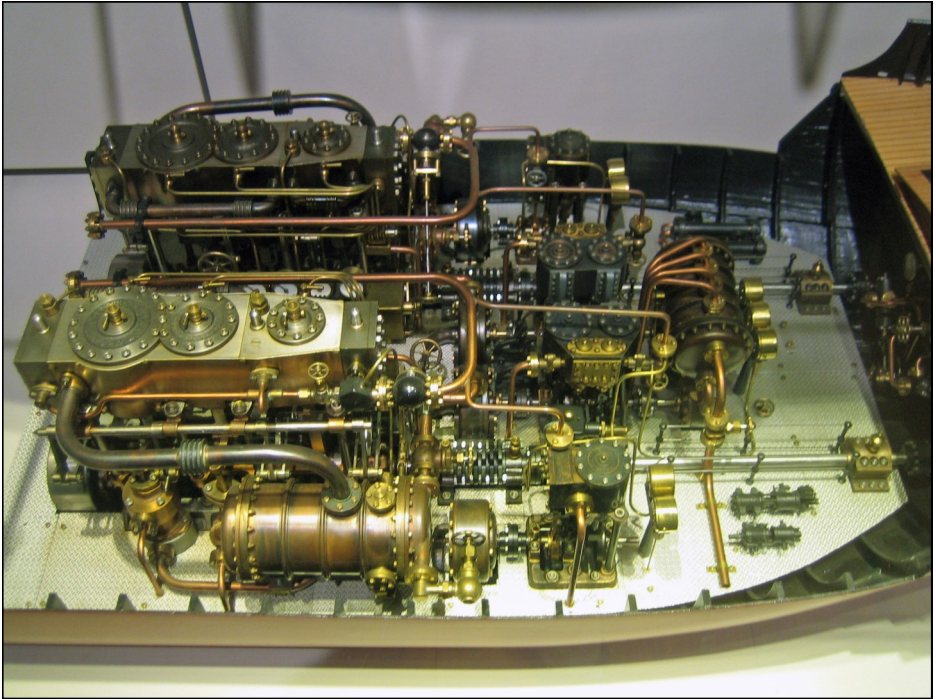




The Journal

The Society of Model and
Experimental Engineers



Hearth Hound

Steam boating

Why on earth ...?

The Apsley piddler - part 2

Re-designing a gas burner - part 2

Decorative heat bluing of steels - part 3

The mono-tube steam generator - part 1

Your *Journal* depends on your contributions

We look forward to receiving articles for inclusion in *The Journal* from you, the members of SMEE. Articles should be relevant to model or experimental engineering, and may be news items, technical articles, small ads, hints and tips, lessons learnt or any other topic likely to amuse, educate or enthuse your fellow members.

The Journal is produced on a personal computer using desktop publishing software. We are pleased to receive articles in almost any format - from word processed documents sent by e-mail to typed papers or even hand written articles sent by post.

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Drawings, figures and photographs are the most common cause of problems for editors. Paper artwork is straightforward - just post it to us and we will scan it and return it to you if required. Computer files, however, can be tricky. If you have created images using software, please get in touch to discuss the best format to send it to us. Above all, please *do not* embed images in Word documents unless you also supply them as separate files. Digital cameras should be set to normal resolution and lowest compression.

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- Do confirm the spelling of unusual names, words or terms.
- Do include your name and contact details - especially a phone number.
- Do let us know if you want photographs or other illustrations returned to you.
- Don't worry if you are not an experienced writer - our team will happily help you in any way we can.
- Don't be offended if your article is edited - we try to retain as much as possible of the original look and feel of submitted work but corrections and amendments are an inevitable part of the editorial process, along with layout.

Editorial Team

or

Mike Tilby - Editor.

Norman Billingham and Mike Chrisp - article editing and final proof reading.

Mike Chrisp - Work on the Table; Graham Astbury - proof reading.

Alan Wragg - initial proof reading.

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The Journal

The Society of Model & Experimental Engineers

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Front cover image: Working model (1:25) of the machinery of a powerful ocean-going tug from about 1900. The model, in the International Maritime Museum, Hamburg, was made by Herr Karl-Friedrich Pohlmann. It includes two triple expansion propulsion engines, two compound engines powering centrifugal water circulating pumps for the condensers and two single cylinder engines that drive electric generators.

Photo: Mike Tilby

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The Chairman's report to the 124th AGM

Welcome to everyone present and our on-line Zoom audience.

As I said this time last year, SMEE is in a transitional period. Most of our new members are coming from IT backgrounds while many of the longer standing members that have the engineering skills learned as apprentices are taking a back seat and putting their feet up. Sadly some of them have gone to that great workshop in the sky and we miss them. This leaves us with critical skills shortages when it comes to instructors on the SMEE training courses. Council decided to not run any courses this year, but it is hoped that they can restart next year in a slightly different format. As you will hear later during the Treasurer's report, training was a source of revenue for the Society which paid for much of the IT equipment and our new defibrillator.

We are attracting younger members, mainly from the Makerspace movement. We are also benefiting from publicity in the model engineering press (thank you Martin Kyte), which has resulted in a number of new members, one of whom lives in Australia. Our website is also an attraction as is word of mouth from existing members. However, overall, our membership is declining year on year and the SMEE Council are currently putting a plan together to address this problem. High inflation and lack of model engineering shows have been a major factor in the decline. We still desperately need new people to come forward to be the future officers of the Society. Our aim is for folk to start training for these roles by shadowing the incumbents. For instance, our treasurer David Taylor has been in the position for over three decades and, believe it or not, he is not getting any younger. It's the same story with all of the other officers of the Society. They have all given their time voluntarily, but their future replacements should be in place for when the officer wishes to step down. If you enjoy the benefits of the Society, and clearly you do or you would not be here, start asking yourself "*how can I help SMEE to have a future?*". Speak to any of the Council members, or better still, ask to come along as a guest to a council meeting to see what is involved.

We can however, look back at the past year and be proud of our achievements. Our 125th anniversary year saw two main events, the summer cruise on a steam launch (built in 1898 of course) and a major celebration of our anniversary at the Midlands Show last October. Our huge stand was well thought out and was very busy for the entire show. We even had a visit from model engineering royalty in the person of Cherry Hill with some of her exquisite models alongside the Duke of Edinburgh trophy that she had won no less than nine times. Our grateful thanks go to the teams that put these events together for us all to enjoy.

We have also enjoyed some exceptional visits and lectures during the past year and I think that everyone that has attended has been impressed with the quality. The programme team are working hard to make SMEE an enjoyable and educational place to be and long



Allen Berman

may it be so. The SMEE lectures are now so well attended that the Kemsley Room is usually full and we also regularly have 40 to 50 members on-line via Zoom who are able to be interactive with the speaker during question time at the end of the talk, so please give a wave to the person manning the Zoom desk, Lex Robinson. In addition to Lex, we have:

- Workshop team led by Andy Tidman.
- Engine Builders Group led by John Fry, Elliot Hirst and Charles Hirst.
- Digital Group and SMEE website led by Brian Neale.
- Stationary Engine Committee led by Peter Haycock.
- Library maintenance led by Rachele Christgau and Jonathan Tickner.
- Journal production team and contributors led by Mike Tilby.
- Exhibition Teams led by Ralph Thompson, Elliot Hirst and Jonathan Tickner.
- SMEE Rummage sales led by David Taylor, Alan Wragg and Peter Wardropper.
- Membership Secretary Alan Wragg.
- Programme team led by Elliot Hirst.

I would also like to thank the outgoing Directors Steve Bil, Andy Tidman and the outgoing Stationary Engine Committee Chair, Peter Haycock. As you can see, Norman Billingham is kindly standing in for our secretary Richard Stonor while he is away in Australia.

At the end of this AGM, I have one more duty to perform as the Society Chairman. That is to say “*Thank you*” to the outgoing directors and department heads on the Council, for all of their hard work. I will then warmly welcome the newly elected Councillors to the meeting. Finally, I will formally resign as SMEE Chairman and it will then be up to Council to elect a new Chairman for the next two years.

It is not the end of the story for me though. I joined SMEE in 2008 by signing up for the Polly Course at Ally Pally. I never dreamed that one day I would be Chairman of such a distinguished and well respected Society. I thank everyone for their support over the years and look forward to my new role as chairman of the Stationary Engine Committee looking after the Society’s fantastic collection of fine models and artefacts. I will also be responsible for the Kemsley Room including its displays, IT infrastructure and keeping the room clutter free. Watch this space!

And finally, I thank the SMEE Council for holding everything together. As I did last year, I would like to especially thank the SMEE Secretary Richard Stonor and our long suffering Treasurer David Taylor.

My very best regards to all SMEE members, wherever you are in the World.

Allen Berman, April 2024

SMEE

View from the new chair

I am honoured and daunted by the confidence shown by SMEE Council in electing me as Chairman for the next two years. I hope I can successfully fill the role, taking the Society forward and continuing Percival Marshall's vision as we reach the end of the first quarter of the 21st century.

I must start by complimenting and thanking my recent predecessors; they have steered us through a very difficult period since the financial crisis some 15 years ago. Recession, austerity, populism, Brexit, the growth of social media and many other social changes have dealt blows to traditional hobbies and interests such as ours. Covid brought the darkest period. But the Society and its leaders reacted well; we are still very much here.

Following the AGM, we have some changes in Council membership and roles. Although Andy Tidman retires as a Director, he will continue to be a member of Council through his role as Workshop Chairman. The workshop plays a core role in our history and values. He has a demanding task, and I am thankful he will continue in the role. He has a good team with him.

As previously announced, in stepping down from the Chairman's role, Allen Berman has taken over the Chairmanship of the Stationary Engine Group replacing Peter Haycock. Peter and the team have done an outstanding job getting our historic collection into a good state of repair and catalogued. Recognising Peter's considerable contributions to the Society in this and so many other ways, Council invited him to be a Vice President and he has accepted.

Steve Bil retires from Council. He has made many significant contributions during his two terms. For me the most notable is his contribution to last year's very successful 125th Anniversary Cruise. In addition to sorting the arrangements with French Brothers, he also provided hospitality and parking at a convenient location for the trip. He is currently working on plans for a Summer Gathering on 24 August at his boatyard in Windsor. Details to follow.

Our new directors are Charles Hirst and Mitch Barnes. Charles has been a cornerstone for the Engine Builders Group over the last three years and a major contributor to our training programme. Mitch probably needs no introduction. He has been a director in the past, with a wide range of contributions to activities; most recently hosting 'Work on the Table'.

I should perhaps introduce myself. I am a relative newcomer and probably the least skilled model engineer to ever hold this post. However, I do have an engineering background. Born and brought up in Leeds, I studied mechanical engineering and went on to a graduate apprenticeship at Leyland Trucks in the early 70s. My career path took me into production engineering and project management. With the help of skilled production engineers, I ran a variety of projects mainly focused on the production of diesel engines for trucks; some of what they knew may have 'rubbed off' on me! Later I moved into factory management running operations at Self-Changing Gears, Lotus Cars, and GEC-Avery. I spent my last 20 years mainly in manufacturing consulting with IBM, enjoying



Elliot Hirst

work in the UK, US and Europe with clients as diverse as BAE Submarines, Philips, Credit Suisse and Dr Pepper-7Up.

On retiring, I decided I wanted to take up model engineering and joined SMEE, mainly for the training courses which were an excellent introduction for someone with lots of theory but little practical experience. I had no thoughts of taking a significant role in SMEE or joining Council. Working with John Fry and Charles Hirst (who is no relation!) to run the Engine Builders Group led to me taking over from Norman Billingham as Programme Secretary and now Chairman.

Hopefully, I bring to SMEE some skills to help us shape our future. Over the last ten years our membership has declined from 477 in 2014 to 317 in October last year. Other model engineering societies have seen similar declines. This trend is not unique, clubs and societies in other interest areas are in the same position and it is easy to be pessimistic. However, others do buck the trend. There are model engineering societies that are thriving, and dealers are finding people from non-engineering backgrounds who want to make things using lathes and mills. New creatives are appearing in parallel with the Makerspace activities and great interest in 3D printing and CNC machinery. Gauge 1 and 16mm railway activities are reportedly growing. It is my view that we are not doomed. If we broaden our appeal and make ourselves more visible, I see no reason why we cannot thrive and grow. As part of finding out how well we are doing, Charles and Mitch have volunteered to contact a sample of members and collect feedback. Please help if you can and feel free to contact them or me if you have views to share. I shall try my best to make the right things happen and I shall report our progress, or lack of it (!), as we go..

Elliot

PS: Members who are readers of *Model Engineer* may not have noted that Duncan Webster has been shortlisted for the Bradford Cup for his articles *Radial Valve Gears Again*. The cup is awarded for the best article published in the magazine in the last year. If you want to vote for him you should write to

. He has my vote.

E.

SMEE

Council matters for March/April 2024

Stationary Engine Committee

Peter Haycock has decided to stand down from the role of Committee Chairman and Allen Berman will replace him. Peter was thanked by Council for his efforts leading the team which has done an excellent job in carrying out repairs to our extensive collection and making an accurate catalogue. In recognition of his efforts with the Committee, and his major contributions to the training programme and other activities, Peter was invited to become a Vice President. Council is delighted he has accepted and looks forward to his continued contributions.

The SEC is also planning to tidy up the Kemsley Room and refresh the exhibits.



Health & Safety

It was noted that one of the steps on the flight to the workshop was worn and could be a hazard. This is to be repaired asap and aluminium front edgings will be fitted.

Membership

The following were elected as Members at the Council meetings on 6 April and 4 May:

Neil Curtis, Monmouth, Gwent. He's been interested in model engineering for some time but it's only with his retirement that he's had the opportunity to set up a workshop and start making a Stuart beam engine.

Andrew Heydenrych, Johannesburg, South Africa. His father was a model engineer so he grew up in a workshop environment. When he was in high school he started his first locomotive and has been a model engineer ever since. His main interest is locomotive models but recently he's been considering a Clayton undertype steam lorry.

Stuart Buck, Tricht Netherlands.

Sodiq Ogunwolu, Stevenage, Hertfordshire. He's an engineer already working in the manufacturing industry. He wants to build up more skills around the use of machine tools such as lathe and milling machine. Also, he would like to build up skills in welding.

Deborah Lock, Norbury, Greater London. Limited experience.

Barbara Reeve, Redditch, Worcestershire. Her experience with engineering is that *"for the last 50 years plus I have trailed round engineering shows and bought bits and bobs for Robert's birthday presents"*. She has helped out for the last two years on the SMEE stand at The Midlands Model Engineering Exhibition. She has also attended Marshal House and vacuumed the floor, made the tea and stood in for the Fire Marshal!

Martin Allen, Hungarton, Leicestershire. His interest is that he has a steamboat on the Thames.

Lachlan Tomlin, London, NW6. He's not a model engineer but has worked in workshops for many years making a broad range of parts, from art sculptures to racing cars. He says perhaps he is more of an experimental engineer. His preference is using CNC machinery, but has some experience with manual machines. He had a home workshop in Australia. However he sold everything when they migrated to the UK in 2015 and now doesn't have ready access to a workshop. He's keen to learn more about grinding, tool and cutter grinding, surface grinding and if a machine were to be found - cylindrical grinding. EDM die sinking and wire cutting are also of interest. His upcoming project is to design and build a novel bicycle drivetrain.

Chris Taylor, Llanidloes, Powys. An armchair model engineer for decades. He has constructed one Stuart Turner engine.

Tripp Yeoman, London, SW6. He is primarily interested in the building, maintaining, and restoration of machines, jigs, and fixtures - making things that make things. He had fond experiences machining with his grandfather, though most of his experience is building 3D printers. He is interested to learn more about and participate in precision machining, casting/metallurgy, and the maintenance/restoration of vintage machinery.

We look forward to welcoming them to Marshall House and online.

Publicity

Martin Kyte was complimented and thanked for writing articles about the Society for inclusion in *Model Engineer*. It was noted that a number of new members had mentioned seeing these articles in their applications.

Training

In the past, our training courses, particularly *Polly*, have been a source for both new members and income. It is proposed to refresh and relaunch the training programme targeting people who want more than YouTube and books provide. A working group will be formed to develop a new offering that can be delivered in 2025. Members who may be interested in helping with this will be invited to get involved.

Commercial adverts in *The Journal*

Following an enquiry from a well-known firm of auctioneers, it was agreed that adverts for auctions, equipment and materials relevant to our hobby could be included at the discretion of the editor. The number of pages would be limited to a maximum of four.

Volunteers

Three volunteers have come forward to take on activities. Over coming months, Nick Lock will take over the role of Membership Secretary from Alan Wragg, and Deborah Lock and Keith Fox have offered to help David Taylor, our Treasurer, to modernise some of our banking and financial activities.

We are still looking for volunteers to assist with the Programme Secretary role, House Committee activities, Web Administration and the Engine Builders Group.

SMEE

Correspondence

(Please send items for Correspondence to [Correspondence@smee.org.uk](#))

Computer woes

Dear Editor, Neil Read (*Correspondence*, April 2024) is perfectly right to consider our rush to total dependency on computer technologies to be a source of wonder. Whilst I don't want this letter to be one of those 'the young of today' rants, it amazes me to watch people in public places engaging with apparently pointless tasks involving colour matching or tiny snippets of dance videos on their sophisticated devices.

Like many of us in SMEE, I have worked with computers most of my life. It is often a frustrating experience. All I ever wanted to do was use them as a tool, but those around me endlessly compared game scores or internal specs. One of my more savvy customers had a sticker on his computer - "*Pentium Inside... Idiot Outside*".

I always likened it to the practice of having the entire contents of your car's engine bay listed on the back of the vehicle for everyone to enjoy reading while they sat in the same



traffic queue as you breathing the fumes produced by your ‘Twin OHC 16V Turbo GTLX Ghia HiLine Auto’ or whatever.

And now I observe my grandchildren, alone in their rooms, curtains drawn on a sunny day to better see the screen, while they ‘Like’ or ‘Swipe Right’ the offerings of a ‘Content Creator’ who appears to be unqualified to do anything actually useful. Asking them what they want to do when they grow up produces a puzzled look. They have no interest in learning anything, technical or artistic. Not even becoming a content creator. I wonder who will be able to spot the faulty Post Office software of the future?

OK, so this did turn into a ‘the young of today’ rant.

Gareth Hughes,

SMEE

Missing from the library

We have noticed that the library copy of *Model Engineer*, Volume 86 part 1, from 1942 has gone missing and there is no sign of it having been signed out. As we have complete sets of copies of *Model Engineer* from volume 1 to the current day, it would be great to get it back.

If you’ve still got it, could you please contact Jonathan Tickner on

Alasdair Milne’s Bronze Medal

Alasdair says that the experience of giving his presentation at Marshall House left him feeling a bit punch drunk and as a result he left the Bronze Medal he had just received in the room. He would be most grateful if he could be reunited with it. He can be contacted at:

Special Offer from *Model Engineer* and *Model Engineers’ Workshop*

Mortons, the publisher of *ME* and *MEW* have an offer on subscriptions to the magazines for members of SMEE.

Go to the following to find more information: www.classicmagazines.co.uk/me014

Visit to West Dean College in July

If you are interested in visiting West Dean College you should contact Norman Billingham - see his notice on page 42.



John Emmett enjoying a trip on the River Avon at Evesham last year in his steam launch Snipe.

These days model boats are not so well represented in model engineering publications as they were in earlier issues of *Model Engineer*. Similarly, although model engineering publications sometimes feature fairly large model railway locomotives and traction engines, examples of steam-powered passenger-carrying boats rarely get mentioned, despite the fact that suitable steam plants and boats can be made in many home workshops. An appealing aspect of steam boating is that, in contrast to traction engines or locomotives, a steam launch can provide a way of combining the hobby of home-workshop engineering with (hopefully) relaxing excursions involving family and friends, without getting their clothes dirty.

A potentially very expensive part of constructing any large scale locomotive, traction engine or boat is the boiler which may have to be built professionally. Steam boats have the advantage of being well-suited to the use of mono-tube boilers (steam generators) which are far easier to make to a satisfactory quality at home than are traditional boilers.

Starting in this issue of *The Journal* we include a series of articles written by Pete Cuthbert and Society member John Emmett that illustrate this other world of home workshop experimental engineering. It also describes some interesting aspects of the history, design and control of mono-tube boilers which could be useful for non-boating projects.

The Steam Boat Association of Great Britain caters for boats from canoe-size upwards:

<https://www.steamboatassociation.co.uk/>

SMEE

The mono-tube steam generator - Part 1

Pete Cuthbert and John Emmett

describe its history and its current use in small launches.*

Historical introduction

Accounts of early mono-tube boilers seem to start with Jacob Perkins who was born in 1766. The Baker Perkins Historical Society (**Ref. 2**) report that the Perkins family were a US/UK dynasty with similar, but wider, industrial interests to the later Herreshoffs (see below). One obsession of Jacob Perkins (and later of his grandson Loftus), was the use of high-pressure steam and the uniflow engine which he had patented in 1827 (See **Fig. 1**).

The Baker Perkins Historical Society (Ref. 2) report a contemporary account by a gentleman called Augustus Muir: *"The generator, as he called the boiler, was the crucial part of his engine. A cylinder of 3-inch thick gunmetal, closed at both ends, was fixed in the furnace so that the fire played all around it. Operated by the engine itself, bellows boosted up the heat of the fire until the generator reached a temperature of 450 degrees F., and the super heated water was forced into a pipe, where it flashed into high-pressure steam and exploded at 500 pounds to the square inch into the working cylinder. At 200 strokes a*

minute, the engine was reckoned

to develop 10-horse power. To keep the pipe joints steam tight, Perkins invented the double-cone pipe joint."

Other accounts describe a matrix of cast iron square section tubes joined outside the fire. Later, the Perkins boilers used the same form of horizontal straight tube matrix but now with vertical link tubes and water gauges (See **Fig. 2**). Clearly this design is not a mono tube as currently understood but is a very different technology to fire tube boilers which were widely used at the time.

By the 1870s the Herreshoff type of coil boiler became popular, as a result largely of steam boat boiler explosions on the US rivers. The first advertisement for these from 1873 is shown in **Fig 3**. Note that this is in the name of the blind John B Herreshoff (1841-1915) and not his brother



Pete Cuthbert



John Emmett

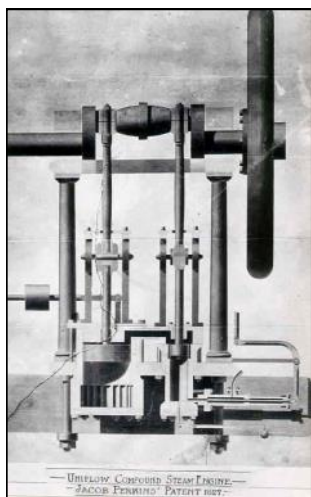


Fig. 1. Perkins compound uniflow engine 1827 (Source: Baker Perkins Historical Society, Ref. 1).

*This article is based on one that was previously published in *Funnel* (**Ref. 1**) which is the journal of The Steamboat Association of Great Britain.

<https://www.steamboatassociation.co.uk/>

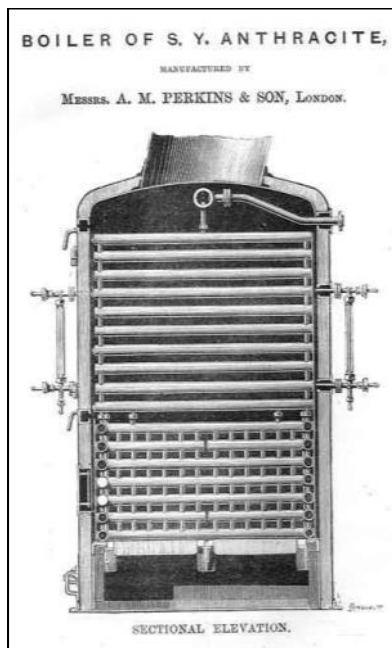


Fig. 2. The Perkins type boiler.

Herreshoff Manufacturing Co.,

BUILDERS,

BRISTOL, RHODE ISLAND,

SOLE MANUFACTURERS OF THE

Herreshoff Patent Safety Coil Boiler.

These Boilers are particularly adapted for Marine, Steam Fire Engines and Agricultural use. Can be used to advantage in all places where steam power is required.

DIRECTIONS FOR USE.

These Boilers should have a feed water pump that can be relied upon to deliver a steady supply of water which can be regulated by the operator. When soft water is used one-fourth of the amount pumped in should be carried over to the separator, so that all minerals may be carried off in a weak solution. In no case should the steam be super heated before entering the separator.

- A.—Air space.
- B.—Blow off pipe from separator.
- C.—Separator.
- D.—Cold water supply from pump.
- E.—Water gauge.
- F.—Feed water heater.
- G.—Feed water pipe from engine.
- H.—Exhaust from engine.
- I.—Steam pipe.

In using soft water be careful to feed more water than is evaporated in coil, otherwise salt crystals will be formed and might obstruct the action of steam. In low end of coil, when a separator would also place, engine the former one designed so that enough water could be pumped in to displace salt crystals. This coil can always be repaired by lowering with right and left couplings a new piece of pipe, or in some cases a short run can be used.

If the coil is found to be full of water in the boiler. When there is sufficient time to generate steam, pump with hand pump enough water to keep the engine in motion until a supply can be had from the engine pump. Then pump hand coil water in over at the water gauge. Then graduate the supply of water so that the proper amount will pass through the coil in the engine compartment. Keep the lower oil valve slightly open so that the water level can be lowered in the separator by the glass gauge. It is preferable to keep the flow of valve open for a short interval when the water is first put into the coil, for if the water should be contained the highly superheated steam would be injurious to engine and hose connection. Feed water should be regulated as soon as possible after the boiler is in operation, after which it is only necessary to regulate the flow of steam to carry off the residue of water from the separator. If these valves are not closed off there will be no trouble for engine to work the Herreshoff Patent Safety Coil Boiler.

JOHN B. HERRESHOFF, Agent,
BRISTOL, R. I.

Fig. 3. The Herreshoff mono-tube coil boiler.

Nathanael Herreshoff (1848-1938), the boat designer. To compound matters, an older brother, James Herreshoff (1834-1930), is named in the boiler Patent. He was a well known chemist. (See Ref. 3)

The iron tubing of that period still had to be hammer welded into a continuous coil, and that seems to have been the weakness of the design. So much so that in 1885 Herreshoff changed to using a square pattern boiler with screwed joints and straight tubes. However, over ten years they built no less than 86 boats using the earlier coil boiler, not counting those boilers that were built under licence. Clearly the boiler was not the failure it is sometimes painted.

Practical small mono-tube boilers for launches

The scaling down (or up) of any successful boiler is difficult. Areas change as the square of the linear scale, and volumes (and hence weights) as the cube. The smaller the boiler the shorter the time constants will be, leading to unstable steam delivery and ‘fussy’ firing demands.

There are fixed size limitations too, as the minimum fire door size in launch applications is about 125 mm × 100 mm and, with solid fuels, space for stoking must be provided around the boiler to allow human size firing tools to be used. This is a particular problem in small canoes or launches where the user has to reach over the engine in order to fire, as

well as needing visibility into the fire bed.

For an example, consider the Herreshoff torpedo boats that were supplied to the British Admiralty in 1878 and whose performance was reported on by Maw in 1888 (**Ref. 4**). Those boats had coil boilers that were 56 in. outside diameter by 65 in. height to the funnel base, and had 12.5 sq. ft. of grate. The heating surface consisted entirely of 300 feet of lap-welded wrought iron pipe of about two inches diameter in a double beehive coil. Boiler weight was two tonnes, and under fairly forced conditions, the compound engine could produce 150 SHP at 150 psig, burning 600 lb of coal per hour.

For launch use, working on a nominal $\frac{1}{4}$ scale version of that specification, it might be expected to get nearly down to the scale weight of 60 lbs (27 kg) using thin modern materials such as stainless steel. That would also provide around ten square feet (0.9 sq m) of heating surface and a one shaft horsepower (0.75 kW) engine would seem to be a fair design target. Proportionately that would be burning up to 8 lb (4 kg) of solid fuel per hour.

Separator

The Herreshoff Patent importantly realised that the stable way to operate the boiler was to use an excess of feed water, and separate the steam from the excess water externally. Notice that the drain valve is not at the bottom of the separator vessel in Fig 3, as that is where scale accumulates. Otherwise, a separator provides a convenient manifold for mounting all the boiler outlet fittings.

Feed

Yet again, on the subject of water feed, Herreshoff's 1873 Patent was spot on in specifying that reliable and regulated feed water is needed. That effectively rules out main engine driven feed pumps. Ideally any solid fuel boiler installation should be able to operate continuously in a stand alone manner without recourse to engine pumps. With a conventional boiler an injector is all that might be required to fulfil this but with the continuous feed needed for a mono-tube, a reliable donkey pump would be required. Fortunately, a rough calculation of the power required to feed this one shaft horsepower boiler, shows that around one watt of mechanical effort is all that is needed. Thus a simple battery operated electric plunger pump should be sufficient. Alternatively, a Weir type donkey pump could be run off the drain valve line.

Mono-tube boilers and the SBA

The Steamboat Association of Great Britain (SBA) is an organisation which prides itself on the breadth of expertise of its members and the variety of the vessels that they run. Given the possibility of scaling down mono-tube boilers to launch size as is suggested above, it comes as a considerable surprise to find that a quick search of the Register of Steamboats yields only five boats that are listed as having a mono-tube steam generator.

That seems unusual as analysis of the Association's journal, *Funnel*, shows that at least twenty articles on such technology have been published in the fifty years since the club was started. However, not all of those articles have extolled the virtues of the mono-tube

steam generator. For example, in 2020 Guild (Ref. 5) suggested “*We had one fitted in our small open launch Breezo for several years which was consistently unsuccessful...*”. A lack of enthusiasm was also reported by Lee (Ref. 6) who stated “*it was difficult to control the steam pressure, the burner was far too noisy and my conclusions were that the flash steam (sic) boiler was not a practical steam plant as one had to spend too much time concentrating on how to operate it.*” Watkins (Ref. 7) rather sat on the fence suggesting that “*one cannot recommend them for a launch, although I would not mind trying one myself*”. Blackstaff (Ref. 8) also warns that “*the scale coming off the tubes and any impurities in the water all had to come out with the steam and go through the engine.*”

Perhaps it would be sensible to take a step back and define what is meant by the term ‘mono-tube steam generator’. Watkins (Ref. 7) suggested that “*in this context I mean coil boilers, i.e. those which contain a considerable proportion of water filled content, not the flash type in which the water is instantly evaporated by the residual heat of black hot tubes.*” Thus we have an important distinction in that mono-tube steam generators are not ‘flash steam’ boilers of the type first introduced by Perkins. Sadly not all SBA members are aware of that important technical distinction as Guild (Ref. 5) still describes his mono-tube boiler as “*Flash steam*”.

‘Flash steam’ boilers were popular with the model boat racing fraternity and were outlined in some details in 1949 by Westbury (Ref. 9). From the data provided by Westbury these designs should perhaps also be called mono-tube steam generators rather than flash boilers. Their designs usually consisted of a large burner and a small coil for the water. These designs have been labelled ‘under fed’ as little water goes in and only steam comes out. The mono-tube steam generator, as Watkins (Ref. 7) pointed out, is generally ‘over fed’ in that the feed pump can shift more water than is needed and in some designs both steam and water comes out at the other end. This has the advantage that scale can be washed through and collected in the separator, rather than passing to the engine.

Watkins (Ref. 7) goes on to suggest that the design of steam car builder White “... was the best since it had a good reserve as well as high evaporative capacity, and many gave good long service.” He also suggested that “*The Stone vapor coil generator is a very successful late development, ... Extensively used ashore and afloat, it has proved itself in hundreds of installations, wherever a compact and responsive steam supply is needed.*”

The technology of the launch sized mono-tube steam generator is clearly explained by Wall (1978). His boiler (Fig. 4) comprised $\frac{1}{4}$ in. steam pipe wound into a two tier coil.

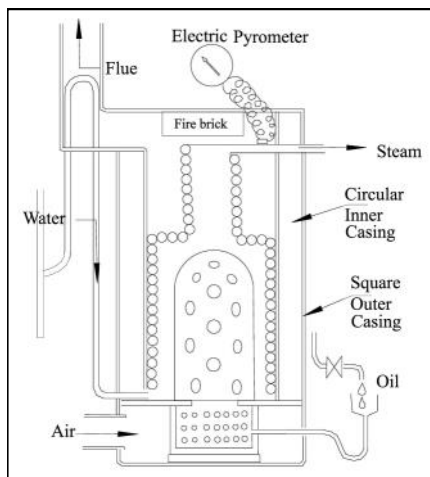


Fig. 4. George Wall's vertical mono-tube steam generator. (Ref.10).'

The lower coil was intended to boil the water while the upper coil was intended to dry the resulting ‘wet’ steam. The water supply was provided by an engine driven pump that supplied about twice the likely requirement. The excess was diverted away by a solenoid driven valve whose frequency could be manually adjusted. The key control instrument was an electronic pyrometer on the outlet steam pipe. Adjusting the water supply affects the temperature of the outgoing steam which is shown by the pyrometer. The boiler was heated by a pot burner using a paraffin and waste oil mixture. (See Fig. 4).

A design that was similar in many ways to Wall’s was explained by Mounster in 1986 in his articles *Development of a Modern Steam Boat*. (Refs. 11 and 12). He pointed out that the principal control issue with a mono-tube steam generator is to control the water flow so that just the right amount of water goes into the tube.

“Too much [water] and the boiler primes, too little and it runs out of steam and overheats”. In Wall’s design the control system is the engineer who keeps an eye on the pyrometer reading and adjusts the pump by-pass accordingly. Mounster proposed making that process automatic by using an electronic control system that monitors steam temperature and adjusts a variable stroke pump accordingly.

Unlike Wall, Mounster’s coils (**Fig. 5**) are arranged so that the inner coils, closest to the fire, will carry the steam while the outer coils in the cooling flue gas will carry the incoming water. The boiler is also made up of three different sizes of stainless steel tube, $\frac{5}{8}$ in. maximum at the superheater, reducing to $\frac{1}{2}$ in. and $\frac{3}{8}$ in. in the evaporative area and $\frac{5}{16}$ in. in the economiser”. This approach makes for a rather less tall design which is advantageous for boat use. The overall appearance is similar to a traditional vertical launch boiler with a cylindrical casing. The coils sit on top of the fire box which is designed for wood burning rather than oil as used by Wall. The firebox is insulated with ‘Fibrefrax’ plus an inner stainless steel lining to protect the insulation from abrasion.

At this point it is perhaps sensible to take the focus somewhat away from the boiler itself and consider the whole plant of the steam launch. Emmett (**Ref. 13**) usefully points out

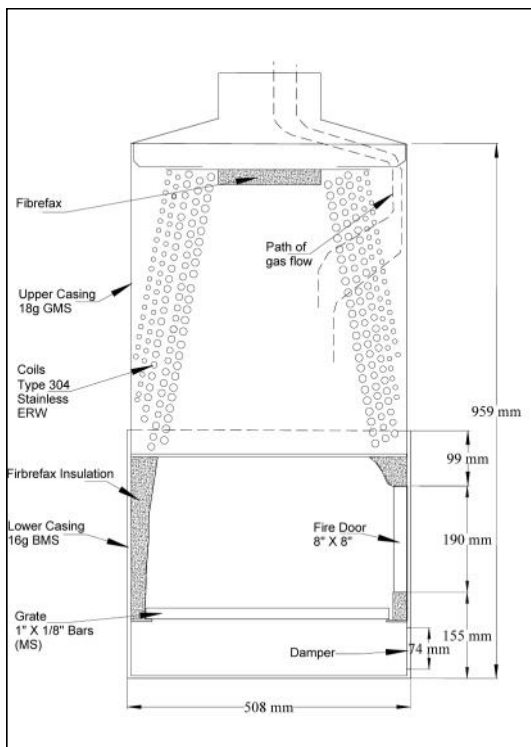


Fig. 5. Wally Mounster's design. (Ref. 11).

that “the engine, pump and boiler combination form a self-regulating steam-motor, whereas a conventional boiler is (or should be) self contained and can feed water, control fire and vent excess energy independently of the engine.” Thus the potential user needs to remember that once started the boiler/engine combination cannot be easily stopped and ‘parked’ as might be the case with a conventional boiler. Thus a clutch mechanism to allow the engine to continue consuming steam when the vessel is stopped is highly desirable. Alternatively, the steam can be diverted straight to the condenser while the engine is stopped plus an independent feed pump to maintain the flow of water to the coil. Emmett (Ref. 13) also suggests that mono-tube steam generators “have one awkward characteristic in that they are only stable when being underfed or overfed with water. Feeding just the right quantity of water for the heat input is impossible due to input/output delay and negative resistance characteristics. ... Overfed boilers ... need a steam separator on the output. Neither system is as simple as one might desire and both types of plant have to be ‘driven’ on the fire, not on the engine throttle. Both systems can be equally and delightfully well-behaved, provided that the engineer keeps out of the feedback loop.”

The next part will discuss the design options in more detail.

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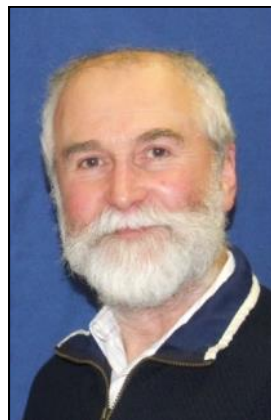
To be continued

Why on earth ...?

Neil Read

gives advice on how to handle transmission chains.

A recent visitor to my workshop greeted me with the question: “*Why on earth do you do it like that?*” I was, in fact, in the process of removing a transmission chain from a motor cycle and had just reached for a pair of pliers to remove the spring clip from the detachable link. I think my reply was along the lines of: “*Because it’s the accepted, proper way.*” My visitor was sceptical because he had devised some scheme which involved levering the clip off with a screwdriver. I explained that such an approach would probably result in him spending many hours searching for missing spring clips. To reinforce the point I mentioned that I had a leaflet published by Renold Chains Limited that confirmed the method he was witnessing was the recommended approach. Of course, when I went to look for the leaflet I couldn’t find it!



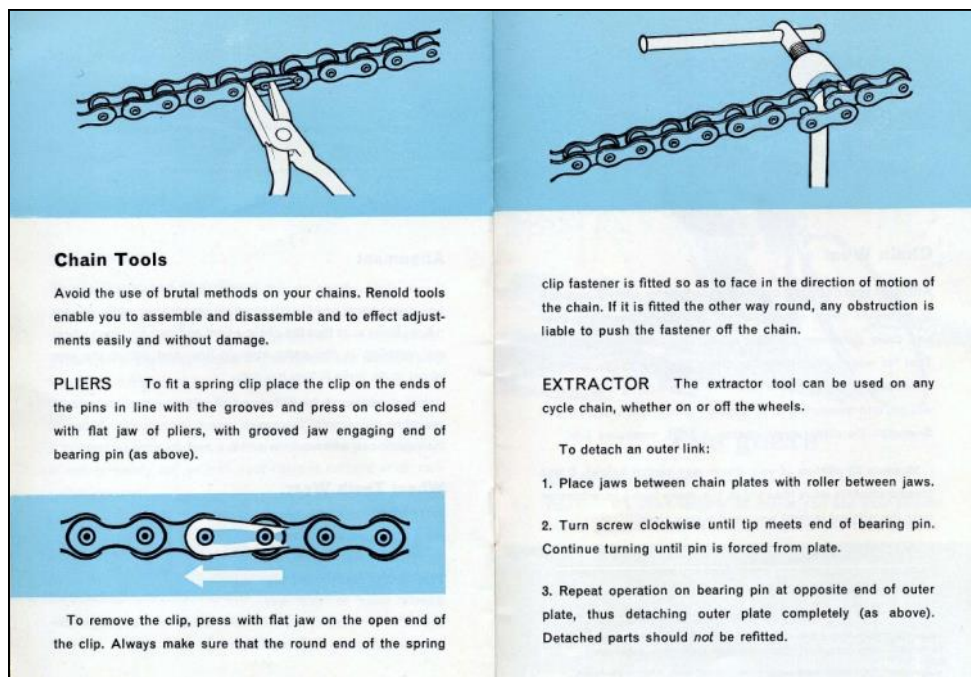
Neil Read.

Antiquity

The missing leaflet turned up the other day and I thought it might be a public service to make the contents more widely known and, in particular, to those who wrestle with the task of removing detachable transmission chain links. This leaflet is entitled *The art of easy cycling* and is one I acquired from Renold many years ago. Its antiquity may be judged by the fact that the envelope it was delivered in, and still occupies, carries a postal charge of 4d - that is four old pence to you youngsters (one new pence = 2.4 old pence). It is addressed to *Master N. Read*, a style of address I have not used for some years. The date stamped on the letter by the Post Office is indecipherable but I think it is safe to assume that the artefact in question is over sixty years old.

So much for the provenance of my information - but what does it say? Well, I am justified in my response to that visitor. As the photocopy (**photo 1**) of the relevant page confirms, the correct way of removing spring clips from or attaching them to detachable chain links is by means of pliers. Messrs Renold used to sell a special form of pliers having one flat jaw and one grooved specifically for the purpose though, in default, (smallish) standard pliers seem to work okay. Despite being involved with cycle and motor cycle chains for many years I have never come across one of the special tools. I would have snapped it up if I had!

It might be worth stressing one or two other important points in connection with transmission chains. As is made clear in the leaflet, the spring clip should always be fitted such that its closed end points in the direction of travel of the chain. The theory is that if it catches anything it is less likely to be knocked off. Check the condition of the spring clip and its detachable link each time you remove or fit them. Old clips can become ‘tired’ and



1. The pages from the leaflet by Renold Chains Limited referred to in the text.

loose in the grooves of the detachable link pins. Having a chain come adrift is no joke and can do much damage to surrounding fittings and any living person or creature standing nearby. This, I know, is basic safety advice but well worth repeating.

Oddments

Shortly after the above encounter with my visitor I attended an autojumble and took the opportunity to enquire at a stall selling transmission chain if the special pliers were still available. My question was greeted with a curt “No!” - I am not sure the man I spoke to knew what I was talking about. Walking on I came across a stall selling oddments and amongst the ‘offers to treat’ were some pliers. Apart from some surface rust they were in excellent condition so I bought them - cost me one whole British pound they did. In case you accuse me of wanton extravagance I should add that the stallholder insisted I put my pound coin in a charity collection box he had with him. When I got them home the pliers were cleaned up and modified for the specific task of working with transmission chains.

Using a Dremel I carefully grooved one jaw and shortened it by approximately 0.04in. (photos 2 and 3) on the off hand grinder. The two serrated jaws were also cut back slightly with a honing stone. This makeshift tool works quite well and I would recommend it to those who regularly work with transmission chains on their cycles or ►



2. The pliers' jaw modified by adding a groove.



3. The pliers were also provided with one shortened jaw (the grooved one).

motor cycles. If nothing else you will have the satisfaction of knowing that your adopted method of working has the full backing of a leader in the roller chain industry. Curious visitors can also be firmly put in their place when they expound the merits of levering spring clips off with a screwdriver!

Postscript

Despite the title of the leaflet described above I'm not convinced the task of cycling was made much easier by studying its pages. I can well believe cycling helps to keep you fit but it is still hard work. Perhaps that is why I bought my first motor cycle many years ago.

SMEE

Editorial

This issue is slightly unusual in having a nautical flavour which I hope will be of general interest.

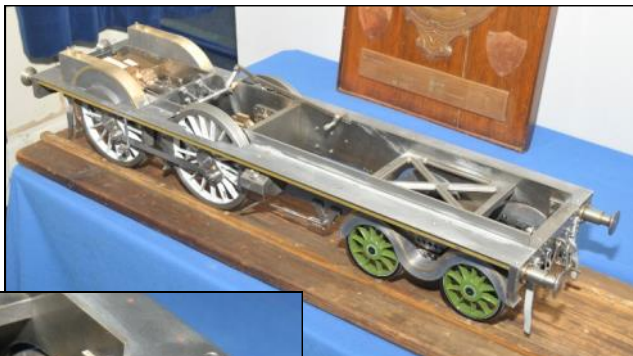
A far more unusual aspect of this issue is that there was too much material to fit into the maximum 48 pages of space that is normally allocated, so the next part of my series about hydraulic drives etc has been postponed. The next part of Brian Neale's *Digital jottings* is also lacking this time but that is not because of any editorial action and is simply because, recently, there have been too few hours in a day for Brian to find time to complete the task of writing it. This reflects the fact that writing articles for *The Journal* can entail a significant investment of time and effort - and all for no financial reward of course. I hope that readers keep this in mind when looking through our pages but also hope that you are not deterred from the possibility of writing your own contributions, be they long or short, polished or just roughly sketched out. Supply of articles is rather like the proverbial buses - none come along for ages and then several arrive at once.

Mike Tilby

SMEE

Work on the real table: 6 April 2024

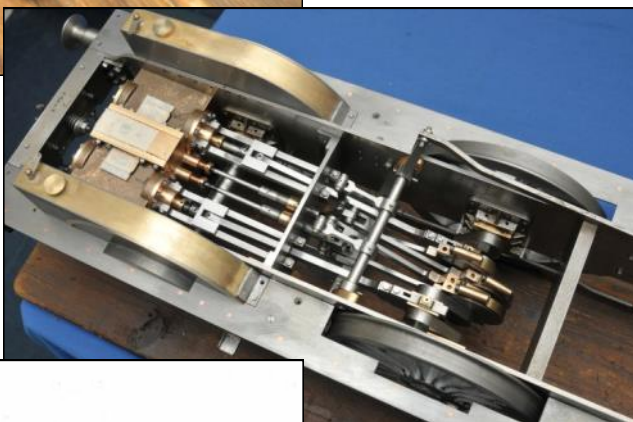
Peter Wardropper is making good progress with his 5in. gauge GNR 0-4-4T locomotive to Martin Evans' Harringay design. The original locomotive was designed by Patrick Stirling for passenger services (c1890) in and around Kings Cross and the W. Midlands



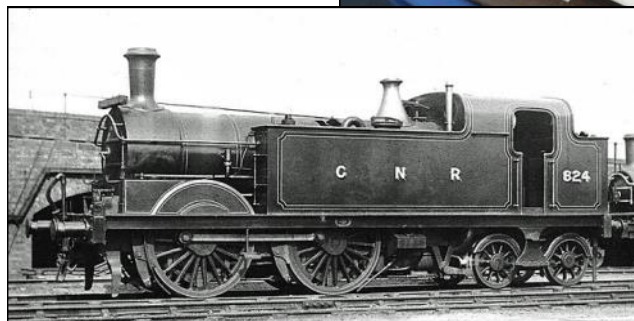
Peter's study of contemporary photographs and observation of the Stirling 8ft. Single preserved at the NRM in York have provided the necessary information to incorporate additional details.



The quality of Peter's fine workmanship is evident in these detail views of buffer beam fittings and the inside cylinders with the steam chest between and associated motion work.



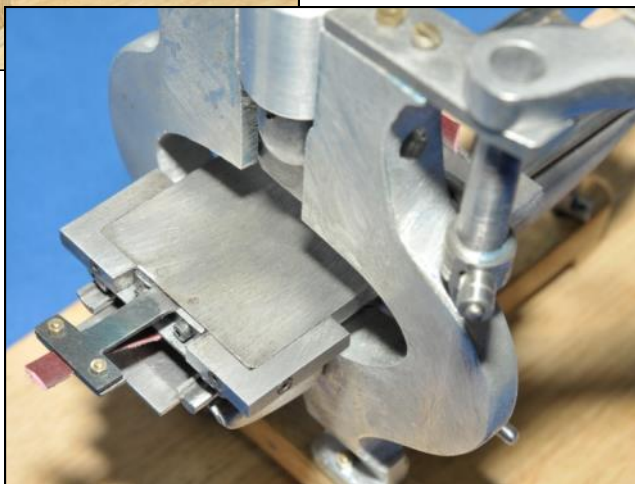
Peter notes that work on the boiler is well advanced and awaits suitable weather conditions to continue with the silver brazing to be completed outside his workshop.





John Clarke is making good progress with his 1:8 scale model of a c1830 Stanhope Press. The weight of the platen is counterbalanced by a heavy weight behind the press. The screw is activated by a bar attached to multiple levers to provide vertical movement of the platen. The levers are in a compound configuration which provides a mechanical advantage and can produce a print with a single pull on the bar.

**Photographs
by
Jonathan
Tickner**

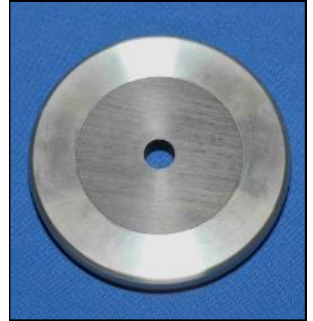


Graham Nickson showed a column collar for the Universal Pillar Tool he's making to the G.H. Thomas design.

Work on the real table: 20 April 2024



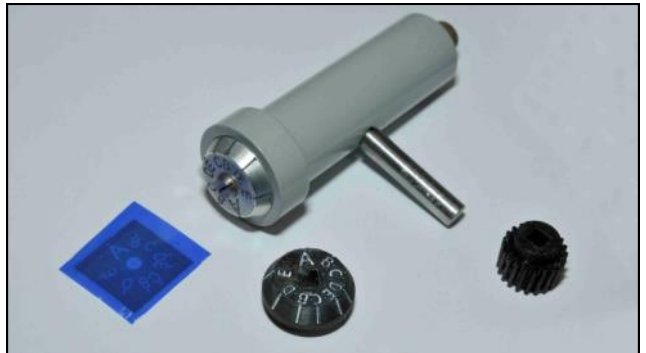
Graham Nickson showed the completed radius forming micrometer assembly for his Quorn Mark 3 tool and cutter grinder (left). The micrometer body has been shown previously as Work on the real table. The screws will be replaced with a ball handle and grub screws.



Work on the real table: 4 May 2024



Stephen Bondfield is working on a desk/table lamp. He showed the stainless steel base (right) which is inset with African Blackwood.



Jonathan Tickner's thread dial indicator for a Boxford BUD metric lathe is based on an Elliott's Engineering Channel (YouTube) design. Tweaked 3D printing files from 'Thingiverse' were printed by Lexi. The aluminium alloy top plate and body were turned and the dial electro-etched using artwork laser printed onto 'Print & Peel' film applied to the polished alloy blank. The backing film was removed and the letters etched using a 9V power source, vinegar & salt solution and a q-tip.

We are very grateful to the members of the SMEE Workshop Team who restored the lamp bracket seriously damaged by a tree brought down during a recent storm. Resplendent in its blue livery, it really looks splendid.

Regrettably there wasn't enough space here for items shown by Joe Sissons, Mitch Barnes and Graham Nickson. These will be included in the next issue.

The 2024 Annual General Meeting and presentation of awards.



Elliot Hirst now wears the Chairman's Collar (and the responsibilities that go with it!).

Allen Berman read the Chairman's Annual Report before standing down from this role.



Awards were presented by Peter Wardropper in his role as Vice President, since Mike Chrisp was unable to attend the meeting.



The Kennion Shield was awarded to Jonathan Tickner, Elliot Hirst and Ralph Thompson for work on the 2023 Midlands Exhibition. (Ralph could not be present at the meeting and so was photographed separately) (A brief note about the history of the Kennion Shield was published on page 25 of the June 2023 issue).



Certificates for 25 year membership were presented to Richard Wood (left) and Mitch Barnes, .



Alasdair Milne received the SMEE Bronze Medal which was awarded in December 2019 for his Beam Engine Lady Stephanie to a design by Tubal Cain. (Alasdair could not receive the medal previously because of the Covid pandemic.)



Peter Wardropper was presented with The Allman Trophy by Allen Berman for the best 'Work on the Table' during the past year.

The Apsley piddler - part 2

Mike Chrisp

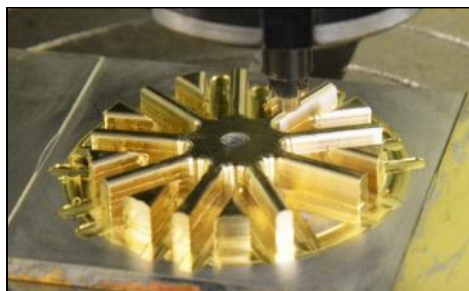
continues the account of his exercise in workshop therapy.



Mike Chrisp

Wheels

The wheels presented an interesting challenge! Each is fabricated in three parts and work began with the spokes. A brass blank was soft soldered onto a brass backing plate with generous clearances for mounting bolts to allow for adjustment. A rotary table was located on the milling machine table and centred. The wheel blank was then centred on the rotary table, clamped in position and its top surface skimmed flat and level. The diameter of the blank was brought to size and the spokes milled using a 3mm end mill.



7: Radiusing the top corners of the spokes.



8: Silver steel corner rounding cutter.



9: Driving wheel rims, bosses, spokes and crankpins (top); leading wheel rims, bosses and spokes (bottom).

Accuracy depended on the use of a digital read-out, careful use of the rotary table and uninterrupted concentration! (**photo 7**). The top corners of each spoke were rounded using a home-made silver steel cutter (**photo 8**) and hand work brought the spokes to a satisfactory finish.

With the spoke disc completed, the rims, bosses and crankpins were comparatively simple turning exercises. **Photo 9** shows the individual wheel components.

Alignment (swash) of the spoke disc was achieved by machining a 0.005in register on the inner surface of the rim to position the spokes midway across the width of the wheel. Located against this register, the outer ends of the spokes were silver brazed in position and the resultant fillets finished as necessary by careful hand work.

Cylinders

The next job was to fabricate the single acting oscillating cylinders (**photo 10**). Port faces and end caps were secured to the cylinder barrel using silver brazing foil and wire. The convoluted steam supply pipes were formed from $\frac{1}{8}$ in. brass tube. An armature was used to support the steam supply pipes, dome bush and port faces for silver brazing the assembly (**photo 11**).



10: Single-acting oscillating cylinder assemblies.

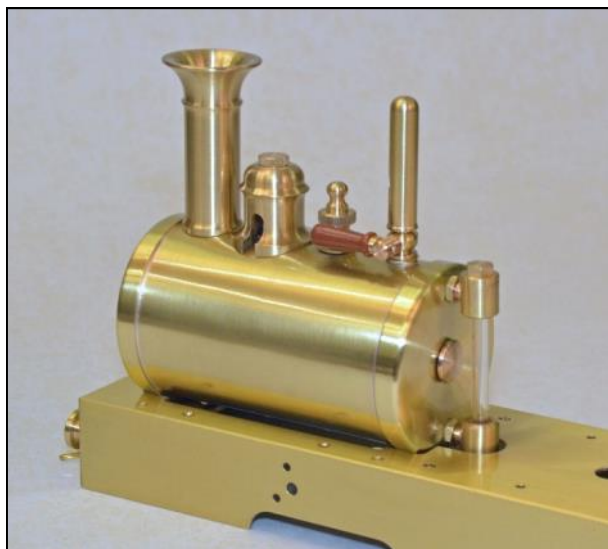


11: An armature was used to support the cylinder steam supply pipework for silver brazing.

Boiler fittings

Boiler fittings include a working but rather shrill whistle operated by a Tufnol® handle. The simple safety valve is fitted with a hardened beryllium copper wire spring. An O-ring seals the valve body onto its seating.

Steam is fed to the cylinders via a banjo fitting hidden by the decorative steam dome held in place with a straight knurled brass thumb screw. The dummy chimney is attached using a bolt. The water gauge is sealed with O-rings and its glass tube was located using a ▷



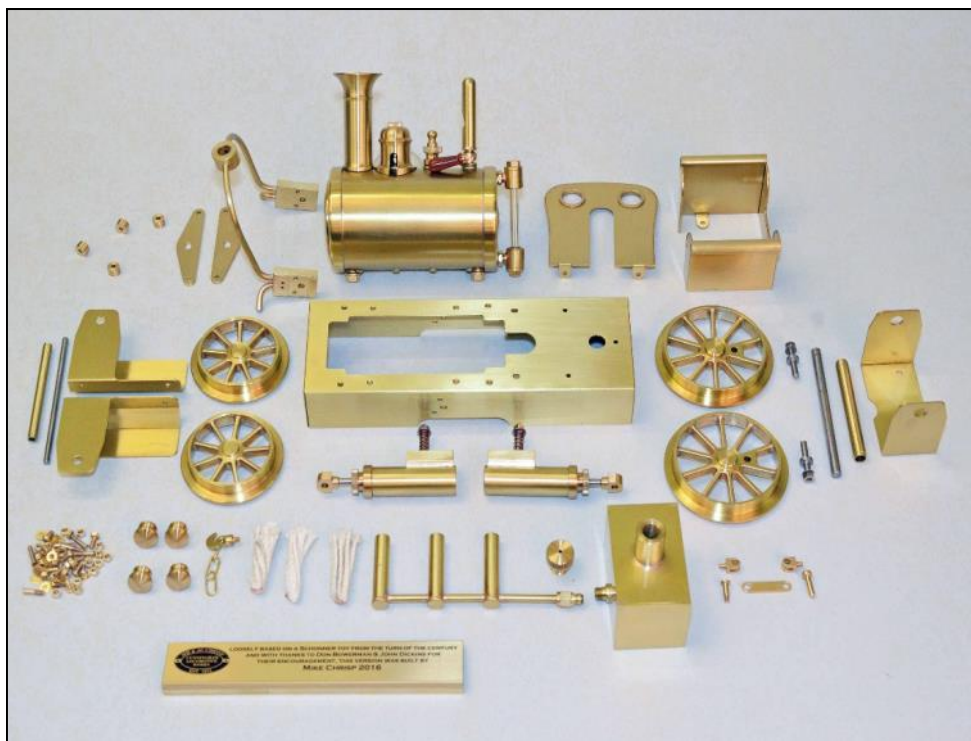
12: Boiler fittings.

Finishing

Chassis components including buffers, front coupling and chain were made to match similar items fitted to the truck. The rear coupling is a simple clevis to accommodate the tender drawbar.

Before final assembly, all the component parts were polished and grained as appropriate, lacquered and baked as previously described.

A display plaque was prepared using ink-jet printed transparent adhesive vinyl film mounted on polished brass plate.



13: Sub-assemblies and individual components ready for assembly.

Assembly

The assembled boiler is secured to the chassis using brass bolts fitted into blind bushes. Apertures each side of the boiler mount provide an exit path for flames from the spirit burner. The cylinder port faces are bolted to the chassis (**photo 14**).

The spectacle plate, cab and driving wheel axle stand with its bearing tube were assembled (**photo 15**) followed by the cylinders, driving wheels, their axle and crank pins. The leading wheels, their axle, axle stands and bearing tube (**photo 16**) were fitted next. The leading axle stands also serve as flame deflectors.

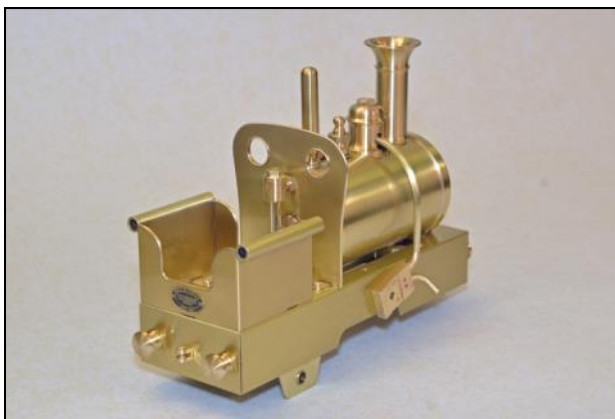
The spirit burner (photo 16) is held in place by its filler plug which facilitates removal for filling and is sealed using an O-ring. The locomotive and tender are coupled by a drawbar fitted between two clevises with one clevis pin fixed and the other removable.

I purchased a length of Gauge 3 display track from Cliff Barker, a custom acrylic display case from Widdowsons and built a sturdy plywood carrying case lined with polyurethane foam. (**photo 18**).

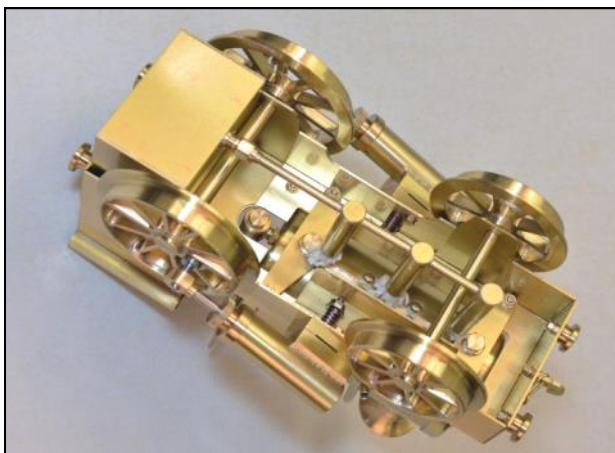
Job done, workshop therapy successful and a pleasing outcome (photo 17)!



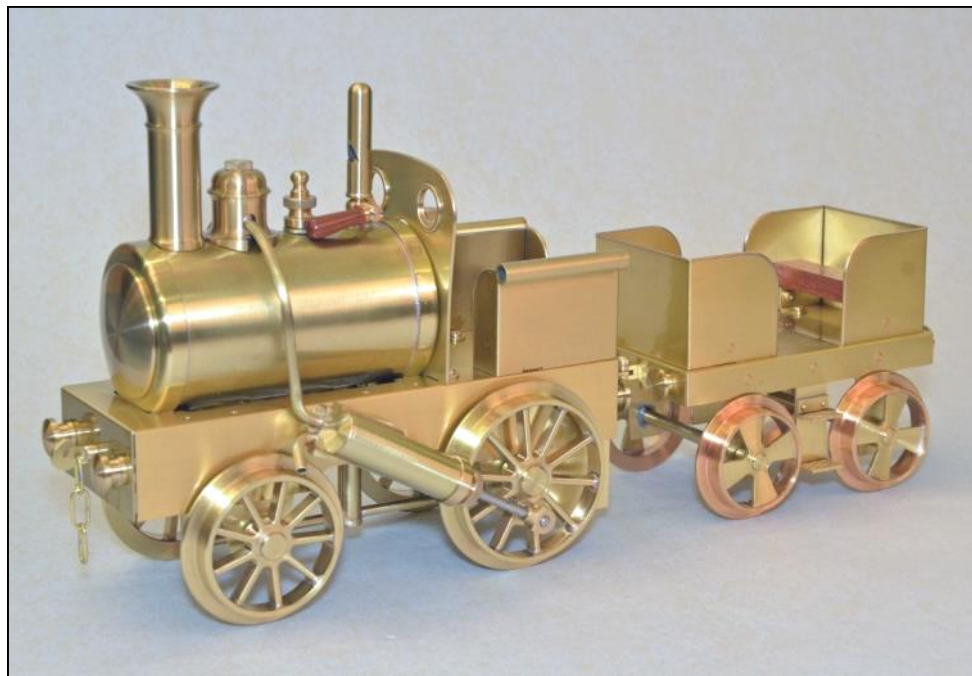
14: Boiler assembly fitted to chassis.



15: Spectacle plate, cab and rear axle stand.



16: Wheels, cylinders and spirit burner.



17: The Apsley Piddler is based on an original Schöner prototype.



18: Carrying case, acrylic display case with Gauge 3 track and brass display plaque.

Hearth Hound

Gareth Hughes

thinks aloud about lessons learnt.



Gareth Hughes

Some years ago, when the internet was still in nappies, I needed an answer to a now forgotten question involving screw cutting on the lathe. I had a copy of the Workshop Practice book 3 on that very subject, but had lent it to someone else (who, I now realise, still hasn't returned it). I thought it doubtful that anything useful would be online, but I tried anyway and was delighted to find several clear, concise and informative videos that perfectly answered my question.

I think most of us have used the University of YouTube now, or other instructional websites to help solve a problem or learn a skill. But in later years I have noticed a steep decline in the quality of educational and how-to videos on video platforms. I suppose the reason is that most things have been covered already, but it means many newer videos are full of errors, made up problems and even conspiracy theories.

Recently I was trying to help a friend with repairing old game consoles. We had one with no output to the screen, and the presenter of the video we found assured us that it was most certainly a timing crystal that had failed. We followed his oscilloscope instructions but found there was nothing wrong with the timing signal.

I then realised I had never heard of a crystal failing before. They do of course - everything has a MTBF - but I've never known it and neither has anyone else I have asked since. So we are pretty sure he fabricated this crystal failure just as 'click bait', desperate to get more content out there and viewed for the advertising revenue.

Remember the days when you could watch a tutorial without being bombarded by ads? Now it's like trying to learn calculus at a carnival - distracting, disorienting and ultimately unhelpful.

So, where does that leave us? Are we doomed to wander the digital wasteland in search of nuggets of wisdom, only to be waylaid by shouty ads and solutions for made up problems? Not necessarily. While the internet may have lost some of its innocence, there are still pockets of knowledge to be found for those brave enough to seek them out.

And there are still plenty of reputable sources of information out there - you just have to know where to look. Websites like Khan Academy and Coursera offer free courses taught by experts in their fields, without all the distractions of ads, fake product reviews and other lies. And there are still YouTubers out there who are more interested in sharing knowledge than racking up views. It takes a little patience and perseverance, but once found they can become your go-to favourites.

Or, you can buy a book. Just don't lend it, eh?

"Google can bring you back 100,000 answers. A librarian can bring you back the right one."

Neil Gaiman

SMEE

Decorative heat bluing of steels

Guy Gibbons, OBE, MIMechE

Part 3 (of 7) - A PID controlled bluing box.



Guy Gibbons

Decorative bluing using a temperature controlled bluing box

I have little doubt that an oven is the best type of machine for bluing steel, but when an article appeared in the horological press some ten years ago describing the construction of a PID-controlled bluing box* I took note, pondering over the design long and hard. In essence, it seemed to be a ‘deconstructed’ electrically-heated hotplate such as found in domestic cooker hotplates but with the heating element extracted from the plate and replaced by a radiant heater. It had many unstated drawbacks and inaccuracies, and could not be considered an acceptable design for general workshop use; nevertheless the concept offered a zero-mess bluing process, so I set about a comprehensive redesign and trials programme lasting over several years.

And was it a success? In overall terms, yes, but it does not offer the performance the horological press implied, it failing to deliver a uniform ‘plug and play’ colouration of long clock and barometer hands. Nor is it, I suspect, useful for uniformly tempering 3-dimensional components such as springs, and I largely ascribe both shortcomings to its use of a hotplate and no forced air circulation.



Figure 6: The author's PID controlled bluing box.

My design will be presented in more detail in the next part of this paper, together with the results of selected trials. Four versions were made (though these will not be described in any detail if only for the sake of brevity), my final version – Version 4 – being shown in **Figure 6**.

* PID: Proportional-Integral-Derivative controller. Providing closed-loop feedback control and adjusting the delivered heater power in an optimal fashion, the hotplate will typically neither overshoot nor deviate from the set temperature value measured by the thermocouple by more than $\pm 2^{\circ}\text{C}$.

It is potentially capable of bluing components measuring up to $180 \times 35 \times 25$ mm, and more details and schematic drawings will be provided in the next part of this Paper.

The PID controller

Before going any further it is perhaps appropriate to say a little about a PID controller. Of perhaps primary interest to those involved in the work of the Digital Group, a Proportional–Integral–Derivative controller (PID controller) is a control loop instrument employing feedback that is widely used in industrial control systems and a variety of other applications requiring continuously modulated control, one common application being temperature control – **Figure 7**.

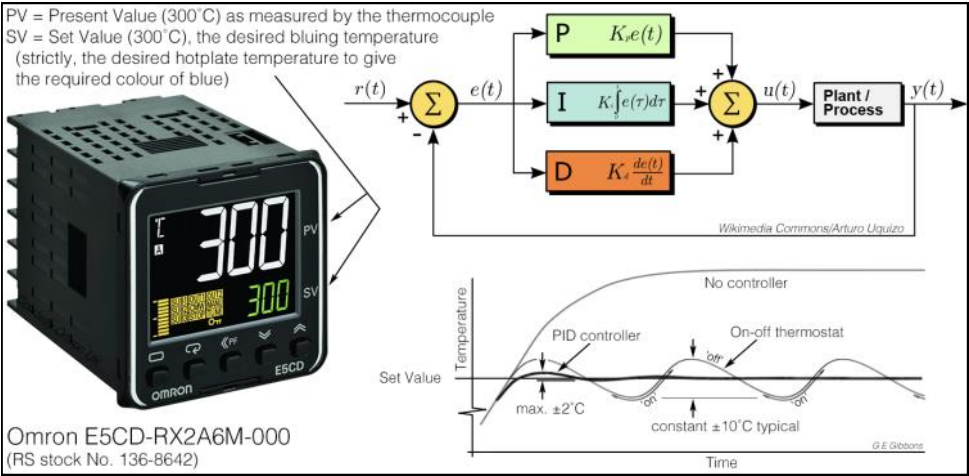


Figure 7: The Omron PID controller selected by the author, and (top right) a typical block diagram. The chart bottom right shows three temperature v time curves representative of no control, thermostatic control and PID control.

Unlike a simple thermostatic controller as found in domestic cookers or laundry irons that switches off when the set value of temperature is achieved and relies on a degree of inherent on-off hysteresis perhaps approaching $\pm 10^\circ\text{C}$ before switching back on again ad infinitum*, a PID controller seeks to minimise overshoot, undershoot and offset between the required temperature (the set value or SV) and the measured temperature (the present value or PV**). The PID controller continuously calculates an error value as the difference between the desired set value and the temperature measured by the thermocouple, and applies a correction based on Proportional, Integral and Derivative terms (hence the name).

Mathematically, the workings of the PID controller are rather beyond the author, but a

* $\pm 10^\circ\text{C}$ (a 20°C range) is rather too coarse for accurate control of the colour (shade) of blue as can be seen from an inspection of Figure 5.

** With the thermocouple embedded in the hotplate, the PV is essentially the hotplate temperature.

generalised description can be found at https://en.wikipedia.org/wiki/Proportional%E2%80%93integral%E2%80%93derivative_controller. **Figure 7** top right gives an outline of the mathematic functionality, but in essence the Proportional term describes change needed to correct the current difference (error) between the measured temperature and the set value, the Integral term corrects for past values of this difference and the Derivative term predicts the future differences.

As far as uncomplicated selection of the PID controller is concerned, one needs to ensure it has an automatic tuning capability which will reduce the overshoot and undershoot after automatic tuning to typically better than $\pm 1\text{ }^{\circ}\text{C}$, and the PID controller output (for simplicity, a relay) is capable of switching the cartridge heater electrical current reliably.

The PID controller selected by the author is also illustrated in **Figure 7**; it is by a reputable manufacturer (Omron) and housed remotely from the heated box so that it always remains comfortably within its specified thermal limits ($+55\text{ }^{\circ}\text{C}$).

Fire and electrocution safety considerations

ELECTROCUTION AND FIRE HAZARD: 240 VOLT MAINS ELECTRICITY CAN BE DANGEROUS, ESPECIALLY IF ASSOCIATED WITH AN ENCLOSED HEATING DEVICE ACHIEVING IN EXCESS OF $300\text{ }^{\circ}\text{C}$ ($\approx 600\text{ }^{\circ}\text{F}$).

Before moving on to constructional details, the author strongly recommends that safety matters be considered from the outset. A bluing box is a potentially dangerous piece of equipment representing both a fire and electrocution hazard not dissimilar to switching on a domestic laundry iron at the ‘linen’ setting, placing it in a close-fitting box and walking away. Temperatures held at around $300\text{ }^{\circ}\text{C}$ for a perhaps considerable length of time unattended are potentially far more destructive than temperatures typically found in the workshop, and require the utmost respect during material and component selection – as well as in the design itself.

The key difference to most other workshop equipment or engineering activities is that



Figure 8: Ignition trial on a piece of kitchen paper.

the necessary long soak times at high temperature (well over 1 hour, as will be described later) will almost guarantee the bluing box is left switched on unattended, and it is essential that all materials are suitable for use at 300 °C, and safety features incorporated to guard against fire.

Plywood or MDF boxes are a definite no-no, the self-ignition temperature of wood being perhaps as low as 300 °C, as too is soft-soldering of any electrical connections. Similarly, PVC insulated cables should not be routed anywhere near the heated parts of the box, and all insulation and other materials should be able to withstand fault conditions without charring or catching fire.

At 240 volts, reliable earthing arrangements are important, and the instrument should be supplied from an RCD-protected workshop supply. All electrical equipment should be accompanied by fully traceable safety documentation and manufactured by manufacturers of repute. Cheap offerings bought from internet market sites are merely a recipe for a repetition of another domestic fire tragedy, and I like to think no SMEE member would wish to be party to purchasing such equipment when the lives of other persons occupying the building might be at stake*.

Figure 8 shows the results of a fire test on my box conducted under a simulated accident condition (the bluing box being left switched on overnight), the scenario being a piece of kitchen towel blown by a breeze over the bluing box. The result of this test was fitting a 250 °C overheat thermostat inside the casing, together with a rotary timer in the control box limiting the maximum unattended heating time to no more than 2 hours.

Before leaving the issue of fire safety, one final warning is appropriate. My fire tests were conducted on my 3.2 mm steel-covered workshop bench, so those that might consider using a bluing box on a wooden- or melamine-topped workbench may need to consider using it on a heat-resisting mat or tray.

Next time I shall consider some details of the design and construction of my PID controlled bluing box.

To be continued

Thermal insulation

The primary purpose of thermal insulation is to reduce thermal gradients within the box while keeping the outer temperature of the box at a level that does not present a fire or major burn risk.

All solids (metals, plastics, glass, ceramics) have a higher thermal conductivity than still air, the thermal conductivity of air being perhaps just 30% that of the 'wool' in Superwool blanket.

Wool-like thermal insulation blanket provides thermal insulation not primarily by the thermal properties of the 'wool' insulation but by preventing the entrapped air from circulating throughout its thickness.

Consequently, it is worth bearing in mind that compressing a wool-like thermal blanket in the hope of increasing its insulating properties may, by increasing the glass content per mm of thickness, be counter-productive and actually decrease its insulating properties.

Closed-pore Aerogel blanket (available from RS(UK)) might offer a small improvement over Superwool, but I have not tested it, so cannot say.

* That a member cannot afford it is no excuse. The starting point of any adjudication authority will be that you introduced the hazard, so you are responsible for the consequences.

Re-designing a gas burner - part 2

Graham Astbury

describes consequences of changing the gas supply.



Graham Astbury

The first part of this article described why the change in the type of gas to be used for the burner meant the jet bore became too small for me to make myself.

British standard jets

There are commercially available jets available in the UK but these are calibrated by numbers being the flow in cubic centimetres per second of petrol that flow through the jet under a specific pressure. Unfortunately, there is no specification for the bore, just the flow. The now-obsolete British Standard for calibrated petrol jets (**Ref. 6**) defines the flow-rate and the physical dimensions of the jet itself. All the jets are threaded 1 BA and have 4 BA spanner flats on them but some have a chamfer and others do not (**Photo 2**). They are calibrated in cubic centimetres of petrol per minute, as they are specified as *petrol jets*. Although the jets are specified for petrol, they are now used as gas jets rather than petrol jets. The jets are numbered, but there is no reference to the diameter of the jet itself, as it is the flow, not the hole size, which is defined. However, diligent searching led to a book by Bernal Osborne (**Ref. 7**) which gives a list of the jet number versus the bore. I plotted Osborne's data on a spreadsheet and derived suitable equations to determine the jet diameter in millimetres from the jet number and the reverse, and also the same in inches. The results were:



Photo 2. A selection of jets to British Standard BS720:1948.

Jet diameter, mm = 0.08636 $\sqrt{\text{Jet No.}}$

Jet diameter, inches = 0.0034 $\sqrt{\text{Jet No.}}$

Jet No. = 134 x (diameter in mm)²

Jet No. = 86505 x (diameter in inches)²

The (jet diameter)² is plotted against Jet No. in **Fig 2**. I tried various exponents between 1.5 and 3, but the best fit to the jet numbers was given with an exponent of 2.0, hence the plotting of the (jet diameter)². I did a cross-check on a No. 160 jet which has a stated bore of 1.092 mm and found that a No. 57 drill (measured at 1.08 mm with a micrometer) would just about enter the bore, whereas a No. 56 drill (measured at 1.19 mm with a

micrometer) would not enter, confirming the calculated bore to be close enough to the actual bore. As for the redesigned burner with the jet diameter being 0.315 mm, using the formula above the jet number required is $134 \times 0.315^2 = 13.29$ which, not being a whole number, can be rounded to a No. 12 or a No. 14 jet as the jet numbers increment by two at these sizes. As this was rather an imprecise determination, ignoring the effect of the jet bore length, I chose to try a No. 10 jet which I already had available as a spare jet for one of my propane gas torches. If this proved inadequate, then a No. 12 or No. 14 jet could be tried instead. As the question of the effect of the length of the jet bore is one which cannot be resolved easily, I decided to work on the principle of starting with a small jet, as the holes in the burner tube can be increased easily if necessary. Whilst it is simple to use a shutter to close off the air inlet hole, the burner port area cannot be reduced easily.

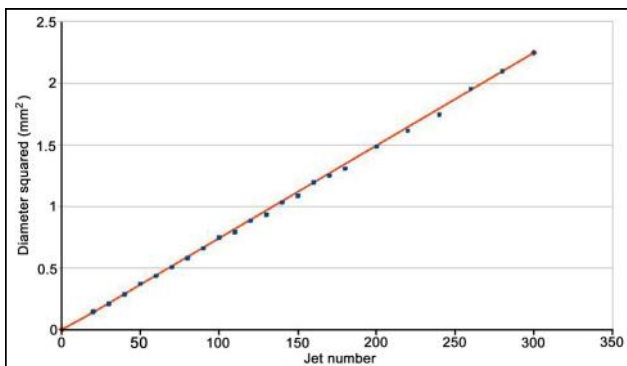


Fig. 2 Plot of jet number (BS720:1948) versus square of the bore diameter in mm. Points represent data from Ref. 7, line represents calculated values.

Other jets

At this point, I must bring up the question of ‘other jets’. Reasonably diligent searching did not lead me to any other jet specifications *per se*, but I have found out by examining my gas cooker (which has Italian-made burners) that it has metric jets which are threaded M6 x 0.75 with a 7 mm A/F hexagon. The number stamped on them appears to be the bore in hundredths of a millimetre, so a jet stamped ‘77’ has a bore of 0.77 mm. It appears that the larger metric jets are marked with the actual bore in millimetres, so a jet marked ‘1.2’ is 1.2 mm bore. Sometimes these jets seem to be rated by their nominal heat output as some are quoted as being, for example, ‘Natural Gas Jet 1 kW 0.72’ which is their nominal heat output on natural gas with the bore size as the following number, which is also stamped on the jet.

In America, it appears that their jets are threaded $\frac{1}{4}$ in. x 32 UNEF and are numbered by the Morse drill size of the bore, so a No. 60 jet has a bore of the same diameter as a No. 60 twist drill which is 0.0400 inches or 1.0160 mm. You will have to check on how jets are numbered and what thread they have in your own locality. These standards are compared in **Table 2**.

As an aside, I have a genuine Swedish Primus paraffin blowlamp made in 1950 which has an un-numbered jet with a $\frac{1}{4}$ in. x 40 thread, but it is not easy to check whether it has ▷

Table 2: Comparison of jet numbering systems

Parameter	British standard jets	Metric jets	American jets
Thread size	1 BA	Either: $M6 \times 0.75$ or: $M5 \times 0.80$	$\frac{1}{4}$ in. $\times$ 32 UNEF
Numbering method	Petrol flow rate (cc/min)	Either: Bore in mm $\times$ 100 or: Bore in mm	Morse drill no.

a unified thread form (UNEF) or a Whitworth (ME) thread form. It does not have a number stamped on it.

As I chose to use the British Standard for my jet, from this point onwards all jet numbers to which I refer are those to the British Standard BS720:1948. I should also point out that it is a legal requirement that *all* gas work on fixed installations in the UK, be it natural (mains) gas or liquefied petroleum gas (propane or butane), *must* be carried out by a Gas Safe registered technician. The Gas Safe Registration Scheme does not apply to portable appliances but it would be good practice to refer to a Gas Safe registered technician about any gas work on portable appliances.

From the above, it can be seen that the jet number that I had available is a No. 10 British Standard jet which has a bore of $= 0.08636 \sqrt{10} = 0.273$ mm. Clearly, as the bore is 0.273 mm, the nearest whole number would correspond to a 0.28 mm bore jet, which if it were a metric jet, would have the number ‘28’ stamped on it. Similarly, for an American jet, the number would be 85, as this is the Morse drill number that corresponds to a 0.28 mm diameter hole. Consequently, the same jet could be described as a No. 10 jet, a No. 28 jet or a No. 85 jet depending on which standard applies to it. It needs care to select the appropriate jet!

The original burner

Haynes designed his burner to use town gas, and the injector was a simple brass nipple drilled $\frac{1}{16}$ in. (1.6 mm) right through (Fig. 1, in Part 1). The end of the burner tube had a small saw-cut horizontally across the tube for the flame to sit, directly below the hot end of the engine cylinder. There is no provision for primary air to be mixed in with the gas before it leaves the burner, so all the combustion air will have to diffuse into the flame. However as the flame would be of a fish-tail shape, i.e. very thin, the distance for air to diffuse into the centre of the flame will be quite small and so there is a possibility that the gas will burn reasonably cleanly without premixing. This is potentially possible as the saw-cut would be typically about 0.8 mm wide. As I never made the original burner and since town gas is now unavailable in the UK, we will never know for sure just how well the secondary air mixed in.

However, the burners for town gas fitted to central heating boilers from around 1945 until replaced by natural gas burners, had non-aerated burners which relied on a thin fan-shaped flame which would allow secondary air to mix with the flame and ensure complete

combustion (**Ref. 8**). This was because there was a risk that in an aerated burner, any change in the gas composition of the high hydrogen content of the town gas would make it liable to burn back, explode or even detonate inside such an aerated burner, hence the move to non-aerated burners. As the stoichiometric composition of town gas is 17.5%, the balance must be air, so the quantity of air required for one volume of town gas must therefore be:

$$\frac{(100 - 17.5)}{17.5} = 4.71 \text{ volumes of air.}$$

In a thin, non-aerated flame, this could easily diffuse into the flame and so complete combustion can be achieved. However for propane, with a stoichiometric composition of 4%, the quantity of air required for combustion is:

$$\frac{(100 - 4)}{4} = 24 \text{ volumes of air.}$$

This is quite a significant increase and such a thin non-aerated flame would be unlikely to produce complete combustion. After the change in the UK from town gas to natural gas in the early 1970s, aerated burners were used almost exclusively in domestic gas appliances.

The next and final part of this article will describe aeration, complete design of the burner and its performance.

References

6. British Standards Institute, BS 720:1948, *Calibration of carburettor jets for petrol engines (all types)*. (This is an obsolete standard but may be available for reference in certain Libraries in the UK which keep British Standards).

7. Osborne, Bernal, *Modern Motorcycle Maintenance*, Temple Press, (1949).

8. Jones, H.R.N., *The application of combustion principles to domestic gas burner design*, Taylor & Francis, (1989).

To be continued

Wise words

Errors using inadequate data are much less than those using no data at all.

Charles Babbage



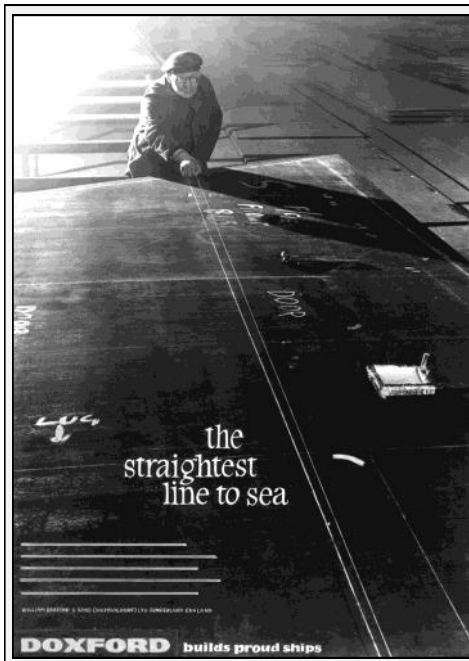
Obituary: Ed Turner

Sadly, we learned at the end of April that Ed Turner had passed away after a courageous fight with cancer. Ed joined SMEE in 2009 and frequently attended meetings at Marshall House. He was part of the training team focussing particularly on the Tool Grinding Course. He spent much of his working career at ICL. In retirement he was a volunteer at the privately owned Fawley Hill Railway which was created by Sir William McAlpine a director of the construction firm Sir Robert McAlpine Ltd. He was heavily involved in the maintenance and making of replacement parts for the rolling stock. He was skilled and did much of the work in his own workshop. In 2022, he decided to downsize, and he gifted two excellent machines to SMEE; a Smart & Brown lathe and a Thiel universal milling machine. Unfortunately, his illness intervened, and it was not possible to arrange transfer. His next of kin have confirmed they wish to see the machines moved to our workshop and plans are underway for the transfer. They will provide a lasting reminder of a well-respected member who made a valuable contribution to the activities of the Society.

Elliot Hirst



SMEE



Picture from the past

A shipwright at work at Doxfords, Sunderland

Tom Jones, a foreman shipwright at William Doxford & Sons (Shipbuilders) Ltd , marking out the front plate of a ship using the traditional chalked string method, 1961.

(Image courtesy of : Tyne and Wear Archives and Museums. Ref. DS.DOX/6/7/4/2).

Engine Builders Group news

The late March 'Tea Room' was well-attended and, again, covered many topics. As members become comfortable with the Zoom format more voices are joining in. Online access is broadening the audience and topics covered are generating some very interesting discussion.

April's talk by Matthew Waterhouse on *Rolls-Royce Merlin to Bentley W12 - Part 2 - The Story of the 'L' Engine* was well-attended at Marshall house and online. Describing the evolution from a design specification of a naturally aspirated V8 engine in the early 1960s giving around 200 BHP through the complexities of emissions legislation to a turbocharged 500+ BHP in the 2010s was a fascinating story. Photographs of engines on test running at sustained power on dynamometers with bright red exhaust systems led to many comments and speculations.

Unfortunately, the talk by Quinn Dunki (BlondiHacks) planned for May has had to be postponed to 15 June. It is replaced by the 'Tea Room' originally planned for 15 June.

The team is starting to feel stretched. Any volunteers who can help with planning and running sessions would be most welcome. Also, suggestions for topics and speakers for next year would be welcome.

Charles, John and Elliot
EBG Steering Group

Forthcoming events at Marshall House

General meetings

Conservation of the SMEE triple expansion steam engine

By Kate Jennings – West Dean College

13 July 2024

A vigilant SMEE member spotted an interesting model steam engine being thrown in a skip. Thinking it looked very interesting, he rescued it in the hope that it could be restored. It was in terrible condition and possibly beyond repair. When Kate Jennings, a tutor at West Dean College contacted SMEE looking for conservation project for a student, Norman Billingham put this forward as a challenge. The project has progressed well, and Kate and colleagues will describe the work that has been done to bring the model to running condition without losing too much of the original and its history.



Disposal sale at Marshall House

2:00pm 1 June 2024

We have a large quantity of high-quality items to sell from the estates of George Evans and MC Black.

Rummage Sale at Marshall House

27 July 2024

This sale will include any items not sold at the Disposal Sale on 1st June plus the usual opportunity for members to sell or buy surplus items.

The Selby Coalfield

Neil Rowley

7 September 2024

Neil is a Mining Engineer who was involved at a practical level in the development and exploitation of the Selby coalfield throughout the 1980s and 1990s. He will illustrate the impressive scale and engineering challenges of the project and discuss the relatively short life span of the coalfield. He will then go on to have a look some of the ways that engineers who developed their skills at Selby have gone on to have an influence on mining in other parts of the world.

Visits and events

Society visit to West Dean College: 3 July 2024

Members who have been before will know that I always try to organise a special Society visit to the annual exhibition and open workshops day at West Dean College in July and I've been able to do so again. This year's show is on July 3.

West Dean is located in a small village to the North of Chichester. The college runs many short courses in arts and crafts but also has full-time students in heritage conservation practice, including metals, clocks, ceramics, books and paper, woodwork and making early musical instruments. On exhibition day the year's graduating students show their work to parents, friends and sponsors before the formal award of degrees and diplomas. The students will be there to discuss their activity, and there is usually some amazing work on display. We've been popular visitors and previous groups have greatly enjoyed the day. As well as the workshops, the College is a historic, listed building located in 6000 acres of parkland and gardens.

The visit will be free but there is a charge of £16.50 for (a usually very nice) lunch. I need to confirm names with College, so that you can be formally invited. If you are interested please contact me as soon as possible . Access to College by public transport is limited, though there is a half-hourly bus service from Chichester station, taking about 25 mins.

Norman Billingham

Social afternoon

Saturday 20 July 2pm - 5pm

Peter and Elizabeth Wardropper welcome members and their partners to visit their garden railway for a social afternoon on Saturday 20 July between 2pm and 5pm.

The workshop and garden railway will be open and Peter plans to steam some of his locomotives. Light refreshments will be available, however, if you require a special diet, please provide for yourself.

We are located half a mile from the south coast at 33 Becton Lane, Barton-on-Sea. Being a tourist area many cafes and restaurants are to be found locally. Places of interest are Lymington, The New Forest, Christchurch and Bournemouth, further afield are the Isle of Wight and Swanage where steam railways are to be found. Sammy Miller's motorcycle museum is in New Milton.

New Milton is on the South West Trains railway line out of Waterloo, with our house being an easy one mile walk away, but taxis are available at the station. If travelling by car we suggest avoiding the A337 south through Lyndhurst. In the summer the traffic queue can exceed 2 miles.

33 Becton Lane, Barton-on-Sea. New Milton, HANTS BH25 7AB

Telephone:

Peter:

SMEE Summer Gathering and Bring and Buy Sale

24 August 2024

Last year Steve Bil and his wife provided hospitality at their boatyard alongside Romney Lock in Windsor for the start and finish of our 125th Anniversary Cruise. This year Steve Bil has kindly offered to host something more informal with the addition of a 'Bring and Buy Sale' following suggestions from members outside London. This would be in addition to our usual and very popular Rummage Sales at Marshall House and would allow easier transport for heavier items.

If you sell something, rather than take a commission, we propose asking for a suitable donation to Society funds of £5.00 per vehicle.

For those with no wish to sell or buy there will be the opportunity to enjoy tea and cakes and to look around the yard and see traditional boat building activities. Steve's yard is one of a handful of yards on the Thames still offering these services, and he has invited members of the Steam Boat Association to join in, possibly providing short trips on the river if people are interested.

For those that wish to go into Windsor or take a trip on one of French Brothers launches access from the yard is easy and parking is 'free.' Runnymede is nearby if you want to make a detour.



Visit to Taylor's Bellfoundry in Loughborough

6 November 2024

Taylor's is the last bell foundry in the UK. Their bells hang in nearly every cathedral in England and in thousands of parish churches including St. Paul's Cathedral and York Minster. Currently, the foundry is undergoing extensive reconstruction thanks to a Lottery Heritage Fund grant and the work is due to be finished before mid-year.

The tour will start at 1:30pm and should take about 90 minutes with time afterwards for discussion. The museum will be open in the morning, and it is proposed that, for those that can get there we visit this before lunch and then take a break to eat at the 'Three Nuns' public house which is near-by.

We have made a provisional booking for 6 November and numbers are limited.

If you wish to go and have not already made a reservation, please let Elliot Hirst) know.

Midlands Model Engineering Exhibition 17 to 20 October 2024

at Warwick Events Centre, near Leamington.

Last year we received much positive feedback for our stand celebrating our 125th Anniversary. This year the organisers have allocated us a larger stand and we plan to use the space to focus more on today's interests. Using demonstrations, running models and recent work we hope to raise interest in the Society and the hobby in general. Coupling this with a revived training programme and details of our programme of talks and discussions, we hope to create greater interest in SMEE and recruit new members. Our ideas are coming together, and we already have a number of volunteers to help on the stand. If you would like to help or have models (especially work in progress) that we could exhibit please get in touch with Ralph Thompson

London Classic Bike Show Kempton Park

7 December 2024

We have taken a small stand at the last two shows generating interest in the Society and recruiting new members. The organisers have invited us to return, and we seek a few volunteers to staff our stand. If you can help, please contact Allen Berman

General notices

Model running and G1 meetings

Gauge 1 has been a popular part of SMEE activities for many years. However, following the sad loss of Maurice Fagg, meetings of the Gauge 1 Group have been suspended. Kim Fisher has offered to restart activities if there is sufficient interest. Members who are interested should contact Kim at [REDACTED] to get the ball rolling.

Recordings of recent meeting talks online

Recordings of SMEE General Meeting talks since January 2017 are available to view on the Society's website, in the members-only area. We try to make recordings available as soon after the meeting as practical, provided that the speaker gives permission. The source videos are converted to MP4 format before upload to the hosting service, which then compresses them further. They view well on a PC monitor or tablet but may not be of HD quality if you view them on a large screen.

DVDs: If needed, we can make DVDs of recent and all previous talks for members who do not have internet access.

Price: £8 each including p&p - contact Elliot Hirst

Books still available

We still have copies of Jörg Hugel's book on drill sharpening (see October 2018 *Journal* for full details) and of Roger Backhouse's fascinating book about Jim Crebbin (See December 2019 *Journal* for full details)

Jörg's book is available only from SMEE. To order, please contact Norman Billingham. Roger's book is available direct from SMEE at the special price for members of £10 plus postage and packing.

To order, send an email to [REDACTED]

Books can now also be ordered via the website.

Next issue

The next issue will be August 2024, due out on 1 August

- Hearth Hound - Gareth Hughes
- Digital jottings 13 - Brian Neale
- A butt hinge on steroids - Neil Read
- The mono-tube steam generator - Part 2
- Redesigning a gas burner - Part 3 - Graham Astbury
- Decorative heat bluing of steels part 4 - Guy Gibbons
- Torque converters and fluid couplings - part 5 - Mike Tilby

Contents subject to alteration



NER Autocar No. 3170. Built 1903 and restored by the NER Autocar Trust <https://electricautocar.co.uk/>

Designed by Vincent Raven (assistant chief ME of the NER) this and No. 3171 were the world's first internal combustion-electric railway vehicles. The vehicle body had been used as a

holiday home for many years and was installed on the converted chassis of a GNR milk and brake van. Originally powered by a petrol engine, the restored vehicle has a Cummins diesel and complies with current safety regulations.

Above: The driver's control panel

Below: At Bolton Abbey Station on the Embsay and Bolton Abbey Steam Railway near Skipton

Photos: Roger Backhouse

