the process with warts and all so when I machine a part and later discover, or think of, a better option then I will include an advisory note to that effect.

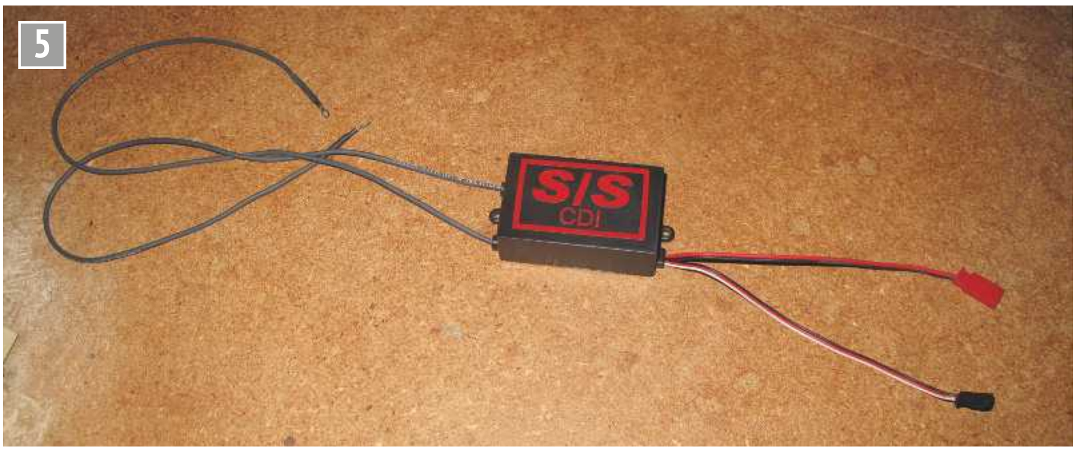
There will be the need to produce a few simple machining fixtures along the way but nowhere near the number or complexity I needed to make for the nine-cylinder radial engine.

Also, I hope the machining set-ups and processes employed will help engineers to develop their skills and understanding of the machining potential of their own small workshop.

As with my previously published builds I am unable, due to copyright restrictions, to support this one with actual drawings but, as in previous builds, I will be supporting all aspects of the machining, final fitting and assembly with plenty of photographs, which I sincerely trust will give the reader a good understanding of the individual components and their relevance in the workings of the engine. Of course, if you do fancy building this engine you will need to purchase the necessary drawings from the supplier of your choice. With the Blackmore plans, you're on your own, while with the Ageless Engine plans if you run into trouble and, as long as you bought the plans directly from him, Lee Hodgson will get you to the end of the build with email advice.

I would at this point like to publicly state that in the writing of this and of all my previous engine builds it has never been my intention to damage or anyway harm any individual's business or undermine their intellectual property. My discussions are merely a pictorial account of my own approach to the build and machining processes and no dimensional information or plans that could be used to reproduce an individual component or completed engine are ever included. I'm sure regular readers would agree that my builds have been successful in this regard, as I would say it's virtually impossible to build the featured engines from my articles alone.

●To be continued.

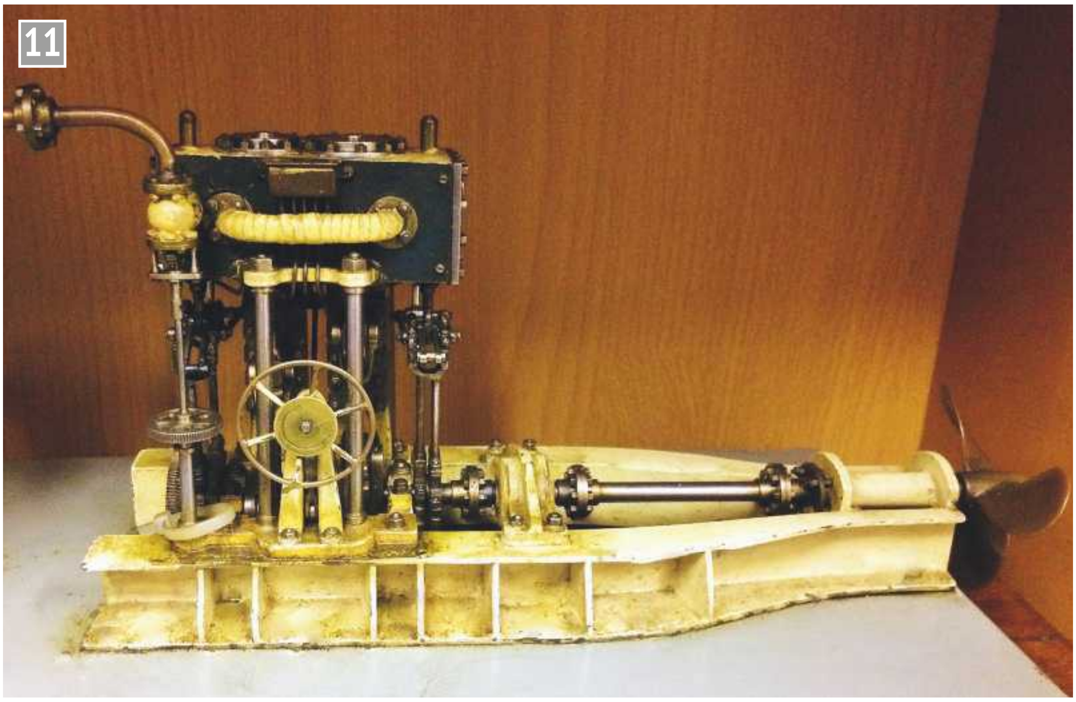


The special CDI unit with twin HT leads.

The Inquisitive Fiddler: Learning the Trade! PART 3

Mitch Barnes tells how, without access to machinery or facilities, he used incomplete and abandoned projects as his way into Model Engineering, to start learning about his chosen hobby.

Continued from p.797
M.E. 4587, 25 May 2018



The second milestone on my Road to Damascus: this model was the talking point that made me join SMEE in 1998.

Stage 5 Longer Term Solution No. 1: A lathe at last!

I spent the first decade or so of my interest in Model Engineering wandering around every show I could get to, photographing the models and, where possible, buying tooling that looked as if it might be useable one day but not knowing when that would occur.

Eventually I managed to buy a rather nice and rather portable Hobbymat MD65 lathe to fiddle with. Who knows? I thought, perhaps I maybe, even, could make something with it…? I bought it from an aircraft engineer who had looked after it as if lives depended on him doing so, as it did for any one of his charges. It had 25 hours on it (a totally professional aviation chap, he had created a logbook too) and it was spotlessly maintained. He'd bought it new, to build a small traction engine after taking his kids to a steam show. Fascinated with engineering for all of two hours while he set up a casting for machining, he realised that they'd lost interest when he looked up after concentrating on tightening up something on the faceplate, to see that the kids were climbing a tree. After a further 23 hours, his level of interest evidently followed theirs and after some money changed hands, I was now the lucky owner.

At least he knew how to use it. Despite its nice friendly yellow paint, I remained somewhat cautious about getting started on that lathe. The first few months in my ownership were, from the lathe's point of view, a life of leisure, occupied mainly with being hesitantly stared at rather than used. It was a peaceful existence for the machine, apart from metallic screeching noises (from the lathe tool, not the operator) on the rare occasions when its new owner gingerly plucked up the courage to have a go! I was amused recently to hear that this is the fate of many modern electronic devices (perhaps without the metallic

Despite its nice friendly yellow paint, I remained somewhat cautious about getting started on that lathe.

screeching) among middle aged and older purchasers, so I was not alone!

I was still stymied by the operation of machines. I'd been using hand tools and small power tools, even fine woodworking machines, but to take part in engineering I was confronted by all those knobs and controls! No lathe or mill seemed to be like any other. No standardisation! An aircraft, boat or motor car, no matter how complex, always has its steering wheel and pedals in basically the same place as any other; not engineering machinery! It's confusing and, not only that, but twiddling the wrong knob can cause catastrophic results. One doesn't relish the thought of picking a piece of metal out of one's forehead. Or worse! No sir.

Anyway, two things happened that caused this engineering inertia to come to a sudden and productive end.

The first milestone on my Road to Damascus was passed when I obtained a copy of 'A Taste of Turning', a video involving the very same MD65 lathe, presented by the user-friendly and avuncular past editor of *Model Engineer* magazine, Ted Joliffe. Here was a jovial and extremely knowledgeable man making use of the very same lathe, with tons of advice, making it look the harmless and enjoyable activity that it is (when conducted properly…) My MD65 had come with no instruction book (I found one much later) and here he was showing what all those mysterious knobs actually do and why. The video also allowed me to be less frightened of those screeching noises because some lesser ones emanated from it even when he used his example. Knowing what was 'normal' in this respect was reassuring because I had no idea at all and some of those graunching sounds were alarming at first.

That video may be unobtainable now but today's hesitant and cautious beginners can take advantage of the myriad short and informative films available on YouTube, a fantastic resource. No more picking that piece of incorrectly-chucked metal out of the ceiling! Having seen one film, one feels inclined to explore further, as there is so much to see. Some of the suggestions YouTube gives the viewer are nothing to do with what you are looking for but - well it's only a four minute film, I'll watch it and go back to learning how to use the lathe. The only danger of YouTube is that, without realising it, you can wind up suddenly aware that you have been watching it for days on end having neglected family, work, food or sleep and your eyelids are propped open with matchsticks!

Spurred on by having completed my machined Stuart 10H without any accidents, albeit only using hand tools, I spent this next phase of my engineering career still tweaking other people's unfinished models but now making the odd bit on this lathe as confidence grew. With a growing collection and lots to choose from and not much time to play with them, most of my collection of projects remained not much more finished! This was basically because I still didn't have the resources or the space to have a mill, let alone a workshop. But I could do a slightly wider range of work on the engines that other people had discarded and bring them to life, or at least, closer to it. I was also becoming able to use machines at work without having to pick the chuck key out of the ceiling quite as often.

Model Engineering is a creative hobby requiring much commitment and patience, due to the time it takes to produce anything. But the positive way to look at the time you will spend building any engineering model, is value.

Without helpful encouragement in the early years, I would never have been able to make these ⅓ scale Motorola radio knob patterns for miniature Aston Martin DB5s.

Stage 6
Longer Term Solution No. 2: Joining a club, in my case SMEE

The second milestone was attending Brighton Modelworld in 1998, almost a decade after I'd started meddling with model engineering. When taking photos of a tiny and intricate marine engine by H. H. Fenn, displayed on the SMEE stand (**photo 11**), I was asked by the kindly membership secretary if I'd like to join the Society. I'd been photographing models on their stand and others at exhibitions for all those years but never considered myself worthy of membership of SMEE. Actually, nobody from most other club stands had ever talked to me (SMEE stand attendees had always been helpful) and here was a friendly voice of encouragement. I replied to her that I rated myself as a 'fascinated know-nothing'. The membership secretary reposted kindly that I was merely a beginner and they welcomed beginners! Groucho Marx said he'd never join a society that would have him as a member but I was delighted to be asked to become one of this friendly band of merry engineers and haven't looked back since.

It was the beginning of the beginning. After a couple of visits to the SMEE HQ I realised that actually quite a few other members never make anything either for various reasons but they are all really enthusiastic, very friendly and pleasant and just so full of helpful advice that they are only too pleased to impart to a know-nothing like me. Not only that but they looked at the ten-thumbed offerings I was encouraged to put among the 'Work on the Table' each month and gave me such unsolicited encouragement that I continued both as a member (now 20 years on) and as a muddle engineer! Model engineering has even hugely increased my turnover of professional work, helping me earn a crust from time to time. The life of a freelance modelmaker is not a regular one so any opportunity to hold the wolves from the door is welcome (**photo 12**).

I have said before that had I not joined SMEE, it is fairly unlikely that I would have continued with the daunting (to me at first) pastime of model engineering because I needed backup and someone to answer my questions. At

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SMEE I found that and more. Also, I was lucky enough right at the start to get into friendships over the phone with two people who answered my ads at the back of *Model Engineer* requesting completed models I could purchase and restore. Both of them were really my mentors and kept the enthusiasm alive in me and I will be forever grateful to them. Because of their selfless generosity, my life has been enriched by the privilege of working on projects such as this Aston Martin DB5 – one of 27 that the team I was part of, with over 120 years of combined experience (they used to joke that most of that was mine) built during 2014–16 (**photo 13**).

Conclusions

We all know that Model Engineering is a creative hobby requiring much commitment and patience, due to the time it takes to produce anything. But the positive way to look at the time you will spend building any engineering model, is value. For the cost of that set of castings and materials, you will get a lot for your money - manifested as contentment and enjoyable time spent just making something. It'll keep you out of the pub for months or years and at the end of it, instead of an increased risk of various life shortening ailments you'll have something that you, your friends, relatives and descendants can admire for far longer than a plastic kit which will crumble to nothing in two or three generations.

The 007 style 'Radar Tracker' unit gives it away. A lot of Model Engineering went into this ⅓ scale Aston Martin DB5 interior. A team effort, its interior was largely the result of my pattern making - from press tools to bend the seat metalwork, a flip top 'ejector seat' gearstick made from brass, turned instrument bezels, sculpted and machined patterns for door handles, handbrake, windscreen wipers and toggle switches, to the steering wheel held together with aircraft rivets. I also patterned up the door cards, between-seats armrest, foot pedals, front seats, steering column, dashboard and the instrument panel.

The best advice I can give to any beginner wanting to complete their first and subsequent models, whether potential engineer or Inquisitive Fiddler is - join a club! Most will welcome you and there are many, many benefits to a model engineer of being a member of a Model Engineering Club or Society. One of the greatest benefits is that, with the advice and encouragement of others, the daunting prospect of building your first ever engineered model becomes somewhat easier, not least because most clubs have some machinery you can use. Whether you want it or not, you will also receive plenty of good natured and priceless advice from others, tea mugs in hand, while you machine away. My experiences at SMEE have been echoed by so many others over the years and at many other clubs. Membership is a great leveller and seeing what others do can stimulate your own efforts.

Since joining, I have learned many techniques and wrinkles but above all, I have had many hours of enjoyment and satisfaction from this wonderful, creative hobby. I have also met myriad lovely and interesting people. At the recent exhibition in January, one elderly gentleman said to me that a psychologist he chatted with while travelling to the show had told him: "If you want to live eight years longer, get yourself a shed." That is really great advice. And what good news that is! I can see the red top tabloids' headlines already: 'A CREATIVE HOBBY MAKES YOU LIVE 8 YEARS LONGER! IT'S OFFICIAL! SAY PROFS'!

Would you like something to show future generations that you existed? Here it is - build an engineering model or three. Your engineering epitaph will outlast you by a huge margin - hundreds of years - if looked after.

Just make sure you put your name on it.

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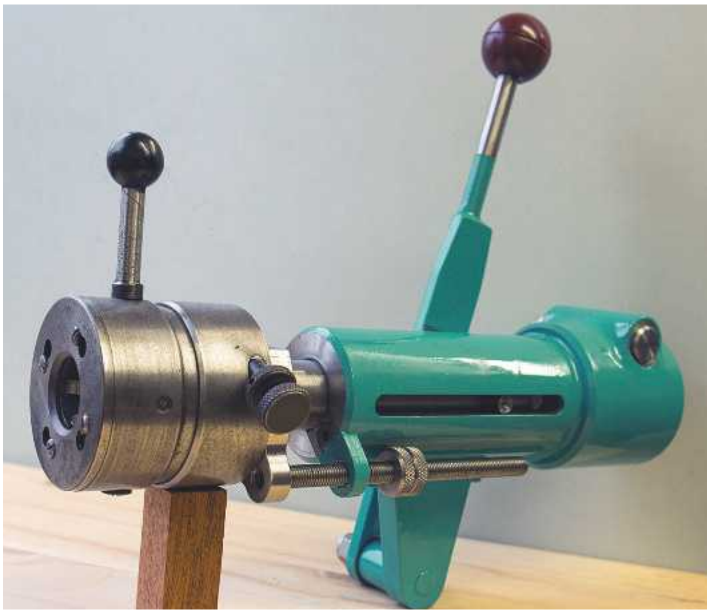
PART 5

A Large Capacity Coventry Diehead Attachment

David Earnshaw describes an attachment for fitting a Coventry diehead to a larger lathe.

Continued from p.783
M.E. 4587, 25 May 2018

We now need to make a handful of small parts before assembling and testing the complete diehead attachment.



Trunnion

The trunnion (**part 3**, **fig 7**) was made from a piece of mild steel plate. Welding it to the body was considered but possible distortion problems ruled out this method of construction. The shape was marked out and chain drilled to obtain the approximate shape. The ⅜ inch UNC pivot hole was drilled and tapped and then used as a location for attaching the piece to the rotary table. Using methods similar to those used for profiling the flange of the shank the outside shape was milled (**photo 38**) The two $\frac{3}{16}$ inch radii at the ends of the mounting surface were filed by hand, using filing buttons to achieve a good result.

38

Machining the outer profile of the trunnion.

Pivot

The pivot pin (**part 5**, **fig 8**) is a straightforward turning exercise and needs little comment except to say that the short thread could be undercut at the shoulder to allow the pin to seat right up to the side of the trunnion. Although ⅜ inch UNC is specified on the drawing, any thread of ⅜ inch diameter could be used. This pin was secured into the trunnion using Loctite at the assembly stage.

Fig 7

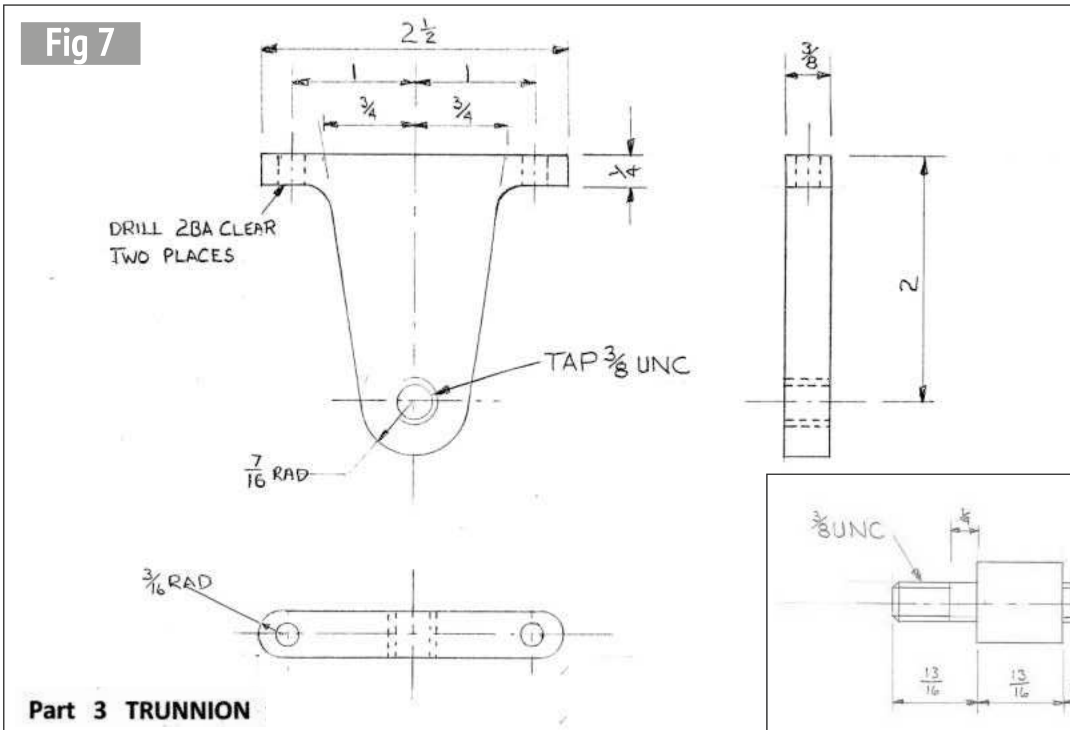
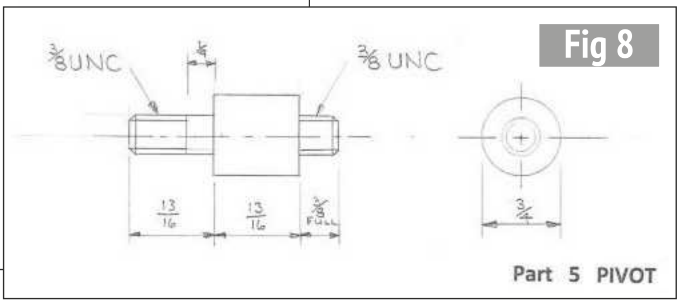
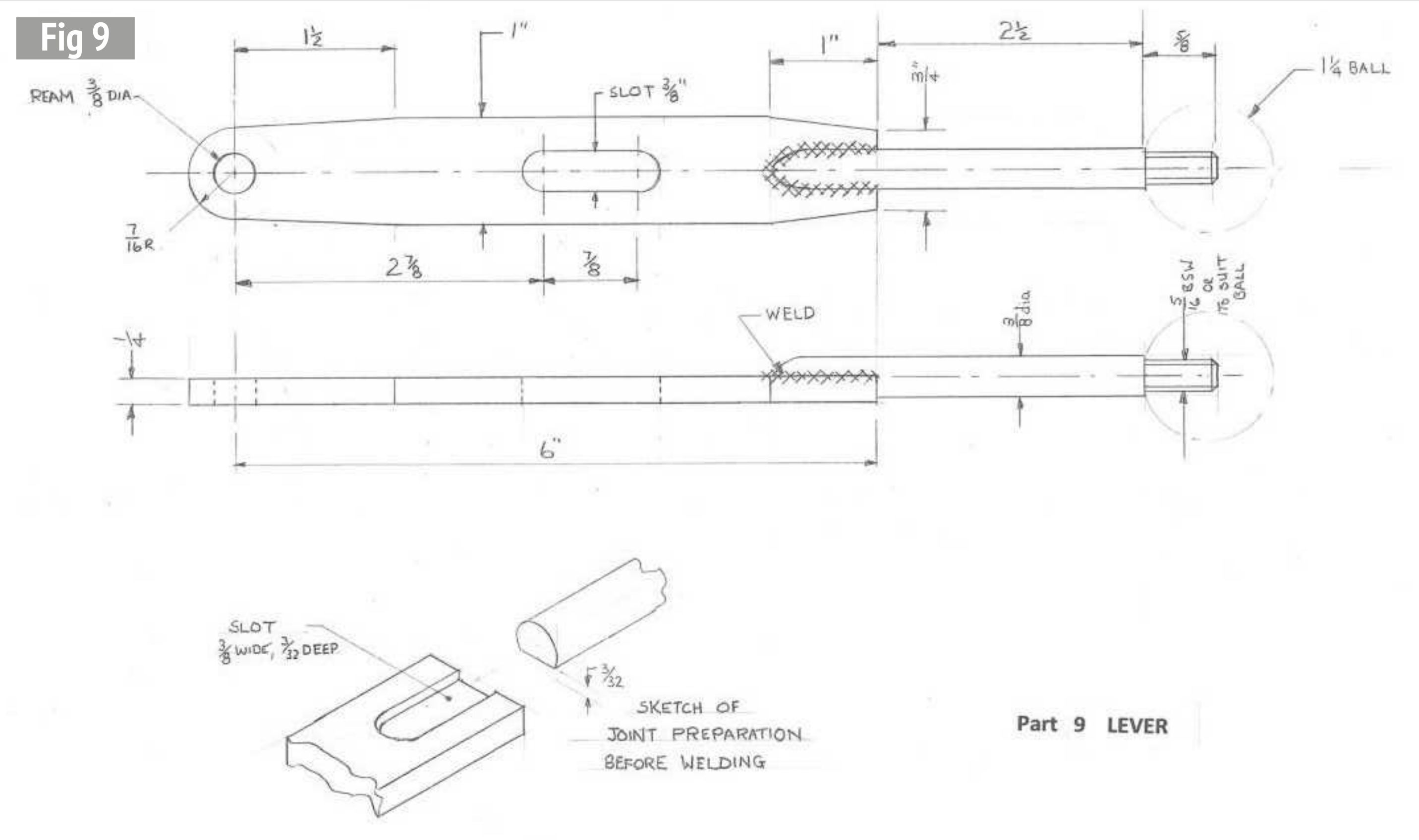


Fig 8





Lever

The lever, or handle (**part 9**, **fig 9**), is a built-up part consisting of two pieces of steel and a plastic ball. Then main part was produced from a length of 1 inch by ¼ inch flat bright mild steel, drilled and reamed to fit on the pivot, a ⅜ inch wide slot milled and the outside profile shaped using a combination of milling and filing to achieve a pleasant shape. A shallow slot was also milled on the opposite end to the ⅜ inch reamed hole to locate the round section of the handle before welding them together. The round section of the handle was simply a short piece of ⅜ inch diameter mild steel turned down and threaded to suit the plastic ball at one end and a small flat machined on the other end. (See sketch of joint preparation on fig 9.) The two pieces were then welded together and the weld dressed using the mini angle grinder and files (**photo 39**).

The finished lever or handle before painting.

The lever pin finished.

Lever pin

This component (**part 10**, **fig 10**) was another straightforward turning job but there were two important points to bear in mind. Firstly, the ⅜ inch BSF thread was screwcut to make sure that the thread was true. This was to make sure that there was no chance of producing a drunken thread, as this would cause binding when the pin is fitted through the slots in the body and into the shank. Secondly, the length of the plain portion of the shank between the end of the thread and the head was controlled carefully so as to give a slight clearance between the lever (handle) and the side of the body when the lever pin was tightened into the shank. The thickness of a turned washer was also included when planning the length of this plain part of the pin (**photo**

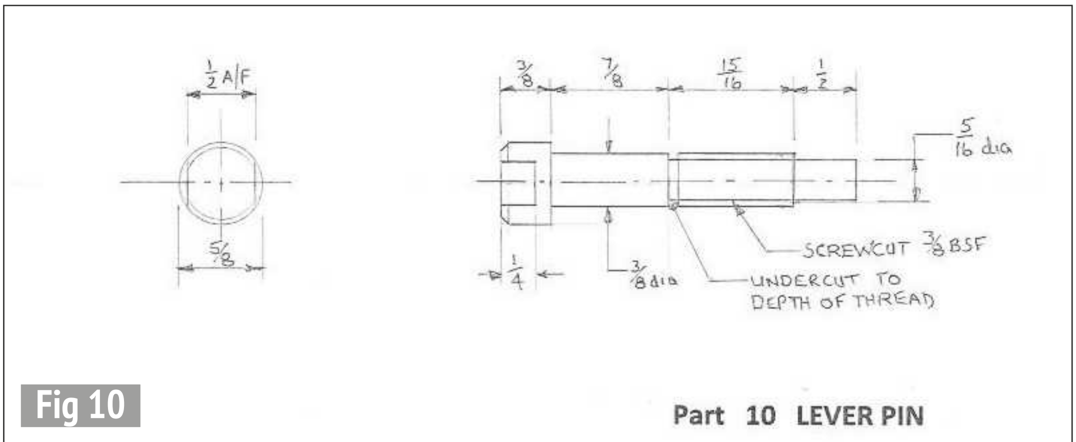


Fig 10

40). **Photograph 41** shows the lever pin with washer loosely assembled in the shank.

Stop screw and stop nuts

The stop screw (**part 11**, **fig 11**) is simply a length of 5/16 inch BSF threaded rod. Not having any threaded rod of this size readily available, the smaller Coventry diehead – the subject of the previous article - was set up and used to produce this component. A length of 5/16 inch diameter steel rod was faced and chamfered and then the diehead used to cut the thread. The first half inch or so was threaded and the diehead tripped. The resulting thread was checked for fit, a slight adjustment made to the dies and then the thread was cut at one cut, under power at about 70rpm. The resulting thread proved to be most satisfactory, as seen in **photo 42**.

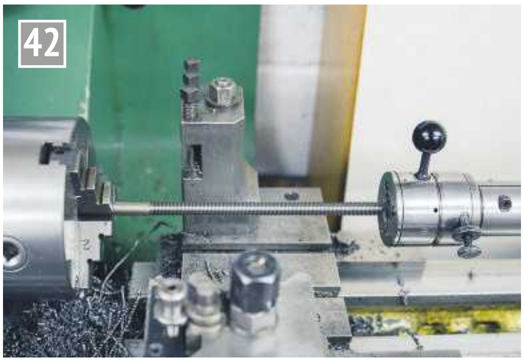
The two stop nuts (**part 12**) were made from a short length of ¾ inch diameter mild steel bar. The first operation was the knurling to make sure a good knurl was produced before proceeding further. Then the hole was centre drilled, drilled tapping size and tapped deep enough for both nuts. A parting off tool was set in the rear toolpost and a chamfering tool in the front toolpost. The bar end was lightly faced and chamfered. The parting tool was then set ¼ inch away from the bar end, parted part way through, the parting tool retracted and the chamfering tool used to chamfer the back edge of the nut. The parting tool was then returned into its original groove and the parting off completed. This was repeated for the second nut (**photo 43**).

Assembly and testing

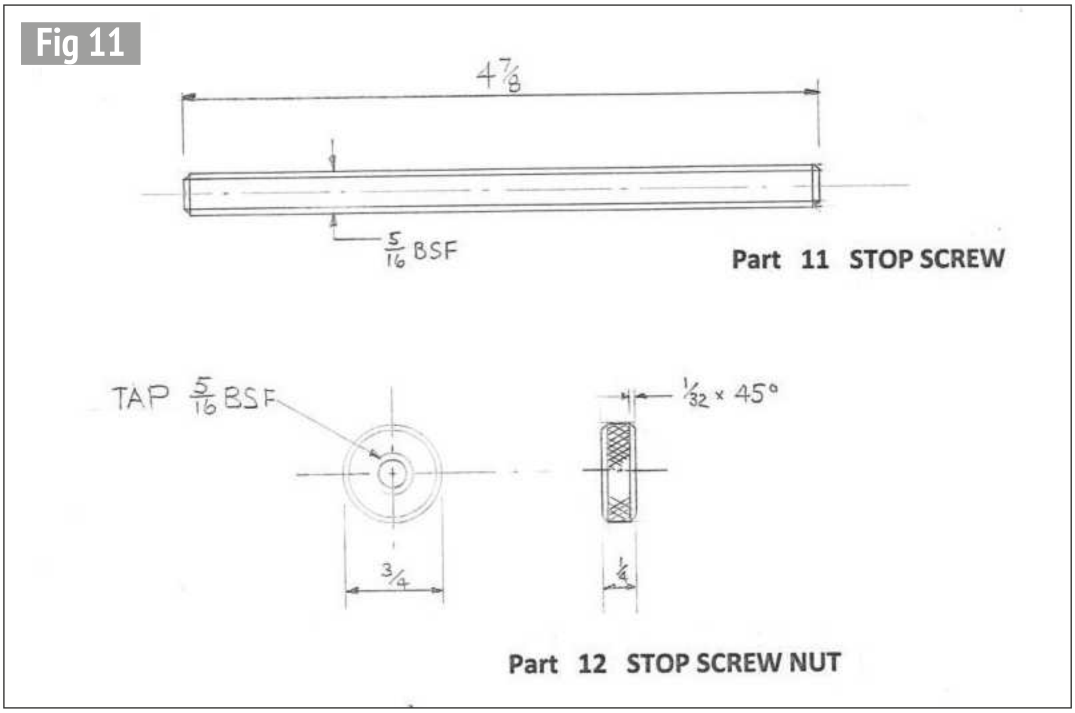
Much of the attachment was assembled as the parts were made. **Photograph 44** shows the components fitted together to make up the whole body and represent what a casting would probably need to look like if the unit was to be made that way.

Photograph 45 shows a complete assembly including the fitted diehead before

The finished shank with lever pin and washer loosely assembled together.



Using the smaller diehead to produce a length of threaded rod for the stop rod. Less than two minutes threading time, including a pause to re adjust the dies.



Stop screw rod parted to length with two knurled thumb nuts.

Unit fully assembled with diehead fitted in place.

Main body and parts assembled together.

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Attachment fitted in place on the lathe.

Attachment in use cutting a large thread.

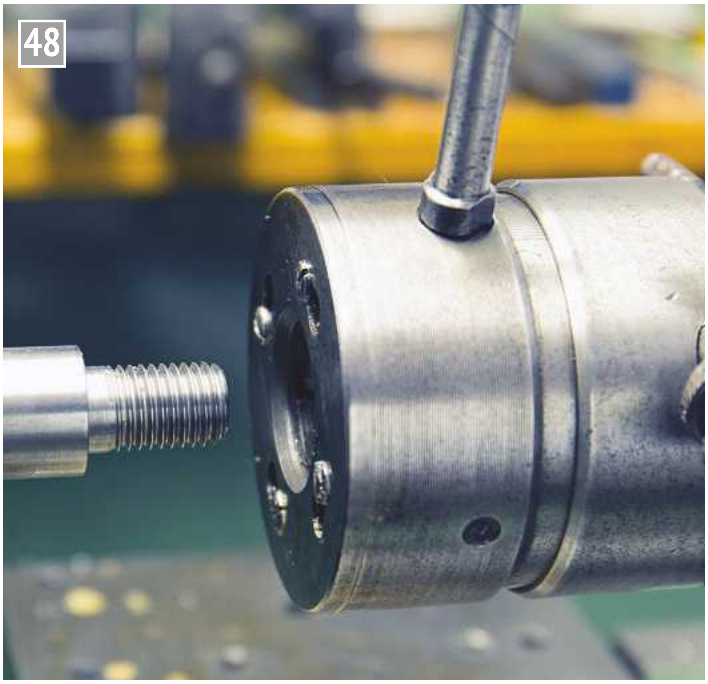
any painting was attempted. **Photograph 46** shows the unit fitted to the lathe, with the toolpost removed in order to take a clear photograph. Some ½ inch BSF threaded parts were required and this seemed like an ideal opportunity to test the new unit. **Photograph 47** shows the unit in use cutting a ½ inch BSF thread and is nearing the tripping point (note the stop nuts approaching the stop lug).

The resulting thread is shown in **photo 48 -** ½ inch BSF x ¾ inch long. After the bar was turned down to size only one cut from the diehead was required to produce the thread, lathe speed about 80rpm, threading time about 12 seconds, excellent finish. This test proved to me that the unit had performed as it had been designed to do AND the Loctite used to secure the two parts of the shank together was doing its job! The arrangement for clamping the attachment onto the tailstock barrel also proved to be sound and secure.

Whilst the attachment has so far proved to be a success it does, unfortunately, preclude any use of the tailstock for any other purpose whilst the attachment is in place so some sequence of planning is required when making threaded components which, for example, require a hole to be drilled in the end of them.

With the editor's permission I will prepare a further article detailing the Mark 2 variant of this unit (*Yes, please – Ed.*).

ME



Result of first test, ½ inch BSF thread x ¾ inch long, one cut, time taken: 12 seconds.

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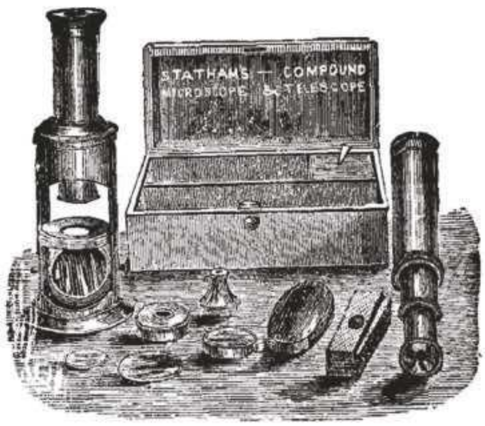
T. 01442 380242. Hemel Hempstead.



■ A later Myford ML4 with Tumbler reverse, 3 jaw and 4 independent jaw chuck, set of screw cutting gears, tail stock chuck, drive dog plus bits and bobs. Stand with NVR switch. Good working order. £400 ono.
T. 01733 769913. Peterborough.

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The National Model Engineering

John Arrowsmith reviews a milestone event in the model engineer's calendar.

A bright Spring morning greeted the opening of the 25th Anniversary Exhibition at Doncaster Racecourse on Friday 11th May. This was a special day for the organisers, Lou and Gavin Rex; as Gavin asks in his address in the show guide, where has the time gone? However, gone it has and this exhibition again showed off the quality and skills that still exist in the UK in the world of model engineering (**photo 1**).

Competition entries were disappointing but that has been the trend for some time now in all exhibitions. The clubs and societies presented an excellent range of quality models and equipment with something for everyone to enjoy. There were a number of outside activities to add to the static and working displays inside. As this was the 25th Anniversary Exhibition a special commemorative cake had been baked which was duly attended to by the organisers and representatives from Doncaster Racecourse.

As I said, competition entries were a little disappointing but in Section 39 for Locomotives there was a competitive selection to test the judges. A First Certificate combined with the Barry Jordan Trophy for Best in Show plus the Myford Shield for the Best Locomotive was awarded to the 5 inch gauge BR 9F 2-10-0 built by A. West. This was a an excellent piece of work capturing all the details of the prototype with first class motion work and an excellent overall finish (**photo 2**). Four Second certificates were also awarded covering a range of different models and gauges. Another 9F, this time in Gauge 1, received a Second certificate for builder S. Johnson who presented his Franco Crosti boiler version of the prototype, a finely detailed model which ran well on the G1MRA track (**photo 3**). The 3½ inch gauge example of the Talyllyn Railway *Tom Rolt*

The writer's personal favourite; John Cottam's splendid P2, Cock O' The North.

Judged to be Best in Show was this 5 inch gauge example of a BR 9F built by A. West.

The Franco Crosti boilered 9F built by S. Johnson at work on the G1 MRA layout. (Photo courtesy Mike Chrisp.)

This fine 3½ inch gauge model of a Talyllyn Tom Rolt *0-4-2 was built by N. Bennett.*

The Vertical Boilered 7¼ inch gauge 0-4-0 Markham *on the Chesterfield stand.*

York City, *the 2½ inch gauge B2 Locomotive by T.Barnes.*

and Modelling Exhibition 2018

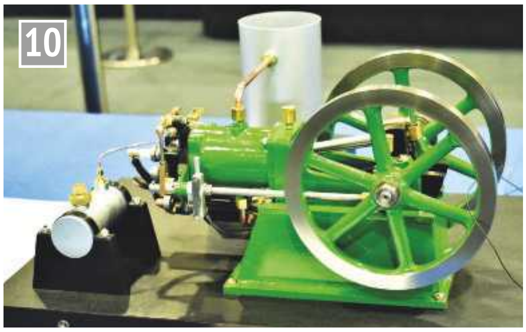
0-4-2 by N. Bennett was quite a large model in this scale and was accompanied by a set of castings and fittings used as the model progressed (**photo 4**). It was a well constructed and finished model. The 7¼ inch gauge vertical boiler locomotive *Markham* (**photo 5**) was located on the Chesterfield stand and was in complete contrast to all the other models in the competition. The fourth Second Certificate went to T. Barnes for his 2½ inch gauge example of an LNER B2 4-6-0 locomotive, another highly finished model (**photo 6**). The winner of the Precision Paints Award for the Best Finished Model also gained a VHC certificate in Section 39 and this was a 5 inch gauge model of a Class 37 Diesel by M. Lock (**Photo 7**). This really captured the appearance of a work weary locomotive.

In Section 40 for Model Road Vehicles there was only one model entered into the competition and this was the 1½ inch scale model of a Burrell Boydell Traction Engine by B. Hutchings. Still under construction it did not receive any award but when finished will be an excellent model (**photo 8**). In Section 42 for Stationary Engines, of the five entries three were awarded certificates. A First Certificate and winner of the Warco Trophy for the Best Stationary Engine went to Tom Pasco for his beautifully made and finished 50cc Five Cylinder 4 Stroke Radial Engine (**photo 9**). A Third Certificate was awarded to J. Brittain for his E. W. Wyvern Single Cylinder Gas Engine (**photo 10**). Frank McCafferty gained a Commended certificate for his $\frac{1}{10}$ scale Ulstien Gearbox CPP with its six cylinder Bergen Engine (**photo 11**). There was a wide range of models in Section 43, Miscellaneous. Two First Certificates were awarded in this class with M. Whittington being successful with his Collection of Handmade Miniature Knives (**photo 12**). The other First went to John Clarke for his Newsham Fire Engine circa 1721 (**photo 13**). Beautifully detailed, this little machine was an excellent example. John also gained a Second and Third Certificate for his models of a Framework Knitting Machine and Shoemaker's Sewing Machine. A Very Highly Commended Certificate was awarded to D. George for his example of Stuart Lathe and

The well finished Class 37 Diesel in 5 inch gauge was the work of M. Lock.

Still under construction, a model of a Burrell Boydell Traction Engine in 1½ scale.

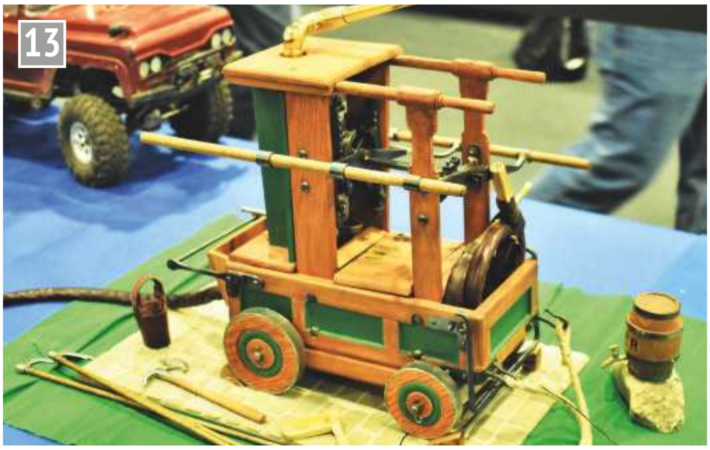
Tom Pasco's award winning 5 cylinder Radial Engine.



J.Brittain's E. T. W. Wyvern Single Cylinder Mill Engine.

The $\frac{1}{10}$ scaled Ulstein gearbox and six cylinder Bergen Engine.

A case of Miniature Knives presented by M. Whittington.



John Clarke's detailed Newsham Fire Engine circa 1721.

An Hour Strike Twin Fusée Skeleton Clock, by Keith Taylor-Nobbs.

Brain Young's model in 1/12 scale of Queen Victoria's Bathing Machine.

Auld George *was awarded the 'Best in Steam' for Alan Phillips.*

The large road layout which was part of the Durham R/C Model Truck club display.

The MSRVS centrepiece was 3 inch scale Burrell road locomotive.

A well built example of a Wallis & Steevens Road Roller.

On the Rotherham & District MES was a well made example of a 7¼ inch gauge Holmside.

a Commended Certificate went to Keith Taylor-Nobbs for his Hour Strike Twin Fusée Skeleton Clock (**photo 14**).

There was just the one entry in Section 44 for Model Boats with C. Behan gaining a Third Certificate for his 1/35 scale model of a German Type 23 U Boat. The final competition Section was 45 for Model Wheelwrights where Brian Young was awarded two Third Certificates for his models in 1/12 scale of Queen Victoria's Bathing Machine and a Yorkshire Plough. The Bathing Machine also won the Guild of Model Wheelwrights' Trophy for Best Model (**photo 15**). There was also an award for the Best Road Vehicle in Steam and this year the Raymond McMahon Trophy was presented to Alan Phillips for his 4½ inch scale Burrell, *Auld George*. (**photo 16**). The winner of the N.A.M.E. Shield for the Best Club Stand display went to the **Durham R/C Model Club** who had a comprehensive working display along with lots of static models on show (**photo 17**).

The displays by the Clubs and Societies really does show off all that is good in the model engineering world; it provides the backbone for all good exhibitions and this one was no exception. Adjacent to the locomotive competition section was the **Model Steam Road Vehicle Society** who had a couple of interesting models on display. The centrepiece was a very nice 3 inch Burrell Road Locomotive (**photo 18**). The model of a Wallis and Steevens Simplicity Roller (**photo 19**) also caught the eye, as did the scaled up version of the traditional Mamod Steam Roller in a scale of 30 inches to 1 foot. The **Sale Area MES** had a good selection of both locomotives and stationary engines to attract visitors and the **Rotherham & District MES** had some very good locomotives on display including a very nice example of a 7¼ inch gauge Holmside by P. Farrar which was a very well finished and presented model (**photo 20**). Adjacent to this display the club hosted a construction demonstration by the **Scamp and Minimal Gauge Railways** group with the aim of building a 7¼ inch 0-4-0 locomotive during the duration of the exhibition. All laser cut parts were bolted and pop riveted together and it was interesting to watch the progress being made. A rolling chassis was certainly completed by late on Saturday (**photo 21**).

Another well filled display was by the **Spenborough SMEE** club who had a wide range of models on show (**photo 22**). **The West Riding Small Locomotive Society** stand included a very nice example of an Aspinall 0-6-0 in 5 inch gauge (**photo 23**) and a well detailed model of a 3½ inch gauge Hunslet which in this gauge is quite a large locomotive. A large presentation by the **Pickering Experimental Engineering & Model Society** (**photo 24**) included a wide range of well made models and equipment. One exhibit that I found interesting was the little test rig for a set of vanes for a displacement supercharger. These revolve with a clearance of less than 0.002 inch over their whole length and the odd shape, which was virtually impossible to machine by conventional means, was completed by using a Wire Eroding machine. This set-up has been tested under power and works very well. In my opinion this is model engineering taken to a new level (**photo 25**).

The **Doncaster Steamers** numbered almost 50 road vehicles in steam during the weekend and a fine sight and sound they made when all gathered together outside (**photo 26**). A certain 4 inch Foster agricultural engine rather drew attention to the ensemble and made sure everyone knew the steamers were out there when it was raising steam (**photo 27**)! There was another comprehensive display by members of the **Bradford MES** with many fine models both under construction and completed for visitors to enjoy, the eight day wall clock by Jim Jennings being typical of the quality of the exhibits on show (**photo 28**).

There are a number of ideas floating about to try and get younger people involved with model engineering. **The National Steam Apprentice Club** provided a good informative display highlighting what young people do and can achieve if they really want to. Staffed by young members, the stand had lots of leaflets and ideas to promote their aims. A good display and selection of locomotives and rolling stock showed off what the **Ground Level 5 Inch Gauge Mainline Association** is about; Steve Clark's Bulk Grain Wagon being typical of the fine models on show (**photo 29**). Last year's club stand winner, the **Hull & District SMEE** again displayed a fine range of models to indicate the different interests within the club. The Lathe Turret Tool Holder by P. Speak looked to be a useful piece of equipment (**photo 30**). A smart display by the **York City & District SME** had the working ⅕ scale Newcomen

A construction demonstration by the Scamp and Minimal Gauge Railways group.

Spenborough SMEE had a wide variety of models on show.

A nice example of an Aspinall 0-6-0 on the West Riding SLS stand.

Part of the extensive display by members of PEEMS.

The high precision vanes for a displacement supercharger.

All lined up and ready to go, part of the large outside group of steam vehicles.

Happy model engineers as this 4 inch Foster raises steam ready for the day's operations.

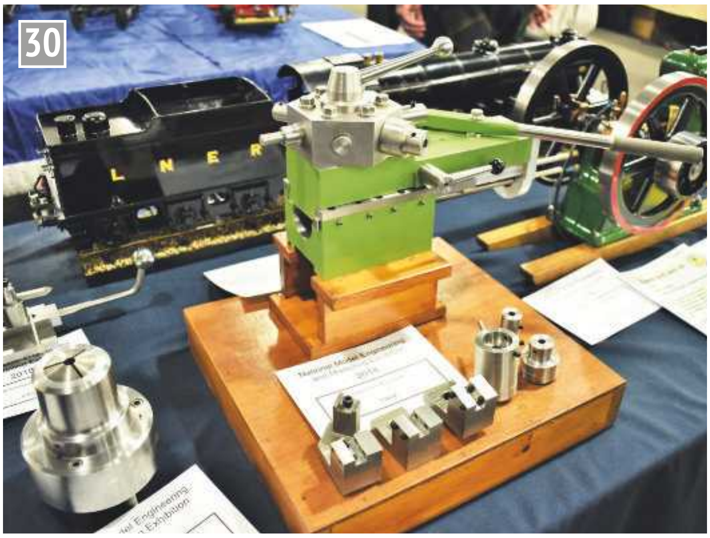
An eight day wall clock by Jim Jennings on the Bradford display.

A fine example of a Bulk Grain Van in 5 inch gauge by Steve Clarke.

>>

Atmospheric Engine built by Richard Gibbon as the centrepiece of their stand along with some excellent locomotives and stationary engines. The Four-Clock Stand was an interesting piece.

A large display by members of the **Society of Model & Experimental Engineers (SMEE)** included a working demonstration of a 3D Printer which always had an attentive crowd studying the workings, as did D.A.G. Brown with his four facet drill sharpening demonstration. Among the fine models on show the Samuel Morey I/C Engine of 1825 vintage was an unusual prototype (**photo 31**).



A lathe turret tool holder displayed on the Hull & District SME stand.

A Samuel Morey I/C Engine of 1825 vintage seen on the SMEE stand.

A feature of this exhibition is the large Gauge 1 railway layout assembled by members of **The Gauge 1 Model Railway Association (G1MRA)** and they provided a full service with a range of locomotives from all the 'Big Four' companies, along with an extensive collection of rolling stock. Both the **Southern Federation and the Northern Association of Model Engineering clubs** displayed a selection of their respective paperwork and information leaflets along with a nice selection of models. There was a good display by members of the **Erewash Valley MES** (**photo 32**) who provided an attractive presentation of a wide range of models including aviation. A number of model boat clubs also provided a great deal of colour and interest to the show with the **Redcar MBC** showing off a wide range of different prototype Lifeboats which enabled visitors to see how these important marine craft have evolved over the years.

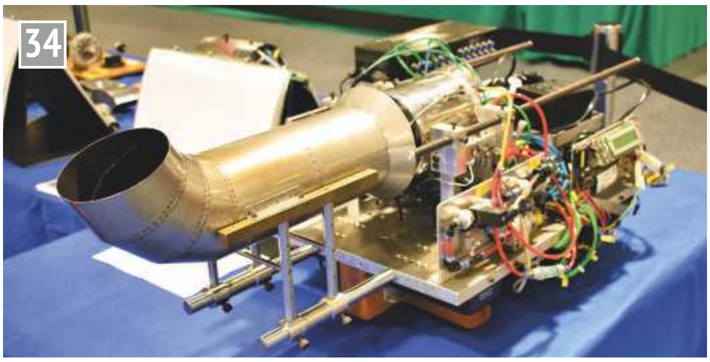
The Erewash Valley MES had an interesting stand.

The upper floor displays contained large presentations by the **Doncaster Model Flying Club, the Stirling Engine Society, the Gas Turbine Builders Association and the Guild of Model Wheelwrights** as well as the **Northumberland Remote Control Vehicle Club**, so there was a great deal to see and enjoy by visitors. The **Doncaster MFC** covered many types of aircraft from old style bi-planes to large multi engine war planes with many variants in between (**photo 33**). The high tech engines produced by **the Gas Turbine** members showed off a large range of prototype engines with very high specifications (**photo 34**). An outside demonstration was also available to show the capability of these machines. **The Stirling Engine Society** had some unusual offerings on show which demonstrated the potential these machines can have in the modern world.

In closing my notes I must mention the splendid presentations also made by the **Scunthorpe Society, Grimsby & Cleethorpes, Chesterfield and the Southport MES**, they were all large displays of excellent model engineering and for me the 5 inch gauge P2 on the Chesterfield stand and illustrated at the head of this article was the outstanding locomotive in the exhibition.

I would like to thank Gavin and Lou Rex for all their hard work in presenting this 25th Anniversary event and thanks are also due to everyone who contributed to a superb exhibition of every aspect of model engineering. It really was appreciated by everyone. Please accept my apologies if I haven't given you a mention; there simply is not enough space to cover everything, but your attendance and contributions really did add to the exhibition. **ME**

Part of the large aircraft display by the Doncaster MFC.

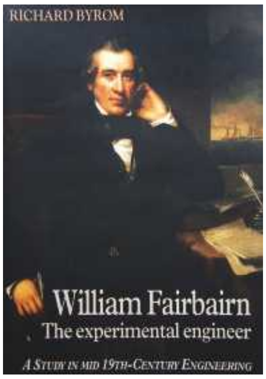


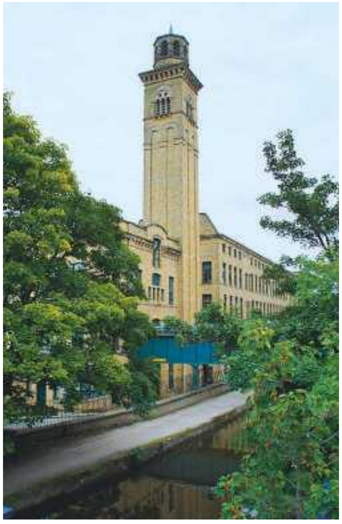
One of the high tech engines from the Gas Turbine Association.

Book Review

William Fairbairn: the Experimental Engineer
A study in mid 19th Century Engineering

By Richard Byrom





Salt's Mill, Saltaire, Bradford. This mill was fully fitted out with engine and shafting; though this has now disappeared the mill remains a fascinating visitor attraction.

Fairbairn type crane on the River Hull (opposite Hull's Streetlife Transport Museum) used ideas from tubular bridge development.

William Fairbairn was one of the of the most versatile nineteenth century engineers. His work included locomotives, bridges, corn milling, shipbuilding, cranes, textile mills and even making the roof of the Royal Albert Hall. His story has been little known but is now illuminated in this thoroughly researched and readable biography.

His was almost a rags to riches story. Of Scottish origins, his first job was delivering coal around a County Durham pit. He became a millwright's apprentice with a thirst for reading and knowledge. After difficulties obtaining London employment due to local millwrights' restrictions he moved to Manchester where he first partnered with James Lillie and then set up his own firm.

Fairbairn made his name with the eponymous waterwheel using a tension wheel approach. Much used for textile mills, one can be seen at Quarry Bank Mill, Styal, now in the care of the National Trust. He developed better rotary corn milling, even exporting mills to Turkey, and made better drives and shafting for large textile mills across Britain and Europe. Salts Mill at Saltaire is a classic example where he supplied all machinery and fittings, though these have now gone.

His firm's venture into shipbuilding at Millwall from 1835-1844 was less successful but he developed an understanding of iron ships as constructed beams which helped later bridge building. He was interested in the strength of material and joints, developing testing equipment and fully justifying his description as an experimental engineer.

This understanding of beams helped him develop Robert Stephenson's ideas for tubular bridges. Though they fell out, there is little doubt that the Conwy and Britannia Bridges would not have been built without Fairbairn's rigorous approach. Knowledge of tube stresses helped the firm develop successful tubular cranes though few now survive. The author even provides evidence that Fairbairn anticipated later understanding of stress in bones as a result of work on crane design.

Like many of Fairbairn's products, tubular bridges and cranes were soon rendered obsolete by advances in lattice girders and crane construction. The same happened with locomotives. Though the firm built around 400 locomotives they were soon overshadowed by others but they made significant developments to the tank locomotive and promoted it extensively. *Folkestone* shown at the 1851 Great Exhibition was a Fairbairn product and the first locomotive be photographed. His firm also built the stationary engine for the Dalkey atmospheric railway.

William took an active part in Manchester life. He encouraged education, took part in the activities of engineering associations and institutions and corresponded with the novelist, Mrs. Gaskell, whose work he enjoyed. Several of his pupils went on to develop engineering businesses abroad including Albert Escher of Switzerland.

The firm seemed highly successful but one son went to India in mysterious circumstances and his son Thomas showed no interest in engineering; he took money out of the business and though he invested wisely in other companies, made no engineering innovations and ceased trading in 1875. Typically, though Fairbairn's had once led in milling machinery, they failed to capitalise on the later shift to roller milling and lost business.

Thomas concentrated on life as a landed gentleman in the south of England and was also an art patron of Pre-Raphaelite painters like Holman Hunt. A Lancashire saying has 'clogs to clogs in three generations' to describe the rise and decline of an industrial family. Fairbairn's managed clogs to clogs in two. The firm's demise was a tragedy but one echoed by many industrial families; a factor that helped fuel Britain's relative industrial decline.

The RCHS is to be congratulated on publishing this excellent work. We need more of this quality to illuminate the people and companies behind Britain's railway and industrial history. I strongly recommend this book.

Roger Backhouse

Railway and Canal Historical Society. 2017. £40 (inc. postage).
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Theasby's Handy Hints'n'Tips

Geoff Theasby is taking a break from Club News this time and instead offers a selection of handy tips for the home and workshop. Club News will be back next time.

I was building an electronic circuit recently and one of the components was becoming rather hot. I added a heatsink to it to reduce the temperature but I had no thermal grease to improve the contact. Researching the matter, I discovered some other items which would serve, ranging from lip balm to Marmite! Cold cream, Zinc oxide (ZnO) ointment (12%) and Germolene (6%) (ZnO is a good conductor of heat) also work well, as does petroleum jelly, mixed to a stiff consistency with ZnO powder. It needs to have a high viscosity, so it doesn't drain away, and I used lip balm. Thermal grease can improve the efficiency of a heatsink. Zinc oxide, also known as Calamine, eases skin itching and is used in brass foundries. Further details can be found online where required.

Petroleum jelly also stops battery terminals from corroding, prevents light bulbs from sticking in their holders and is used in plastic explosive. Hexamine (solid fuel tablets for camping and small boilers) can be used to make said explosive. (My service provider wouldn't let me research this...)

A 50/50 mixture of acetone (nail varnish remover) and automatic transmission fluid (ATF) makes a good penetrating oil. They don't mix, so shake well before use. To derust an item, soak overnight in white vinegar, then spray liberally with WD40 and leave overnight again, then a third night in the acetone/ATF mix. Acetone also removes marker pen ink and cleans off fibreglass resin from hands etc.

Washing soda, a plastic bucket and a battery charger will derust electrolytically.

Vinegar will clean and degrease your spectacle glass and frames. It will also remove stains from the inside of coffee cups. So will bleach, Steradent tablets and Milton. These last two don't smell.

At last! A use for all those redundant cassette tape cases.

Caustic soda and vegetable oil can be used to make biodiesel! A by-product is glycerine, a lubricant.

Vegetable oil - rapeseed has the highest smoke point. Use it to make emergency lighting - a wick in a dish. It is also a lubricant and of use in D.I.Y. dummy loads for transmitters - proper transformer oil is expensive!

Mothballs (camphor) placed in a drawer or cupboard release an anti-rust vapour as good as the dedicated product.

Lighter fluid (naptha) burns without smoke and also removes sticky labels and stains from clothing.

Does your machinery drip oil? Put a small magnet in a fairy-cake case and place it to catch the drips. The magnet makes sure it stays put and is not easily knocked over.

Cola or brown sauce will remove tarnish from nickel and silver plating.

Rub candle wax on drawer slides, zips, locks and keys to stop them sticking.

Washing up liquid will ease a woodscrew that becomes tight before it is fully home.

Find an old cassette box where the lid opens to about 120 degrees. This will hold your smartphone at a convenient angle to keep an eye on (see photo).

A pinch of salt makes your coffee taste nicer, by interfering with the bitter taste receptors on your tongue.

To touch up paint - spray a little of the aerosol into the can lid, then use a small brush.

'Dust bunnies' beneath furniture contain skin cells, hair, carpet fibres and cosmic dust! 40,000 tons of this last falls upon the Earth from space every year so, statistically, and in practice, it collects in fluff. Out with the microscope!

Please avoid using exfoliator/hand cleaner containing plastic microbeads. They are indestructable and get into sea creatures and then us. They are not toxic *per se*, but unnecessary.

A plastic chopping board, cut to a suitable size, makes a good bed protector for your lathe when changing chucks, etc.

For scraping, instead of Engineers' Blue, use your Significant Other's discarded lipstick, or Prussian Blue oil paint, (not acrylic or water-based).

ME

JUNE

20 Chingford DMEC. Talk: 'Stretching a Point'. Contact secretarycdmec @gmail.com.

20 Leeds SMEE. Public running, Eggborough track from 10am. Contact Geoff Shackleton: 01977 798138.

20 Salisbury DMES. Talk: 'The Development of Steam Engines up to the Newcomen Atmospheric Steam Engine of 1712' – Mike Lee. Contact Jonathan Maxwell: 01722 320848.

23 Gravesend MMES. Running day,10am – dusk. Contact John Gibbs: 01622 880652.

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

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

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

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

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

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

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

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

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

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

26 Wigan DMES. Presentation by Malcolm Tranter on 'Going Up in the World – Locks, Lifts and Inclines'. Contact Kevin Grundy: 01942 522303.

28 Sutton MEC. Afternoon Run from noon. Contact Paul Harding 0208 2544749.

28 Worthing & District SME. Club meeting – 'The Life of a Bargee', 7.30pm. Contact Geoff Bashall: 01903 722973.

29 Wigan DMES. Visit from Butterley society. Contact Kevin Grundy: 01942 522303.

30 Romney Marsh MES. Midsummer track meeting, noon with BBQ 1pm. Contact Adrian Parker: 01303 894187.

30 Southampton SME. Traction engine and 3½ inch gauge locomotive running day. Contact David Goyder: 02380 421201.

JULY

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

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

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

1 Northampton SME. Open to the public 2 - 5pm. Contact: secretary@nsme.co.uk 07907 051388.

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

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

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

1 Plymouth Miniature Steam. Public running, Goodwin Park (PL6 6RE), 2 – 4.30pm. Contact Malcolm Preen: 01752 778083.

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

2 Peterborough SME. Bits & Pieces, 7.30pm. Contact Terry Midgley: 01733 348385.

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

4 Bradford MES. Steerage competition, 7.30pm start, Wibsey Park. Contact Russ Coppin: 07815 048999.

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

5 Sutton MEC. Bits and Pieces. Contact Paul Harding 0208 2544749.

6 North London SME. BBQ at Colney Heath. Contact Ian Johnston: 0208 4490693.

6 Rochdale SMEE. Annual Model Running Night, at Springfield Park, 7.30pm. Contact Rod Hartley 07801 705193.

7 Lancaster & Morecambe MES. Open day at Cinderbarrow. Contact David Wilson: 07721 020489

7 Tiverton & District MES. Running day and summer BBQ at Rackenford track. Contact Bob Evenett: 01884 252691.

7 West Huntspill MES. Ladies' afternoon, 2.30-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

7/8 Guildford MES. Stoke Park Railway Gala Weekend 10am-5pm. Contact Mike Sleigh: pr@gmes.org.uk

7/8 North Wiltshire MES. Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

8 Bracknell Railway Society. Public running 2-4.30pm. Contact Paul Archer: 07543 679256.

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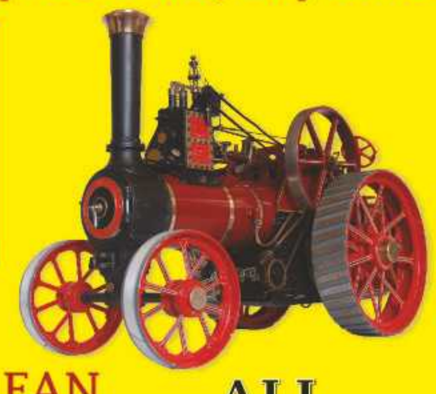

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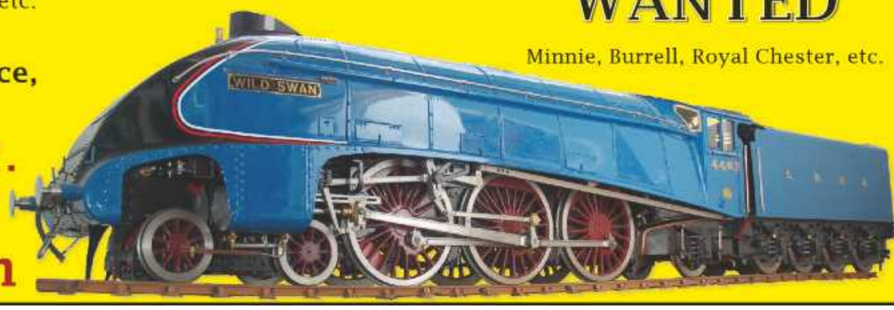

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