THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 226 No. 4661 • 26 March - 8 April 2021

MODEL ENGINEER

Join our online community **www.model-engineer.co.uk**

Garrett 4CD

Reviving Files

Cylinder Boring

COVER FEATURE

Queensland Loco

mytimemedia ENGINEERING GROUP
61
£4.20
9 770026 732216

MODEL ENGINEER

Published by **MyTimeMedia Ltd**.
Suite 25S, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

EDITORIAL
Editor: Martin R Evans
Tel: +44 (0)7710 192953
Email: mrevans@cantab.net
Assistant Editor: Diane Carney
Club News Editor: Geoff Theasby

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching Manager: Brian Vickers
Ad Production: Andy Tompkins

ADVERTISING
Advertising Sales Executive: Angela Price
Email: angela.price@mytimemedia.com

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Beth Ashby

MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

mytimemedia
print & digital media publishers

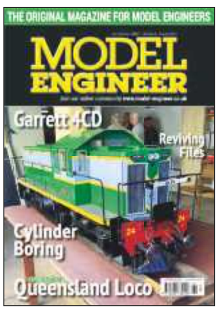
Model Engineer, ISSN 0026 - 7325 (USPS 24828) is published fortnightly by MyTime Media Ltd, Suite 25S, Eden House, Enterprise Way, Edenbridge, Kent, TN8 6HF, UK. The US annual subscription price is 136USD. Airfreight and mailing in the USA by agent named World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Periodicals postage paid at Brooklyn, NY 11256. US Postmaster: Send address changes to Model Engineer, World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Subscription records are maintained at DSB.net Ltd, 3 Queensbridge, The Lakes, Northampton, NN4 5DT, UK. Air Business Ltd is acting as our mailing agent.

http://www.facebook.com/modelengineersworkshop

http://twitter.com/
modelengineers

IN THIS ISSUE

Vol. 226 No. 4661 26 March - 8 April 2021



ON THE COVER...
George Punter's DH Class Diesel hydraulic locomotive in 5 inch gauge (photograph – George Punter).

MODEL ENGINEER SUBSCRIPTION ORDER FORM

DIRECT DEBIT SUBSCRIPTIONS (uk only)

Yes, I would like to subscribe to *Model Engineer*

❏ Print + Digital: £18.25 every quarter
❏ Print Subscription: £15.25 every quarter (saving 41%)

YOUR DETAILS must be completed

Mr/Mrs/Miss/Ms .... Initial ....Surname ....

Address ....

....

Postcode .... Country ....

Tel .... Mobile ....

Email .... D.O.B ....

I WOULD LIKE TO SEND A GIFT TO:

Mr/Mrs/Miss/Ms .... Initial ....Surname ....

Address ....

....

Postcode .... Country ....

INSTRUCTIONS TO YOUR BANK/BUILDING SOCIETY

Originator's reference 422562 DIRECT Debit

Name of bank...

Address of bank ....

....

.... Postcode ....

Account holder ....

Signature .... Date ....

Sort code ☐☐☐☐☐☐ Account number ☐☐☐☐☐☐☐☐

Instructions to your bank or building society: Please pay MyTimeMedia Ltd. Direct Debits from the account detailed in this instruction subject to the safeguards assured by the Direct Debit Guarantee. I understand that this instruction may remain with MyTimeMedia Ltd and if so, details will be passed electronically to my bank/building society.

Reference Number (official use only) ☐☐☐☐☐☐☐☐☐☐

Please note that banks and building societies may not accept Direct Debit instructions from some types of account.

CARD PAYMENTS & OVERSEAS

Yes, I would like to subscribe to *Model Engineer, for 1 year* (26 issues) with a one-off payment

UK ONLY:
❏ Print + Digital: £77.99
❏ Print: £65.99

EUROPE & ROW:
❏ EU Print + Digital: £104.99
❏ EU Print: £92.99
❏ ROW Print + Digital: £117.00
❏ ROW Print: £105.00

PAYMENT DETAILS

☐ Postal Order/Cheque ☐ Visa/MasterCard ☐ Maestro

Please make cheques payable to MyTimeMedia Ltd and write code ME2021 on the back

Cardholder's name...

Card no: (Maestro)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐

Valid from.............................. Expiry date.................... Maestro issue no...................

Signature.. Date............................

POST THIS FORM TO:
MODEL ENGINEER SUBSCRIPTIONS, MYTIMEMEDIA LTD,
3 QUEENSBRIDGE, THE LAKES, NORTHAMPTON NN4 7BF

CODE ME2021

PRINT + DIGITAL SUBSCRIPTION

- 26 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- ***Download*** each new issue to your device
- A ***75% discount*** on your Digital Subscription
- Access your subscription on ***multiple devices***
- Access to the ***Online Archive*** dating back to August 2001

PRINT SUBSCRIPTION

- 26 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- Never miss an issue

SUBSCRIBE TODAY

SMOKE RINGS

MARTIN EVANS
Editor

DIANE CARNEY
Assistant Editor

YVETTE GREEN
Designer

IMLEC 2021

Sadly, the International Model Locomotive Efficiency Competition had to be cancelled last year – just one of the many casualties of the covid-19 pandemic. I am very pleased to be able to say that it will be happening this year. This is a welcome sign that things are slowly getting back to normal.

The competition is being hosted this year by the Maidstone Model Engineering Society at the track in Mote Park over the weekend of the 20th-22nd August. An application form and a copy of the rules are included in this issue on pages 429 and 430. The closing date for applications is the 30th June but there are already several entrants for the competition so, if you would like to enter, I would suggest getting your application in fairly promptly!

More details about the competition are available via Maidstone's website (maidstonemes.co.uk/imlec), including information about how to get there and camp sites and other places to stay.

Mystery Object

I am now an expert on shotgun choke gauges! I have received several further replies about our mystery object from issue 4658 complete with many details about the design and use of shotguns, including one from David Richards, from the Lake District, who tells me that he makes these gauges for the local gunsmiths.

Model Engineer readers are certainly a very knowledgeable group of people.

Model Engineer Index

There are a number of indexes (indices?) available online for *Model Engineer* magazine, and also for *Model Engineers Workshop*. I personally have found these very useful for tracking down past articles and answering some of the queries I receive as editor. The apparent disappearance of one of these indexes has caused some consternation and Chris Orchard (Taunton) informs me that it has been relocated and is now resident at www.ropewalkview.uk/me_index.html. Another index that I am aware of may be found at www.itech.net.au/modelengineer (up to 2014 only).

17D Slate Wagon

17D have just announced their new 7¼ inch gauge slate wagon kit. This is a complete set of bolt together parts to build a narrow gauge slate wagon like those seen, for instance, on the Ffestiniog Railway. All the parts needed are contained in the kit, including laser cut steel frame work, machined axle boxes, curly spoked, CNC machined wheels and axles. Assembly is very straightforward and fully illustrated instructions are available.

Dimensions when assembled:
* Overall Length: 752mm
* Overall Width: 352mm
* Height above rail head: 360mm

This could be very useful for conveying your picnic around your club or garden railway or for the containment of unruly children.

The kit is available to purchase now on the 17D website: www.17d-ltd.co.uk – or call 01629 825070 or 07780 956423.

And Finally...

Having been banned from the barbers during this latest lockdown, many of us may have grown rather impressive heads of hair (those of us who have any to start with, that is). A friend suggested that I run a competition for the most glamourous *coiffure* amongst the model engineering fraternity. Upon reflection I concluded that this would probably be a *flop* as the words 'fashion', 'glamour' and 'model engineer' do not generally inhabit the same space. Instead, I include a photograph of a model built by the late Tony Oxley, to remind us all what a barber shop looks like and to help us in locating one once they open again.

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

IMLEC 2021 Application form

THE INTERNATIONAL MODEL LOCOMOTIVE EFFICIENCY COMPETITION
For the MARTIN EVANS TROPHY AND PRIZE MONEY

Hosted by MAIDSTONE MODEL ENGINEERING SOCIETY
On the weekend of 20th – 22nd August 2021
In Mote Park, Maidstone

Closing date for applications 30 June 2021

Applicant's details for correspondence to be sent:

Name:
Address

Phone:
Mobile:

Email:

Name of driver *if different from above*:

Home club/society of competitor:

Identity of locomotive: **Gauge:**

Brief details/history of loco, including any points of interest:
(*Please also attach a photo if possible) continue overleaf if necessary*

We will endeavor to accommodate all applicants, however please indicate your preferred running day in order of preference, and whether you would be willing to be a reserve.

Friday **Saturday** **Sunday** **Reserve**

It is possible that throughout the competition video will be taken. By signing this form permission is granted for this to be taken and used.
Would you also be willing to be interviewed on camera?

Signature of applicant: Date:

Please return to:
Tom Parham
11 Valentine Drive
High Halstow
Rochester
Kent ME3 8BA **or email:** tom_parham@hotmail.co.uk

IMLEC 2021 - THE INTERNATIONAL MODEL LOCOMOTIVE EFFICIENCY COMPETITION for the MARTIN EVANS TROPHY AND PRIZE MONEY - MAIDSTONE MMES

RULES

Applications and Allocation of Places

1. The competition shall be open to any applicant on the proviso that he or she can provide a valid current boiler certificate for the locomotive to be used and evidence of adequate public liability insurance. The locomotive must be 5 or 3½ inch gauge, able to run on raised track and the driver must not ride on the locomotive or tender.
2. Once the driver has accepted the offer of a competitor's place he or she must either compete in or retire from the competition. The place is not transferable to another driver or locomotive.
3. Once the driver has accepted the offer of a competitor's place he or she is obliged to compete only with the locomotive identified in the application.
4. In the event that a competitor withdraws from the competition in advance of the competition date, or on the day of the competition, the competitor first named on the reserve list shall be invited to compete. (Subsequent such invitations shall be issued in number order as required.)
5. Ballast (including water) added externally to the scale outline of the locomotive (or, in the case of a freelance model, the likely scale outline) is not permitted.

Preparation for the Run

6. The host club shall prepare a suitable timetable for the duration of the competition.
7. The steaming bay marshal's instructions with regard to movements shall be obeyed during steam raising.
8. Competitors should arrive at the track at least one and a half hours before their run and report to the steaming bay reception. At this point the competitor shall:
   a. Present the necessary documentation including boiler certificate
   b. State the amount and grade (size) of coal required for the run. The coal will be weighed and allocated in the presence of the driver. Additional coal will not be available during the run.
9. Ample preparation time shall be allocated to the competitor and the competitor shall be ready to run at his or her allocated time. Failure to run on time may be regarded as a retirement. The judge shall use discretion and make the final decision.
10. The driver shall use his or her discretion with regard to the appropriate time to light up. (The driver will be notified of any foreseeable delay to the running time before lighting up.)
11. The driver will be provided with as much dry, or paraffin soaked, charcoal and wood as is required to raise steam. The driver may use his own wood for lighting up purposes but this must be approved by the steaming bay marshal.
12. Any coal used during steam raising will be from the measured allocation.
13. The driver may decide when to start to use coal but the locomotive must be burning coal before leaving the steaming bay.
14. The train will be prepared for the driver with the dynamometer car at the front and sufficient passenger cars to carry the number of passengers he or she requires. (For practical reasons it may be necessary to limit the load or number of carriages pulled in the contest.) The train will be made ready before the locomotive leaves the steaming bay.
15. The driver will be allocated an observer. The observer will oversee all procedures between and including raising steam and completing the run.
16. The observer shall give an instruction to move to the start line at an appropriate time. The driver shall advise the observer of the number of passengers he/she wishes to take.
17. All coupling and uncoupling of the locomotive must be carried out by the host club marshals, to the driver's satisfaction.
18. The observer will record the initial dynamometer car readings in the presence of the driver.
19. The driver shall inform the observer when he is ready to start the run and the timekeeper shall give the driver permission to start.
20. If the driver is unable to commence the run within a reasonable time of the designated start time, he/she will be deemed to have retired.

The Run

21. The run length is nominally 30 minutes. a. The timekeeper shall inform the driver when he has been running for a) 15 minutes and b) 20 minutes.
    b. The driver will be notified when he/she has completed 25 minutes of the run, at which point the driver can either finish the run at the finish line or continue for one further lap (or more, if time permits) but in any event the driver must start the last lap no later than 30 minutes after the start time.
    c. The run shall finish before 35 minutes, after this point the driver will be deemed to have retired.
    d. Recording will commence and conclude at the start/finish Line. (A slight over-run at the finish line will be disregarded.)
22. In the event that the driver does not complete his/her run, he/she shall be deemed to have retired. ('completing the run' means bringing the train to a stand upon reaching the finish line, the locomotive having reached the finish line entirely under its own steam.)
23. The total period the train may be stationary during the run will be eight minutes. If this is exceeded then the competitor will be deemed to have retired.
24. Water will be provided in suitable containers during the run to enable locomotive water tanks to be topped up without stopping. The amount of water used shall not be recorded or limited in any way.
25. Additional coal will NOT be available to the driver during the run.
26. Unused coal will be weighed and recorded in the presence of the driver upon completion of the run. This will be debited to the recorded coal consumption.
27. Only the total weight of coal used will be included in the calculations. No allowance will be made for any unburnt coal in the firebox.
28. The maximum speed permitted will be 8mph. The dynamometer car shall provide a speed indication at the driver's position. The observer will issue a warning to the driver of the speed limit if necessary. Three such warnings may result in disqualification. The observer will have the power to end the run should the driver be considered to be driving unsafely. In the event of a disagreement the judge's decision will be final.
29. The use of a hand or electric pump is not permitted once the run has commenced. However, it may be used in emergencies when all other means of water feed have failed and in which case the locomotive must be retired and the run terminated immediately.
30. The driver may elect to set down passengers during the first 25 minutes of the run but only when the train is stationary and it is safe to do so. Passengers may not be picked up at any time. In the interest of safety, the guard may, at his discretion, instruct that passengers be redistributed throughout the train. After 25 minutes, passengers may not be unloaded until the end of the run, otherwise the driver will be deemed to have retired.
31. No external assistance is to be given to the train in any way whatsoever, at any time during the run.
32. The driver shall have access to a train brake for emergency use only. Any use of the brake under non-emergency conditions may result in disqualification. This includes use of the brake to slow the train at any point. The brake may be used to stop the train at the end of the run.
33. Any locomotive fitted with working sanders shall be allowed to use them for the purpose of sanding the track.
34. The host club will endeavour to post the results of each run as soon as possible following the end of the run.
35. In all matters relating to the competition, the decision of the judge is final.

The Wouda Pumping Station

Leen Brouwer conducts us on a tour round the world's largest steam-powered pumping station still in service.

The Netherlands is a river delta and consists partly of silted up land; Friesland, one of the northern provinces of the Netherlands, is partly silted up land so we have to have a means of keeping the feet of the Frisians dry! Following a period of exceptionally heavy rainfall the electric pumping stations don't have enough capacity so, in these events, the steam powered Wouda Pumping Station is pressed into service to get rid of the excess water. This usually occurs, on average, about twice a year. The crew is mustered from the surrounding areas where their usual daily work is as bridge operators, lock keepers and other such occupations.

The Wouda Pumping Station is the largest pumping station ever built and it has been on the UNESCO World Heritage List since 1998, being one of the ten such recognised heritage sites on the List that represents the Netherlands. All countries that have signed the UNESCO treaty have committed to protecting their heritage, among other things, and making it accessible to future generations. In addition to an entry on the World Heritage List, the Wouda Pumping Station is also one of the top 100 Dutch national monuments.

The Wouda pumping station.

One evening back in 2012 I was listening to a popular evening radio programme when, between 11pm and midnight, the Friesian weatherman forecast some exceptionally heavy rains, likely to result in a huge amount of water in Friesland. The following Sunday was the day the Wouda Pumping Station would be in operation to pump the water out of Friesland, so I decided to go and have a look.

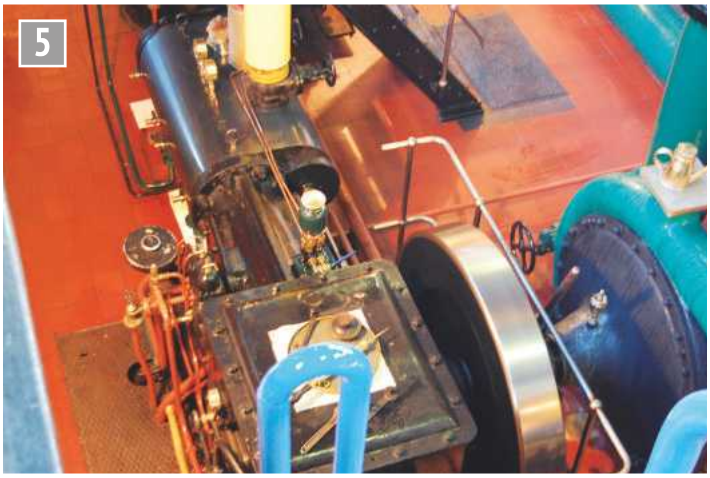
The construction of the Wouda pumping station, named after the water company's Chief Engineer, IR. D. F. Wouda, began on 19 January 1915 and it was commissioned on 7 October 1920 by H.M. Queen Wilhelmina. The architectural design of the pumping station (**photo 1**) is very reminiscent of Berlage's Stock Exchange building in Amsterdam.

There are four tandem compound steam engines in the machinery hall, each

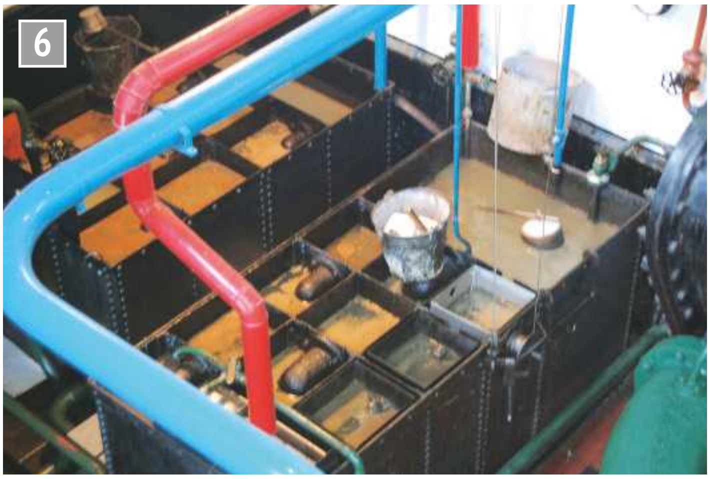
The row of four tandem compound steam engines.

'Jaffa' centrifugal pump.

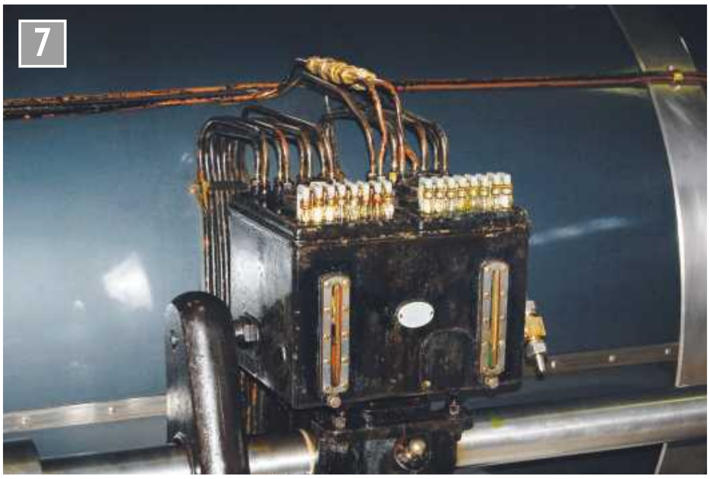
>>



Condensor units, driven by steam turbines.



Oil separator.



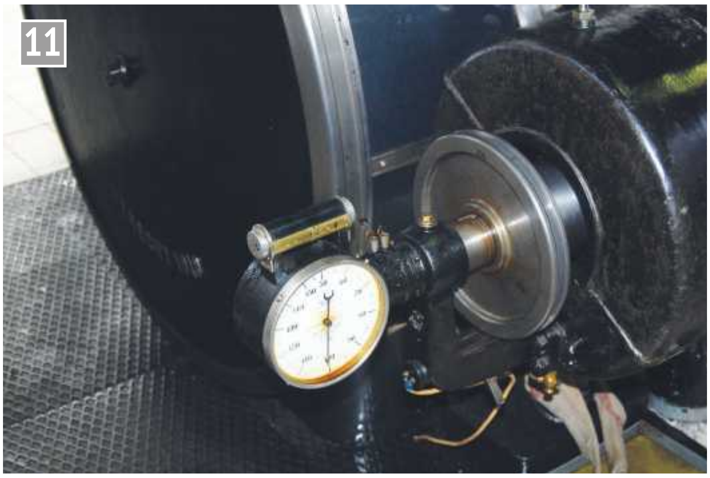
Cylinder lubricator.

Steam admission valves.

The control wheel.

of about 500 horsepower, designed and executed by the Machinery Factory Louis Smulders, Jaffa in Utrecht in 1919 (**photo 2**). Each steam engine drives two centrifugal pumps (**photo 3**) made by Jaffa in 1920. In the basement are two condensers, each powered by a steam turbine that drives three pumps (**photos 4** and **5**). These are a circulation pump that supplies the cooling water for the condenser, a condensate pump (plunger pump) that drains the condensate and an air pump (piston pump). After the condenser, the condensate goes to the hot water tank (**photo 6**) where the oil is separated. The high pressure cylinder of the steam engines is single acting, the low pressure is double-acting and works according to the DC principle. The machine works with superheated steam, 12 bar at 310 degrees Celsius. The steam must be superheated because the distance from the boiler to the steam engine is up to 60 meters and a lower temperature would cause condensation before the steam enters the high pressure cylinder. Use of superheated steam makes lubrication necessary and this is done with a cylinder oil lubrication device (**photo 7**). For the steam distribution equilibrium valves (double beat valves? –Ed.) have been employed, which move vertically in liners of particularly hard cast iron (**photo 8**). Piston valves have

Keeping things running smoothly.



Revolution counter.

Oil fired boilers.

Vital signs.

the advantage over slide valves in that they have better longevity. The steam supply to the high pressure cylinder is controlled with a valve. The number of revolutions - up to 125 revolutions per minute - can be regulated with the hand wheel (**photos 9** to **11**). The high pressure cylinder diameter is 500mm and the low pressure, 825mm diameter. The stroke is 1000mm. The surface condenser area is 152M^2.

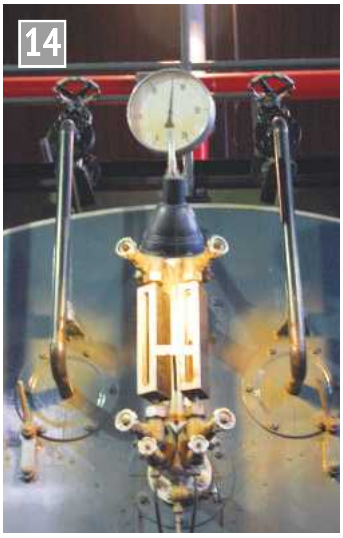
In the boiler house there are four Werkspoor boilers that have supplied the steam since 1955 (**photos 12, 13** and **14**). The only significant change at the pumping station has been the replacement of the six original Lancashire boilers by four larger capacity installations in 1955 and their subsequent conversion from coal to fuel-oil firing twelve years later. Each of the new boilers produces steam at 4750kg/hour (over 10,000 lbs/hour!), which corresponds to a load of 21.6 kg/hour per M^2 of heating surface. The boiler shell diameter is 3600mm, the length of the boiler between the tube plates is 3950mm and the total length over front and rear smokeboxes is 5300mm; there are twin furnaces of 1100/1200mm diameter. The smoke tubes have a diameter of 95/88mm. The plate thickness of the boiler shell is 23mm and the tubeplates, 30mm. The furnaces have a plate thickness of 15mm. The superheaters have a heated surface of 31M^2 and consist of a number of parallel tubes welded in collection headers with a diameter of 33.5/25.5mm.

As an old ships engineer I was impressed by the beautiful building and how it seems so inkeeping with the machines - and how little noise the machines made.

If you would like to visit, it's a trip of about two hours from Schiphol Airport.

W. www.woudagemaal.nl

ME



Water gauges.

PART 1

A Queensland DH Class Diesel Locomotive in 5 Inch Gauge

George Punter builds a 5 inch gauge version of a locomotive that evokes old memories.

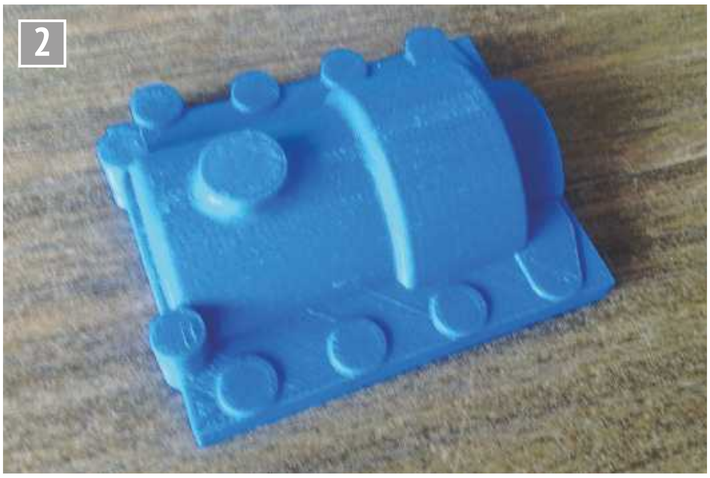
I hope the old saying that 'the longer you keep the wine the better it will taste' applies to model engineering projects as this project began back in about 1987 but the real story starts back in the late 1970s.

At that time my youngest son was just beginning to take an interest in all things mechanical and I felt that it was my duty to foster this interest so decided it was time for a ride on our local train. He is now forty plus years old! In the 1970s the main line north ran through Bundaberg, but it also had a spur line to a small town called Gin-Gin, some 50km inland. This line had originally run through to Mount Perry, an old gold mining town, but when the gold and other minerals ceased to be financially viable that part of the line was closed.

The day arrived for our train ride. What an adventure this was going to be! At the station we lined up to buy our tickets and when I asked for 'one adult and one child to Gin-Gin please', there was a startled reply, "are you sure you want to go there? I will have to see if we have a carriage". And with that he proceeded out across the tracks with dustpan and brush in hand to a carriage parked in a siding. The train was now being assembled and our carriage was the last vehicle to be added. It turned out that we were the only passengers on board and had all the carriage to ourselves. The train was being pulled by a Queensland DH class Diesel locomotive that had been manufactured by Walkers Ltd. in Maryborough about 110km south of Bundaberg. This company has a long history of making steam and Diesel locomotives and over recent years has manufactured the high-speed trains that ply the Queensland east coast route to the north of Brisbane. Queensland uses a gauge of 3 foot 6 inches but due to lack of standardisation in the early years other states opted for a larger span between the rails.

The DH class locomotive.

The train gave a toot on the horn and we were away, trundling across the girder bridge that spans the Burnett River and on our way to Gin-Gin. This was no high-speed train and it seemed to take quite some time before we left the built-up area of the town. We were now out in 'cane country' – that is sugar cane country - and making steady progress. The train had goods wagons that contained a wide variety of materials. There were large concrete irrigation pipes for the new irrigation system that was under construction, timber being delivered to Gin-Gin and drums of some unrecognisable material for the farms. At one point we came to a grinding halt out in the bush where some of the goods were off loaded, later to be collected by trucks and taken to where they would be required. At a small settlement called Bullyard the train must negotiate not only curves but also a slight incline. The wheels could be heard squealing under protest as the flanges pinched the rails. The scenery has now changed; we have left the cane fields behind and are about to enter cattle country. This area has more gum trees and less flat arable land. After quite some time we arrived in Gin-Gin where we left the train and walked into the town for some food and drink. The train continued for a few more kilometres to retrieve some freshly cut, hardwood railway sleepers and later returned to the station so that the driver could have his lunch. We returned to the station and had a chat to the driver. When we told him we are the only occupants of the carriage he asked, "would you like to ride up the front in the locomotive with me on the way back home?". *Would we... ?* There was no need to ask twice and with that we both hopped into the cab, thrilled to think that we were going to be up where the action



Gearbox top pattern.

Gearbox castings.

took place! The first thing to hit you is how hot this cab is. There is no air conditioning and only small fans to blow the already hot air around. The second thing is how noisy it is with a thumping great Diesel engine bellowing its heart out just a couple of feet from where you are standing. At this stage my son's eyes were just about to pop out with joy. Could this really be happening and have I got a story to tell them at school next week?

We trundled back at about the same speed as we had come up but arrived back at the junction of the main line earlier than expected. Not being able to proceed forward what does one do? The answer is quite simple - you just get out of the locomotive, make a cup of billy tea and take a rest. The main line train passed and we returned to the station after a very memorable day and one that made a lasting impression, not only on my son but also on his dad!

It was this experience that was later to generate the motivation to want to make a model of a DH locomotive. In these days of workplace health and safety this journey would not take place and we would have been denied the experience. Unfortunately, this railway line has since been closed which is a great pity as it would, I believe, have made a great preserved railway and tourist attraction.

The DH class locomotive (**photo 1**) is a Diesel hydraulic with a power rating of 375kW (Caterpillar D353) and weighs 40 tons. It is just over 10 metres long, 3.8 metres high and 2.8mtrs wide. As these locomotives were withdrawn from service some were converted to sugar cane locomotives and regauged to 2 feet. It was at this point I had access to them to photograph and measure them for the purposes of making a 5 inch gauge model. On my way back from work I would call in and spend some time collecting information. Having this type of access made life easier as I was able to photograph inside the cab, under the chassis and in the engine bay. I had also written to Walkers for information and they hand supplied drawings of the side and end elevation that I was later able to scale up using a photocopier. When a project like this is undertaken there are no instruction sheets on how it is to be made or assembled and one must rely on experience or analyse how the full-sized locomotive had been made and assembled.

I decided that my starting point would be the chassis, and this would take the form of a channel of 16swg zinc coated steel 200mm wide, 52mm deep and 1200mm long. As bending this to shape was beyond my workshop capabilities it was taken to a local sheet metal workshop where the job could be completed accurately. The running boards are made of the same material, only this time they were bent to an 'L' shape so that they could be bolted to the sides of the main frame chassis. The resulting shape is very strong and provides a good platform for the mechanical parts and cab etc. On the full sized locomotive the two bogies are fabricated from sheet metal and then welded up. I used the same method except I silver soldered my structure taking great care to avoid any warping. This was quite a difficult job as there are many parts to be joined and two bogies to be made. At this stage some of the peripheral parts and small brackets were added. As these frames are hollow, I had to allow for the expanding air to escape so a small hole was drilled in the underside to allow this to happen – this would later be used to inject fish oil to prevent corrosion. Adding fish oil sounded good at the time but the smell pervaded to workshop for quite some time, much to the pleasure of the local cat population! When these parts were roughly assembled on the bench, I could begin to see the task ahead. It's the vision of the finished project that provides the drive, but in my case that did waver at times!

All eight wheels on the locomotive are driven and use was made of bevel gears from cotton picking machines, these being donated by a cotton farmer from over the Great Dividing Range. At that stage I did not think I could accurately cut eight gears of this type. Spur gears I could manage and would go on to cut many of them for the gearboxes. The housings for the bevel drives are split horizontally and involved making suitable patterns and castings in aluminium. A successful day in the foundry part of my workshop saw not only these being cast but also the gearbox cases that are attached to the centre axle gearboxes of each bogie (**photos 2** and **3**). These castings were then machined up and bronze bushes fitted as there was insufficient space for ball races (**photo 4**).

●To be continued.

Partially assembled gearbox.

My Introduction to Engineering

D A G Brown recalls his first experience of real engineering.

Reading Roger Backhouse's accounts of large stationary engines jogged my memory to the time when I was fresh out of university and being exposed to the manufacture of large items of machinery of not dissimilar type. I was recruited by ICI who deemed that I should join their graduate apprenticeship scheme, which turned out to be a real eye-opener and generally valuable experience. They sent me for my first year to Peter Brotherhood Ltd., of Peterborough, a firm of general engineers, whose team of around 1200 personnel operated from a long, narrow site alongside the east coast main line, some two miles north of Peterborough city centre. Although the firm survives today as a shadow of its former self, in those days they made most things from first principles, starting from patterns; they had two foundries, one for ferrous and the other much smaller one for non-ferrous metals.

During my time in this environment they were casting some crankcases for large compressors for the oil industry. Although in no way related to stationary steam engines, the scale of operations was not dissimilar. Each crankcase had to be cast from 22 tonnes of iron, an operation which took the whole of the foundry capacity for a day. Two moulders spent more than two weeks building the sand mould in the floor of the foundry, with 'CO^2 sand' rammed around the huge pattern which was upside down in a sand-lined pit. The sand contained sodium silicate which, when treated with carbon dioxide, went rock-hard as it changed to sodium carbonate. This transformation enabled the great pattern to be withdrawn piecemeal from the sand mould, making room for the implanting of the various sub components and cores, as well as the runners and risers. The final move in forming the mould was to position the top cover which furnished the main runners and the vent pipes, or risers, to allow the air and other gases to escape. The finished mould rose up about a foot above floor level. At its ends were built two pouring chambers with the normal runners leading out from them to enable the molten iron to be poured simultaneously from two sets of runners. The sheer size of the job can be imagined when it is realised that over 20 tonnes of iron must be poured in under two minutes from the two ladles.

Bearing in mind what has already been stated about foundry capacity, the crankcase pouring occupied one whole day's melting and pouring, making use of two 10 ton ladles, with a smaller one standing by as a top-up. Realising what was going on and knowing the spectacular nature of the occasion, I sought permission to linger after work to watch the procedure. I was sternly warned, "stay on that platform and don't wander, but you may take photographs for your own use. Furthermore, don't get in the way of the professional photographer who will be there for the company's benefit." And so it came to pass; the foreman, factory manager and various dignitaries clustered around the mould and stepped back at the right moment as the two overhead cranes brought in their respective 10 ton loads of molten iron. A further small crucible of iron was positioned on the floor nearby.

Pouring the mould happened in a few minutes, molten iron being fed to both ends of the mould simultaneously. At first the molten streams of metal just disappeared quietly into the runners but, as the pour approached its end, fierce jets of flame started to appear from the risers with a crescendo of noise accompanying the firework display. Finally, the whole mountain of moulding sand filled up and the excess iron flowed out and formed a network of white hot 'pigs' of iron in channels that had been fashioned in the foundry floor. The whole process was spectacular, appealing to all the senses as the foundry atmosphere became really foggy and then gradually cleared as the pour was completed.

I was by this time well acquainted with the sounds and smells of the foundry, so in the short time that the fireworks took place I was able to record what I wanted on my little *Agfa Silette* camera. Not so lucky was the poor old professional photographer beside me who had probably never been inside a foundry before. While I clicked away merrily during the whole process, he was so terrified and startled that he never made a useful exposure from his *Rollieflex* kit. I had the last laugh when the following day I was asked to show him the pictures I had obtained whenever they were processed so that he might better understand the procedure during a return visit. Fortunately, my old photographs have survived, so a brief description of the process they represent is as follows:

1 Two ten ton ladles of molten iron have been brought in by the overhead cranes and are positioned to pour (**photo 1**). A layer of flux protects their top surfaces and retains the heat.
2 As the pour is under way fierce jets of flame leap from the risers (**photo 2**).
3 When the mould is full of metal, excess runs out to form 'pigs' of iron (**photo 3**). The presence of these extra pieces is a reassuring indication that the mould has been properly filled. They will be later recycled in the foundry process.
4 The 'pigs' cool safely as the activity dies down (**photo 4**). Everything will still be hot the following morning.

The day after the cast took place the moulders started digging out the casting; it was obviously still too hot to handle. Remember too that, as it had been cast upside-down the whole of its middle had to be excavated with a shovel before the cranes were brought in to lift it out from its place in the floor. In an organisation like Brotherhoods the ability to perform such operations as these placed the company in a very favourable position. Even in those days the number of firms with their own foundries were few, let alone their own pattern making facilities! But that is another story.

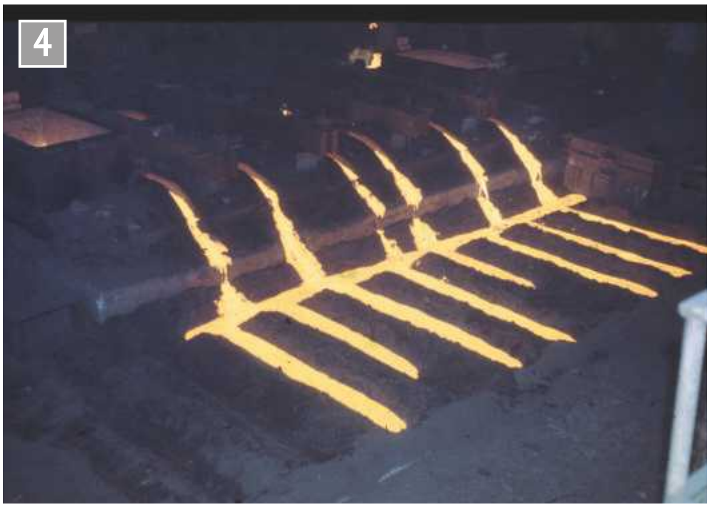
The foundrymen were a close-knit bunch, typically working in pairs to produce a specific kind of casting. Thus this pair who produced the large crank-cases specialised in burying their patterns in the floor and building up to just above ground level, but most patterns were split through their centre lines, each half starting upside-down resting on an iron surface with the sand rammed into an iron box mould in such a way that the mould could be filled hard, level with its top. After ramming with sand the pattern was 'rapped' with a suitably sized bar of metal to loosen it within the mould. This enabled withdrawal of the pattern, leaving a void into which metal could be poured to make the casting. It was alleged, although I have never verified the claim, that the reason that Brotherhoods was located in its particular position was that the water table was low and it sat upon a sandy sub soil, rather than the peaty fenland structure for which the immediate area is renowned.

I soon understood the provision of runners and risers to allow the iron to fill the mould and to make sure that no air pockets spoiled the shape of the finished casting. A short while before I arrived on the scene the foundry industry had been revolutionised by adopting the CO^2 sand process for moulding. Originally in the green sand moulding process sand with some small amounts of additives was rammed into the mould around the pattern and when the pattern was withdrawn the mould was very fragile and liable to collapse. The CO^2 process speeded things up and produced a much more resilient structure, albeit with a slightly rougher finished surface on the casting. The

Ladle positioned to pour.

Flames emitted from the risers during the pour.

The excess forms 'pigs' of iron.



The 'pigs' cool down.

>>

new sand (which could not be re-used) arrived at the foundry already mixed with the right amount of sodium silicate. Having rammed the iron box containing the pattern full with sand, CO^2 was administered to the mass of sand through small tubes which could be found all over the foundry. The gas just found its way through the structure of the sand and the whole thing went hard normally in under a minute. At this stage the pattern could be lifted out to reveal the void into which metal would be poured. Before this happened however, the skill and knowledge of the foundryman was relied upon to cut the necessary runners and risers into which the metal would flow.

In normal days the team of moulders would produce a large number of sand moulds in iron moulding boxes of various sizes ready for casting during late afternoon. Each one had to be put together from its two halves, complete with its runner and riser system and the provision for pouring from a ladle as each mould was filled in turn. One piece of folk law governed the way that moulding boxes are assembled. Each box comprises two halves in which typically the upper and lower portions of the pattern are assembled. In the normal method of assembly, the lower part of the pattern is placed top face down on the moulding table, surrounded by a moulding box. The sand is rammed tightly everywhere it can go, thus producing a hard bottom surface that is then turned over to allow the other half of the mould to be filled. The two halves of the mould are doweled together with loose dowels and the convention is to twist the top one clockwise ('following the sun') to take up backlash.

Pig iron was melted in a pair of cupola furnaces, the preserve of one particular character whose life was ruled by the need to produce molten iron every afternoon and to pour it into a large number of waiting moulds. Modest quantities could be handled by two men who carried the ladle rather like a sedan chair, while the overhead cranes were required for larger quantities. Pouring occurred in the late afternoons – logically, because pouring hot metal does not easily mix with other activities like building the moulds nearby. Furthermore, the moulds were left to cool overnight ready to be broken and fettled in the morning.

The chap who ran the furnaces (or cupolas) was a bit of a loner. He knew what his special responsibility was and, when pouring was taking place he was master of the whole area. His boots had no laces, since he maintained that in the event of a spill of molten metal he would be able to leap clear of danger, leaving his boots to perish in the molten metal.

At one end of the foundry was the fettling equipment: a dedicated small team of fettlers split the moulds and removed first the loose sand and then cut away the runners and risers as necessary. One dapper little fettler used to arrive very smartly turned out first thing in the morning. He had a good mop of pure white hair and matching eyebrows. After a hard day's fettling he was dark haired and seemed quite content to go home in that state ready for a bath. I have often wondered about the life-expectancy of people like this in industry sixty years ago. I had already been alerted to the threat of silicosis in occupations such as this; full sensitivity to these problems at this stage was still some way off.

The range of castings produced was wide and this meant that their sizes varied greatly. The largest items were the crankcases for giant compressors for the oil industry, which have just been described. At the other end of the scale were myriad small items from all sorts of pieces of equipment being made by the company. Alas, today the foundry no longer exists and castings are bought in from dedicated suppliers. Methods of production starting with pattern making have changed and one is hard put to find general engineering firms with their own foundries. This was my lucky opportunity.

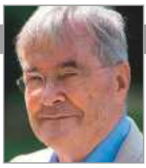
My time in the foundry was so fascinating, partly because it came at the beginning of my training period.

Whether the castings being produced are for a stationary steam engine or for a compressor, the principles are the same; since the industrial revolution mechanisms have evolved that require castings to do their jobs economically. With the more recent introduction of sophisticated profiling and fabrication methods, the need for castings is perhaps not as great as it used to be. Perhaps we have lost some of the nicer aspects of life, such as the way that some of the castings were embellished with ornamentation, but they are still needed and the way they are turned out in small numbers is still the same as ever. One of the things that can now be taken for granted is the composition of the iron and within the designation 'cast iron' one can be more specific to achieve one of a number of grades whose physical properties vary over a significant range. Gone are the vague days of Bouch's Tay Bridge when the Wormit foundry could get away with describing it as *best best iron.* We all know what happened to the Tay Bridge in 1879!

ME

PART 2 - STRESSES AND DISTORTIONS DURING OPERATION

Stress Analysis of a Model Steam Boiler



Wim Merks, Chairman and Safety Coordinator of the Dutch Model Steam Society, shows how Finite Element Analysis can be used to analyse stresses in model boilers.

Continued from p.389
M.E. 4660, 12 March 2021

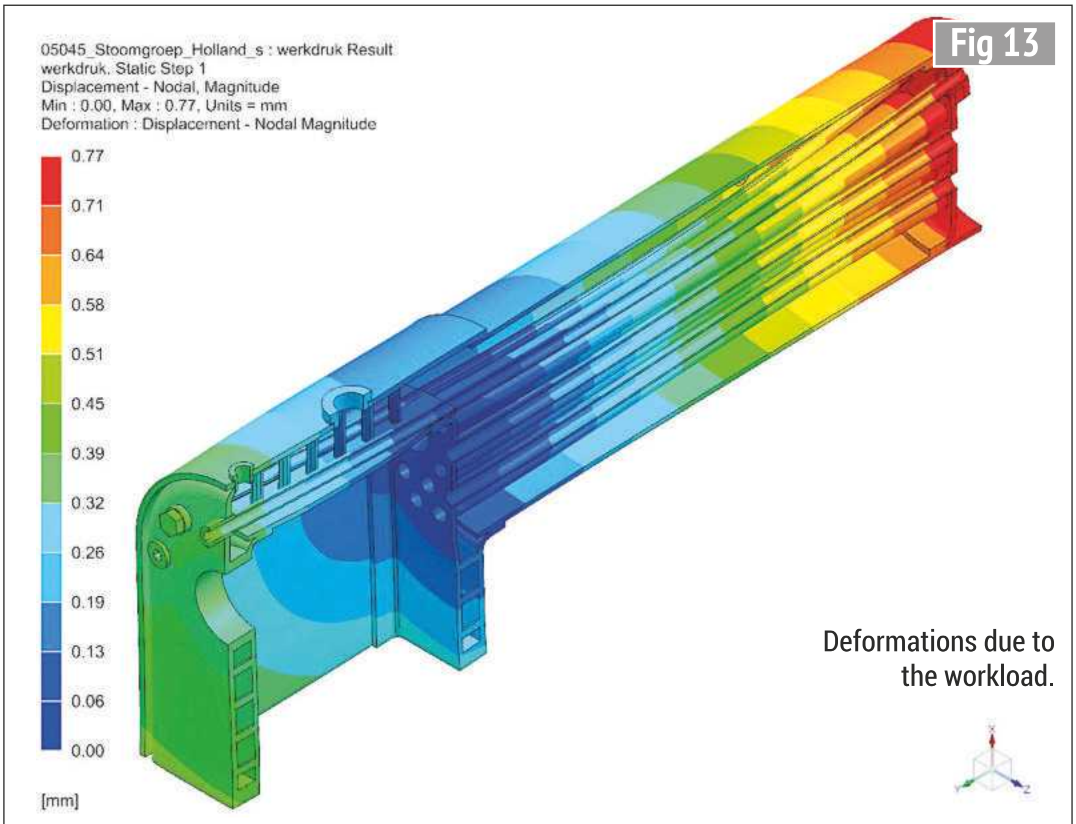


Fig 13

Deformations due to the workload.

This article was first published in 2020 in *Onder Stoom*, the magazine of the Dutch Model Steam Society.

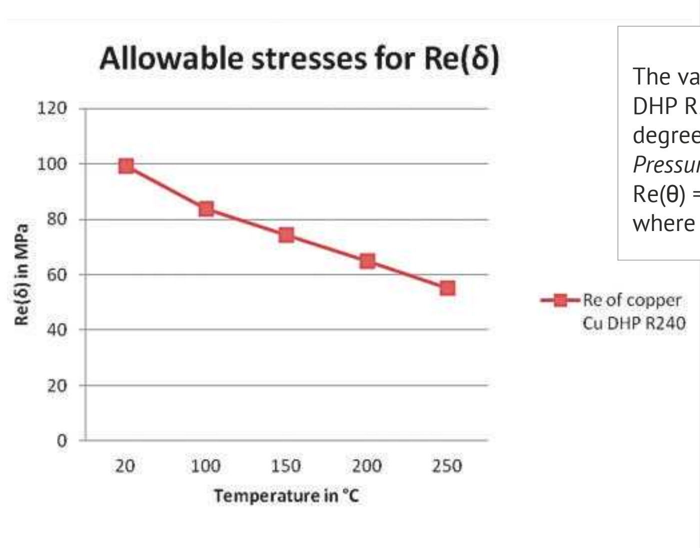
In part 1 the boundary conditions were shown and a thermal analysis was described. In this section the deformations and stresses will be shown during operation of the boiler at a pressure of 6 bar (0.6 MPa) at 165 degrees C and in part 3 at a test pressure of twice the working pressure, i.e. 12 bar (1.2 MPa) at 20 degrees C. Bar in this context means pressure over atmospheric pressure.

The working pressure results include the stresses resulting from the thermal analysis. The stresses, as shown in the pictures, are shown in MPa, according to the Von Mises criterion. This criterion determines the point where a body starts to deform plastically (i.e. exceeds the yield strength) when it is subjected to a multidimensional (3D) tensile, torsional and/or shear stress. This stress is thus comparable to the stress that occurs in the tensile test of a material in which the load only occurs in one direction. The value in MPa determined according to the Von Mises criterion must therefore not exceed the yield strength of the material, determined in a tensile test.

Deformations during operation of the boiler at 6 bar and 165 degrees C

The distortions in **fig 13** are shown 100x magnified to show more clearly what they look like. The maximum deformation of any part in the boiler is 0.77 mm and - as shown in the figure - this takes place at the smokebox end of the barrel. It can also be deduced that firetubes will show some deformation as a result of the uneven expansion of the whole and due to deformations of both tubeplates. The firebox also shows some uneven expansion.

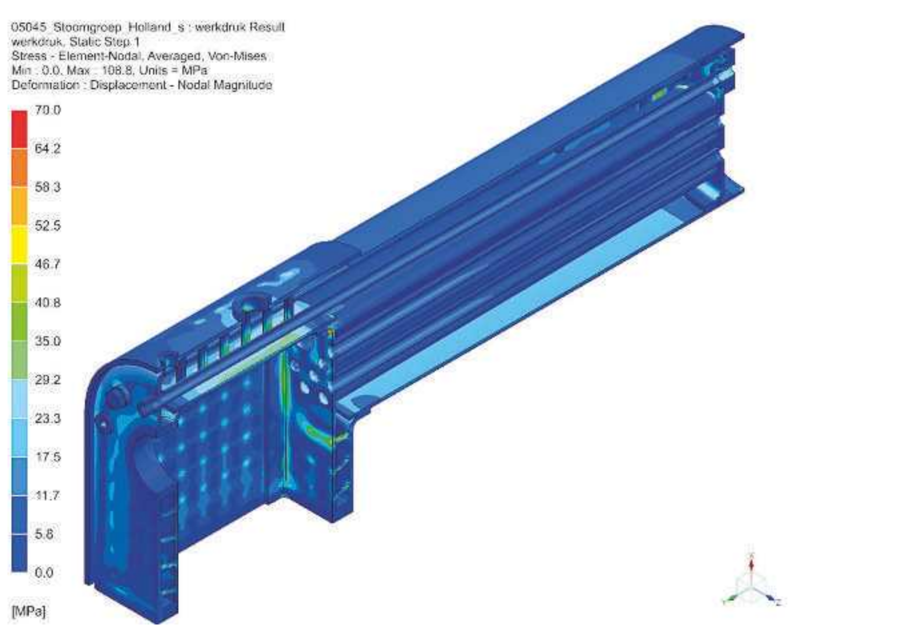
»



The values introduced for the yield stress at temperature θ for copper CU-DHP R240 (former indication SF-Cu as per DIN1787) at temperatures >20 degrees C are in accordance with sheet D105, Attachment 1 of the *Rules for Pressure Vessels* of the former Dutch Stoomwezen
Re(θ) = Rm × (540- θ)/1260
where Rm = tensile strength at 20 degrees C

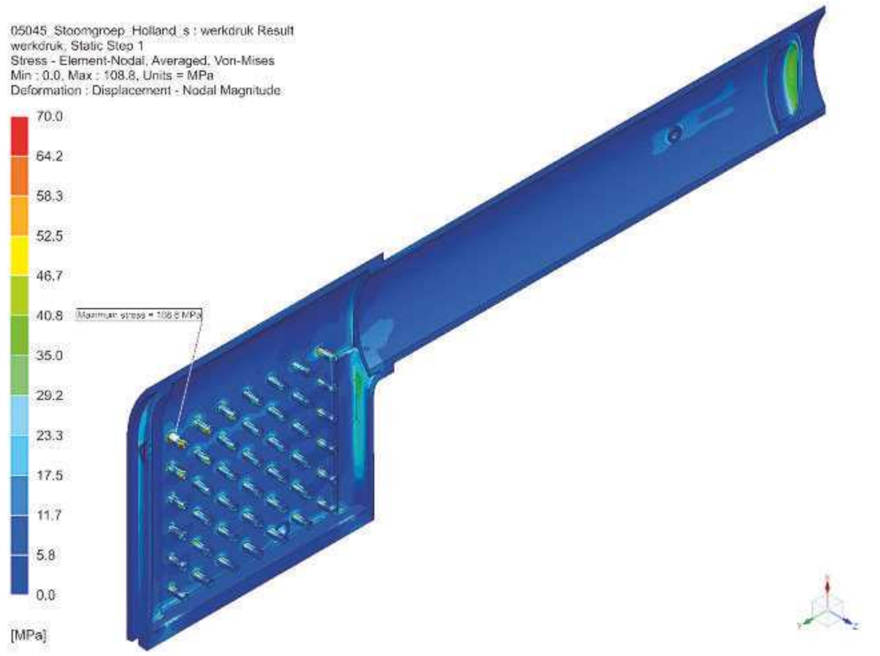
The Crampton boiler has already been built by a number of model engineers and as far as is known, not a single boiler has failed.

Fig 14



Stresses at working condition.

Fig 15



Stresses due to working pressure in outer wall and firebox support bolts.

Material stresses during operation

The stresses that occur during operation at 6 bar and 165 degrees C are shown in **figs 14** to **18**. The higher stresses occur in the positions where the boiler is relatively stiff. The graph shows the allowable yield strength for copper Cu-DHP Condition R240: the tensile strength is 240 MPa at 20 degrees C. The allowable yield strength at elevated temperatures is calculated as shown next to the graph. Thus, the maximum stress as calculated with FEM is at some points above the allowable yield strength at 165 degrees C from the graph. This is not to say that the boiler will fail at that point. The Crampton boiler has already been built by a number of model engineers and as far as is known, not a single boiler has failed. Firstly, the value given in the graph contains a large safety margin. Secondly, the usual calculation methods generally do not take into account possible peak stresses at certain points in the construction. But of course, that is the value of an FEM analysis. On the basis of this analysis, such peaks can be avoided where necessary by adapting the construction.

Material stresses in the outer wall of the firebox

Figure 15 shows a cross-section showing the inside of the outer wall of the firebox including the stays. It can be seen that the stresses in the stays have an acceptable value, except the left stay in the top row where an elevated stress of 108.8 MPa is shown.

Again, the thickness of a stay, calculated by a conventional boiler design code, applies to a selected number and position of stays. The FEM method shows that not all stays are stressed at the same values.

Material stresses in the half section of the boiler

A half-section of the boiler is shown in fig 16. It can be seen that the crown stays on both sides, at the points where they are soldered in the firebox are subject to higher stresses. The stresses in the middle two crown stays reach approximately 70 MPa at a single point where they are soldered to the firebox roof, but not over the entire cross-section.

Material stresses in the smokebox tube plate

The highest material stresses in this part (fig 17) occur around the solder connection between the boiler barrel and the front tube plate.

Material stresses in the firebox tube plate

Here too (fig 18) we can see that the top row of stays in the tube plate are relatively heavily loaded. It should also be noted that the scale display as shown in this figure is insufficient to show precisely the peak stresses which cover only a very small area. The enlarged images show those points clearly on a computer screen.

●To be continued.

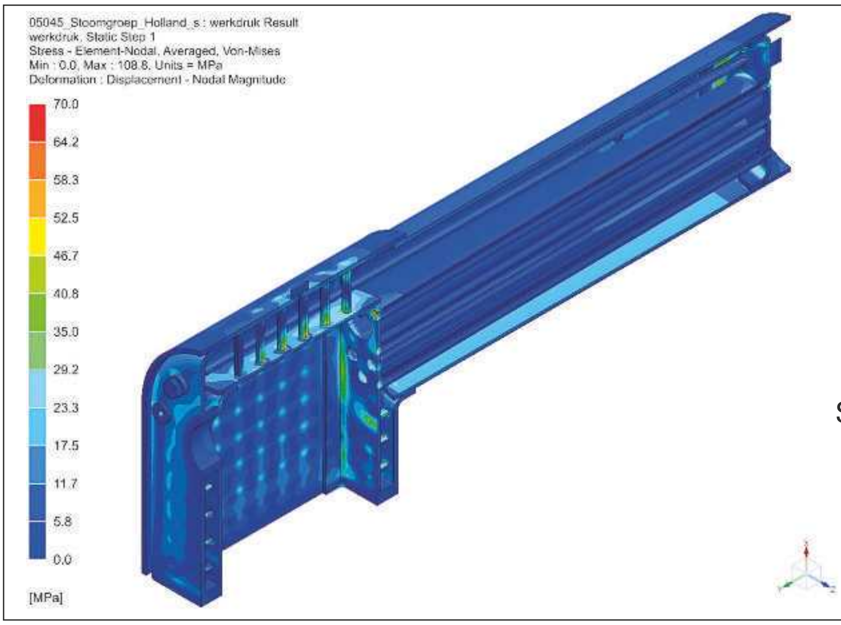


Fig 16

Stresses due to the working pressure in the half section of the boiler, including crown stays.

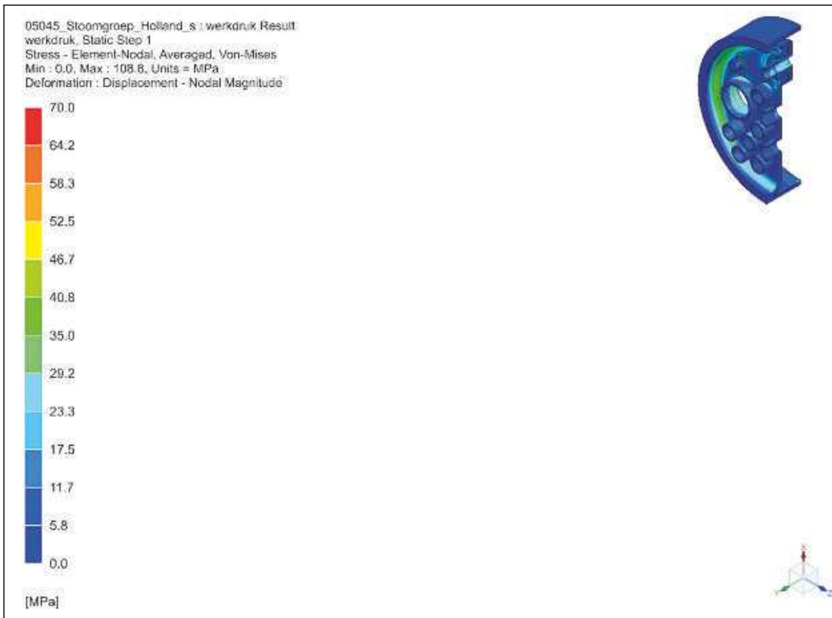


Fig 17

Stresses due to the working pressure in the smoke box tube plate.

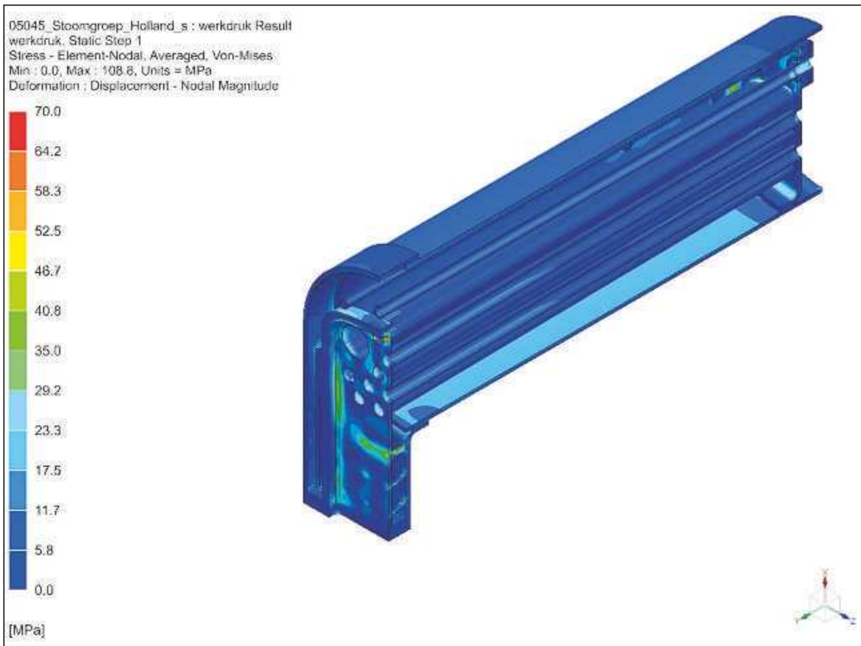


Fig 18

Stresses due to the working pressure in the firebox side tubular sheet.

NEXT TIME

We look at the stresses and distortions during hydrostatic pressure testing.

FREE PRIVATE ADVERTS

MODEL ENGINEER | MODEL ENGINEERS' WORKSHOP

Did You Know? You can now place your classified ads by email. Just send the text of your ad, maximum 35 words, to neil.wyatt@mytimemedia.com, together with your full name and address, a landline telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses to protect your security.

Classifieds and Coronavirus
Please follow local government advice in Wales, Ireland, Scotland or England as appropriate if you are considering buying or selling items for collection. In most of the UK this means you cannot collect until lockdown ends.Please respect the needs of delivery drivers to protect their own safety and, if receiving a parcel take sensible precautions when handling anything packaged by someone else.

Machines and Tools Offered

■ Myford shallow drip tray for ML7/ ML7R. Grey Hammerite finish, with drain plug. NB there is a surface rust patch about 3 x 2 inches on one end. £25 plus postage, or buyer collects from mid Bedfordshire.
T. 01462 701055 Biggleswade.

■ Centec 2 Milling machine, screw feed table lift mod fitted. Loads of tooling included, cutters, arbors, boring head, two vices etc. Just totally reconditioned, not just a paint job. Single phase ready to use. Price £700. **T. 01423 780359. Nr Harrogate, N. Yorks**.

Models

■ American locomotive, £5,750. A John Clarke designed 5" gauge 4 4 0. It has a new GB boiler with shell test certificate. Completed and track tested last year and fully working. Water feed is 2 crosshead pumps, injector and emergency hand pump. Oil feed by pump. Superheaters and steam brakes. Pictures if required.
T. 017844 56938. Staines upon Thames.

Parts and Materials

■ Dart 7¼" machined parts, including cylinders, pistons, valves, valve chest, eccentrics and frame parts. No crankshaft, no wheels. Parts have been in loft for 35 years; surface rust on some parts. Photos available. Offers.
T. 01631 770255. Oban.

Wanted

■ Myford ML7 or Super 7 lathe with accessories. Retired toolmaker. **T. 01943 877455. Ilkey. West Yorkshire**.

■ Set of change wheels for a Murad Cadet lathe. ¼" pitch, 3.8" thick, ¾" bore. Also 4 jaw chuck, thread 1 7/7" x 8TPI for above.
T. 01227 272039. Whitstable.

■ Pre used copy of John Wildings book, 'Clock construction and the Rehousing of Discarded Movements', I am hoping to build a Skeleton Clock out of one of the now defunct pigeon Timer Clocks I have.
T. 01298 85456. Buxton.

YOUR FREE ADVERTISEMENT (Max 36 words plus phone & town - please write clearly)

❑ WANTED ❑ FOR SALE

Phone: | Date: | Town:

NO MOBILE PHONES, LAND LINES ONLY

Please use nearest well known town

Adverts will be published in Model Engineer and Model Engineers' Workshop.

The information below will not appear in the advert.

Name ....

Address ....

....

....

.... Postcode.......................................

Mobile .... D.O.B.......................................

Email address...

Do you subscribe to Model Engineer ❑ Model Engineers' Workshop ❑

Please post to:
ME/MEW FREE ADS, c/o Neil Wyatt, MyTimeMedia Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF
Or email to: neil.wyatt@mytimemedia.com

Photocopies of this form are acceptable.

Adverts will be placed as soon as space is available.

Terms and Conditions:

PLEASE NOTE: this page is for private advertisers only. Do not submit this form if you are a trade advertiser. If you wish to place a trade advert please contact David Holden on 07718 64 86 89 or email david.holden@mytimemedia.com

By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from MyTimeMedia Ltd. and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from
MyTimeMedia Ltd: Email ❑ Phone ❑ Post ❑
or other relevant 3rd parties: Email ❑ Phone ❑ Post ❑

POSTBAG

STEN Guns

Dear Martin,
I was most interested on what Mr Kirby had to say about the mechanism of the STEN gun (M.E.4659, 26th February).

When on a schoolboy expedition to the Officer Training School at Sandhurst, we were introduced to and allowed to operate all sorts of weapons. As I am left-handed, I quite naturally held my STEN gun with the butt into my left shoulder. I was not merely shouted at but really, really shouted at!

The point is that the aperture through which the spent bullet cases were ejected would have been only a little way from my right eye. Should a round have failed properly to have been fully home when fired, the exploded casing and combustion gasses would probably have blinded me.

The description that Mr Kirby gives, describing the construction of the firing pin and the breach block, explained everything most clearly. Thank you.

Best regards, James Buxton

Bridget Boiler

Dear Martin,
I was interested in Jon Edney's account of his Bridget boiler (M.E.4659, 26th February) and commend him for his confessions about movement of the crown. I doubt he is alone. I have built and restored quite a few of the older designs and have found that they are nearly always deficient in the area of crown staying and upper back head staying, especially on Belpaire style tapered boilers.

A case in point is LBSC's Britannia which has a 'T' girder on the crown but no equivalent support on the Belpaire outer wrapper. Possibly the fact that a round top outer wrapper does not need such a support was missed when it became a flat plate!

Times have moved on and the AMBSC codes provide a ready means of determining suitable staying arrangements, designed to consistently comply with a 26 MPa safe working stress. I can recommend using rod in lieu of the traditional girder stays (installed radially in a round top boiler) and for the back head consider thicker plates, doubling plates, girders and/or palm stays.

A suitable scheme of staying can usually be devised that avoids large numbers of longitudinal stays, avoids regulator rods, and is even easier to construct, in the knowledge that a consistent level of safety is also being achieved.

Yours sincerely, Warwick Allison

Drawing Errors

Dear Martin,
It was with great interest that I read your 'Smoke Rings' article and the letter from John Roberts on drawing errors (M.E.4659, 26th February). This is a subject that needs wider debate.

Recently I paid good money for a set of traction engine drawings from one of the specialist suppliers.

I can't say how disappointed I was at the poor quality of the drawings received. They are reprints from 25 year-old originals, unmaintained for 20 years or so. Moreover, they have incoherent and cramped layouts, missing elevations, missing assembly arrangements and, I would bet my pension, laced with uncorrected errors. They are non-compliant with BS308 (or whatever the modern standard is) and I have absolutely no confidence that these drawings would allow me to make the traction engine without a) having to refer to external data and/ or b) generating significant (avoidable) scrap.

In short, my assertion is that these drawings are not fit for purpose and, with some regret, have decided not to embark on construction, the technical risk being deemed too high.

I further assert that anyone selling drawings on a commercial basis should be responsible (and liable), in all respects, for their adequacy.

Whilst this would likely limit the number of drawings commercially available, anyone using them could commence construction with confidence - of particular importance to newcomers to the hobby.

Yours sincerely, David Proctor (Pickering)

Shot Guns

Dear Martin,
The mention of using a shotgun to ward off burglars in your editorial (M.E.4659, 26th February) reminded me of an incident in the USA, where I worked for several years in the late 1980s.

I was based at the company HQ near Phoenix, AZ but spent a lot of time at the main aerospace composites manufacturing plant in Greenville, TX. My group leader there was an evangelical Christian with a quite large family. Early on in my time there I spent an evening at his home at dinner etc. After admiring several beautiful display cabinets he had made (he was an expert woodworker - a very common hobby in the US) he showed me his gun collection. Prominent in this was a sawn-off shotgun. I raised an eyebrow. It was legal in Texas and referred to as 'my home protector'. It combined the virtues of a low inertia swing and a large scatter - not much aiming required. In Texas, and in Arizona, if you disturb someone (a stranger) of malevolent intent in your home you are entitled to 'blow them away' and no questions asked - not the case in the UK. One of those moments when you appreciate that you really have landed in a different culture.

Best Regards, Mike Gray

Write to us

Views and opinions expressed in letters published in *Postbag* should not be assumed to be in accordance with those of the Editor, other contributors, or MyTimeMedia Ltd. Correspondence for *Postbag* should be sent to:

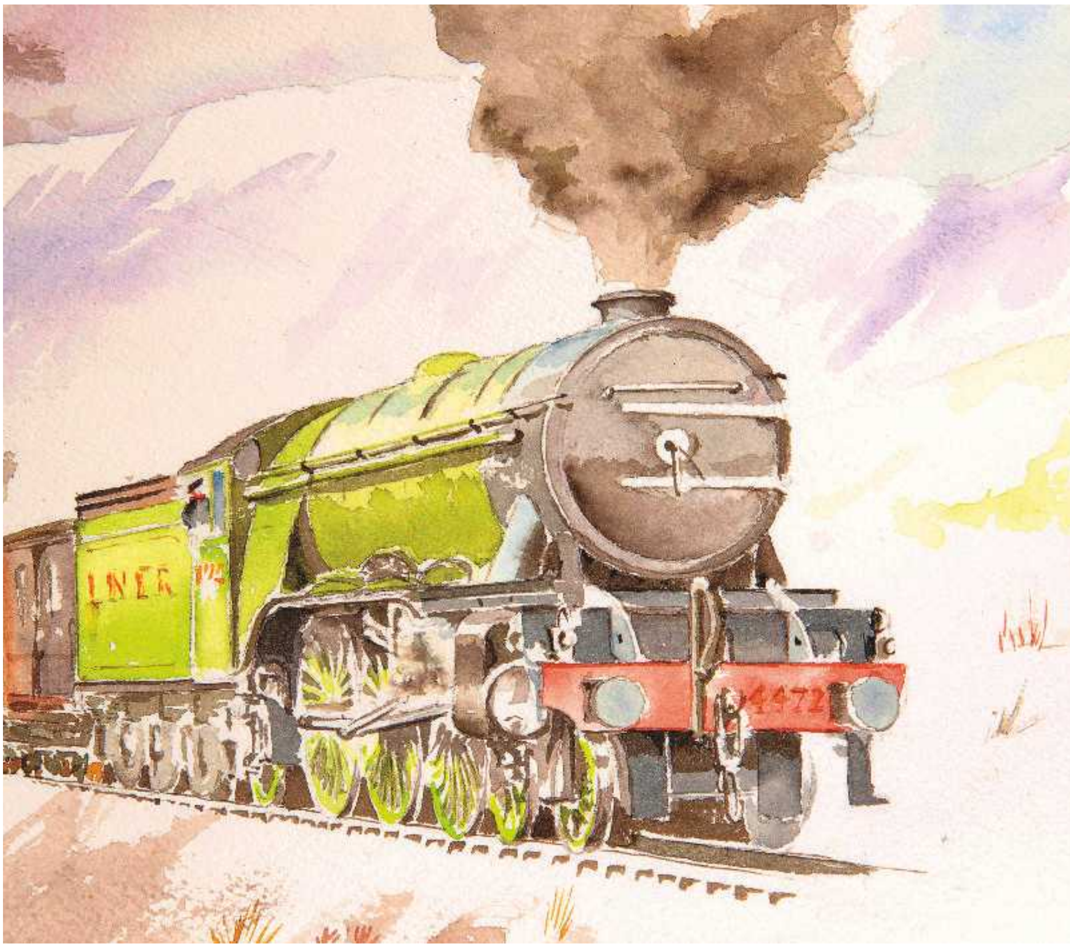
**Martin Evans, The Editor,
Model Engineer, MyTimeMedia Ltd,
Suite 25S, Eden House,
Enterprise Way, Edenbridge,
Kent, TN8 6HF
F. 01689 869 874
E. mrevans@cantab.net**

Publication is at the discretion of the Editor. The content of letters may be edited to suit the magazine style and space available. Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.

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

Continued from p.409
M.E. 4660, 12 March 2021



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge

PART 7 - TENDER BRAKES

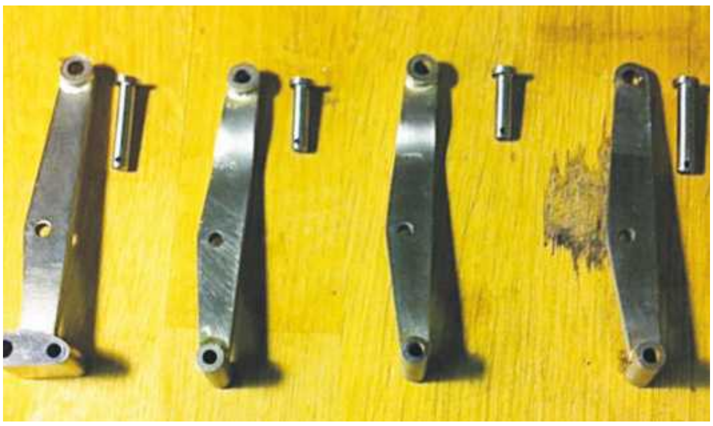
Moving on to the brakes, I started with the brake hanger brackets. There are two types and these four are the middle and rear hangers. They start as a simple turning job and are then transferred to a rotary table to drill the four fixing holes.

To finish the machining of the brake hanger brackets I transferred the four fixing holes to a piece of flat steel, drilled and tapped for 8BA. With the bracket thus held I could finish the ⅜ inch recess, cutting directly out from the centre. The final operation was to cut the flat section at 90 degrees to the recess 5/16 inch from the centre, as shown in the photo, which shows the finished item ready to be fixed to the frames. The holes have been drilled and tapped for 8BA bolts.

Each bracket was then held in place using a nut and bolt, squared to the frame and the holes were transferred using a transfer punch. The bracket was then removed, holes drilled and each bracket was then attached to the back of the frames as shown in the photo.

These are the brake hangers - they are laser cut items from Model Engineers Laser. There are eight in total – two front, which are the ones with the boot leg shape at one end, four intermediates and two for the rear. In the foreground is a jig made to ensure that they all have 2¾ inch centres between the hanger pin and control rods. There will be another hole about one third up from the control rod pin hole to fix the brake shoes to later. The intermediates have to be bent a little as shown on the drawings - these need to be longer to allow for the two bends as all have the same centres of 2¾ inches. For some reason they were all supplied the same length but this was no big deal as I intended to machine the bosses as one piece and cut a slot to slip over the end of the hanger. To allow for this I cut off the end of each hanger half way through the hole. With the bosses brazed on they look complete. The advantage of using laser cut parts is you can make a lot of progress. We can all saw/file out metal sheet but why do that when you can put the time into super detailing the model instead. Well at least that's how I see it...

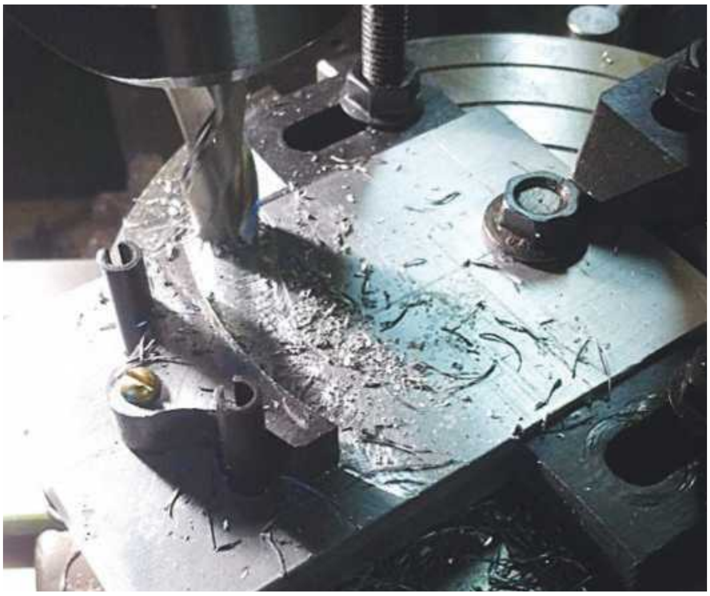
The intermediate hangers have an offset angle as shown here. They have a small boss on one side at the top so no need to cut a slot for this one. The bottom does need a slot which is offset at 9/32 inch on the inboard side for wheel clearance. Here the parts are ready for brazing.



Here are the completed hangers and pins for one side. The pins are 5/32 inch steel with ¼ x 1/16 inch collars brazed on as suggested by Don – this made sense as it was quicker to make. The pins are also cross drilled to take a 1/16 inch split pin.

Brake hangers fitted. The front hanger has two bottom holes - one (large) is for the front brake beam, the second being for the first control rods.

It was then time to tackle the brake shoes. In the photo are the laser cut shoes from Model Engineers Laser. Having now machined these I think it may have been quicker to machine from solid. Being such thick material, the laser had hardened the edges deeply and cut at a slight angle in places plus the material was thicker than the drawing so had to be machined to size. They also needed making symmetrical too. Still I persevered and battled on...



Here is the jig I made/used for holding each shoe while its inner face was machined to $2\frac{7}{32}$ inch radius. The pin hole has already been drilled to No.30 and used to help hold the shoe rigid between the two 5mm roller pins. Next stage was to mill the slot that slides over the brake hanger and is then held by the pin. The pins were made the same way as the larger hanger pins.

This photo is an inside view of the rear axle. I can confirm that there is indeed an error for the third brake hanger as has been mentioned by others regarding 'drawing errors' before me. It's nothing big - just needs some metal removing from the back edge of that particular brake hanger to allow enough clearance for the shoe to fit between the hanger and wheel without fouling the rear stay.

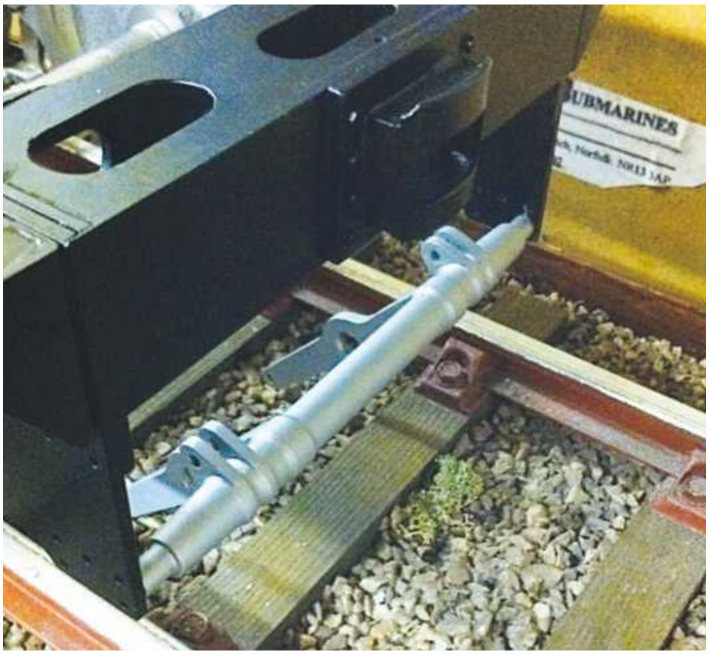
Continuing with the brakes here we have the last laser cut part from Malcolm's brake hanger kit. This is the front brake beam. If you look closely you'll spot the ascribed lines across the end tabs. I decided to remove these and turn up the required $\frac{5}{32}$ inch diameter spigots separately and silver solder them on.

I forgot to take a picture of the parts before brazing but here is the finished beam, now fitted. It's had both the two No.30 holes drilled for the connecting rods to the brake shaft and also been cross drilled for $\frac{1}{16}$ inch split pins.

The two coupling rod pins for the front axle were a similar exercise to the brake shoe pins but have 7BA threaded ends and a small 1/16 inch spigot on the end. The washers are commercial items - about time I found something already made to use - so much time spent making things with little to show for it!

Close up of the fourth axle brake beam. The beams are made up from three parts: two ends with the slots and the central BMS bar that fitted into predrilled holes in the end pieces. A jig was made up with 4 inch centres to hold the parts together for brazing.

I then turned my attention to the brake coupling rods. There's nothing much to these other than lengths of ¼ x 1/16 inch BMS bar, machined to profile and with a No.30 hole drilled each end and then rounded off. The distance between the holes is critical and the chassis needs to be at its right height before measuring the distance between pins. So first the chassis was raised on blocks to achieve this, and then all brake blocks were clamped tightly against the wheels. It was then a simple job of measuring each distance between the pins and making the coupling rods up as pairs to fit. Here we can see the coupling rods fitted. I was pleased with the end result - all four wheels locked when the front brake beam was pulled, which boded well for the brakes working as they were supposed to later.



The brake shaft, shown here, took me two days. So much work for a relatively small yet important part of the tender's braking system. The photo shows the finished brake shaft placed loosely between the frames awaiting the support brackets that will hold it.

Here we see the finished brake shaft and trunnion parts ready for fitting to the frames. The trunnions were pretty straightforward affairs, consisting of ⅛ inch steel plate cut to size and shaped. Next, 7/16 inch BMS bar collars were machined to size and bored out to ¼ inch to accept the spigots on the brake shaft, and these were then brazed to the plates. The final jobs were the four small webs that were first cut oversize, soft soldered in place and then ground down to their final shape, leaving just the mounting holes that were transferred from the frames, drilled and then tapped 8BA.

A photo to show the parts fitted - here's a view from the front.

●To be continued.

Workshop Tip

New Files for Old!

Noel Shelley shows how you can revive your tired old files.

Well maybe not quite 'new', but this little trick will turn a near useless file into a tool that will get you out of a muddle. A file should be used dry, to allow the filings to fall away, as oiled work will soon clog a file and a clogged file will soon blunt if not cleaned. A file that pins will immediately leave quite deep grooves in the work that may be difficult to remove.

The quick and easy way to clean a clogged or pinned file is to take a piece of ¼ or 5⁄16 inch diameter copper tube, long enough to hold (8 to 10 inches) and flatten one end. If the tube diameter is bigger than this it will be too wide when flattened and difficult to use. If you want the deluxe version then use 5 inches of copper tube, then hammer into a medium file handle and flatten the end, as shown in **photo 1**. This is pushed across the teeth of the file (**photo 2**); the end will adopt the tooth form and clean right to the root of the tooth. Reasonable pressure is needed and for a bad case it may need several passes before all the detritus is removed. Files should not be kept loose in a tool box as they'll lose their edge - an ideal protector can be made from a length of good fitting plastic tube.

Hand crafted file revival tool.

Whilst the file's place has in many cases been taken over by the cheap and aggressive little 4½ inch grinder, another application where this tool may be recommended is when fitted with a 1 or 1.5mm cutting disc. So equipped, the hacksaw will soon seem very old fashioned! The disc will cut tool steel or aluminium with equal ease. In the case of aluminium or soft metals, being so thin it cannot clog as one might expect. The important thing when using these thin discs is to let them cut at their own speed and hold both the tool and work steady. If the disc is allowed to bounce on the work or is forced it will wear rapidly, and trying to cut round corners by bending the disc will break the centre out. This disc is ONLY for cutting, NEVER grinding. Having used boxes of these over the last few years I can say (as is true for plastic cable ties) 'how did I live without them?'.

ME

Revival tool in use.

PART 2

Focas Connecting Rod

Peter Worden continues his occasional series describing the building of his FOCAS engine.

Continued from p.331
M.E. 4659, 26 February 2021

What follows is the series of steps needed to machine the FOCAS connecting rod using the single fixture described last time.

NEXT TIME

I'll complete the creation of the connecting rod.

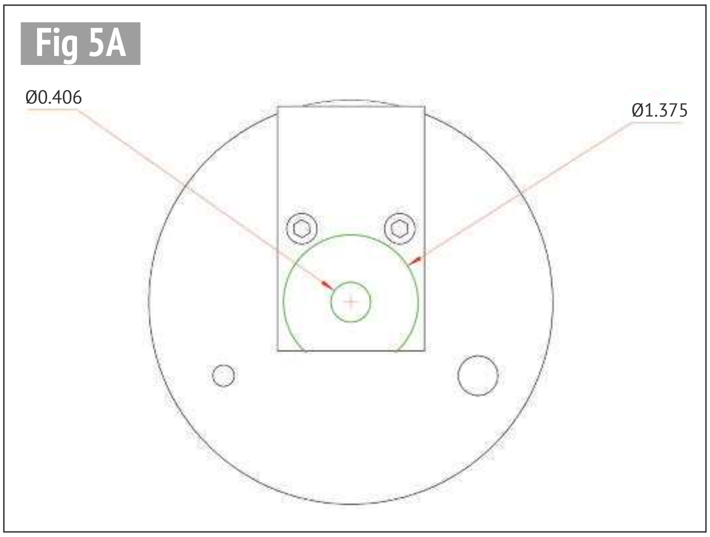
ERRATUM

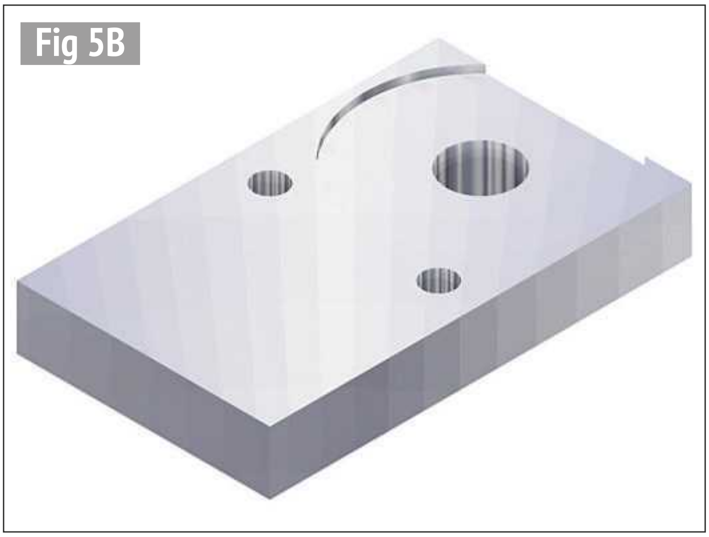
There are a couple of problems with figure 1 in part 1 (M.E.4659, 26th February).

Firstly, the dimension given for the bore diameter of the small end on the side view in the centre of the drawing was shown as 0.218 inch diameter and should be 0.250 inch.

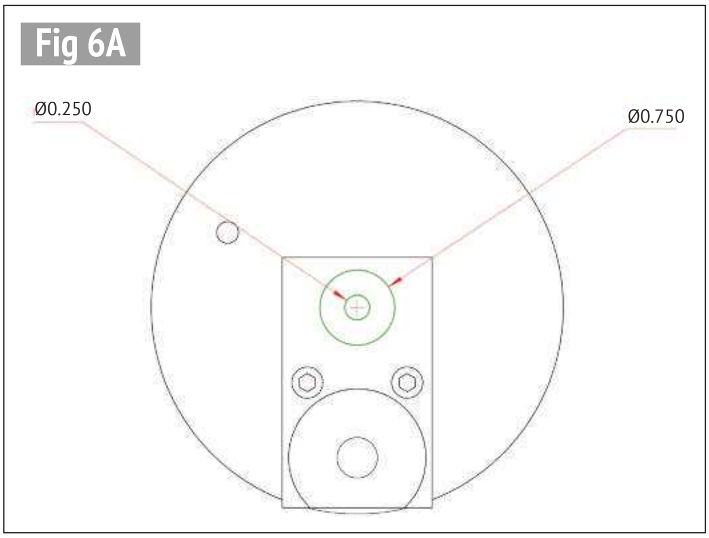
Secondly, the dimensions of the big end in the side view have been printed far too small to be read. The diameter of the big end bore should be 0.406 inch, with the tolerances shown, and the depth of the big end should be 0.250 inch, again with the tolerances shown.

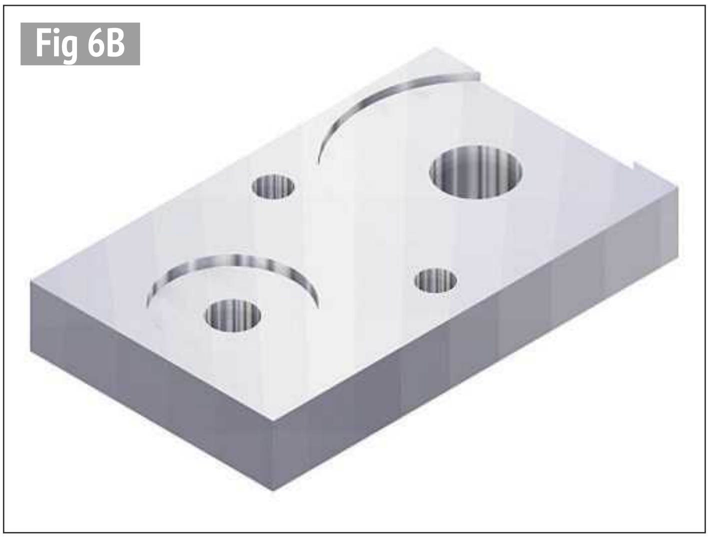
We apologise for any inconvenience caused by these problems with the drawing.





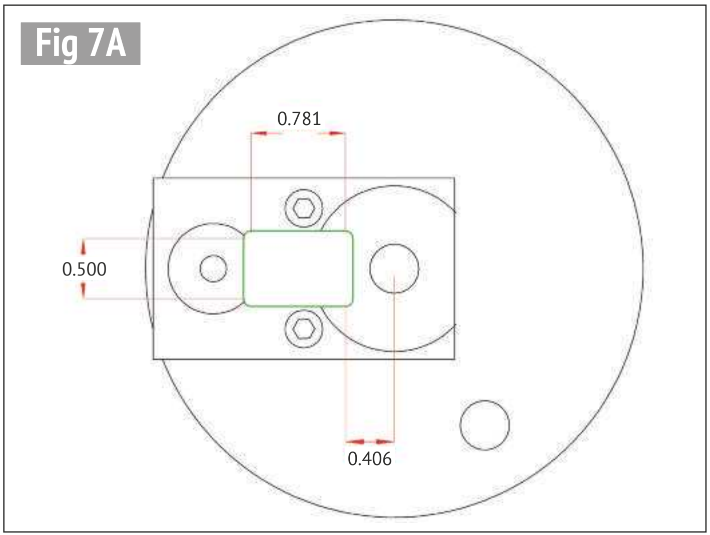
Stage 1 - The fixture was held in the lathe by the 1.000 boss in a collet and clocked to set it perfectly true. A blank was loaded to the fixture in the location without the spigots and secured with two 2BA screws. A hole was rough drilled ⅜ inch diameter and bored to 0.406 inch diameter +0.0005 -0.0000 and faced to 1.375 inch diameter x 0.062 inch deep from the front face of the blank. The blank was flipped on the fixture and the 1.375 inch diameter x 0.062 inch deep facing operation was repeated. Concentricity of the 0.406 inch diameter at this point is not vital as this part of the operation is only to set the width of the big end of the conrod to the 0.406 inch dimension.

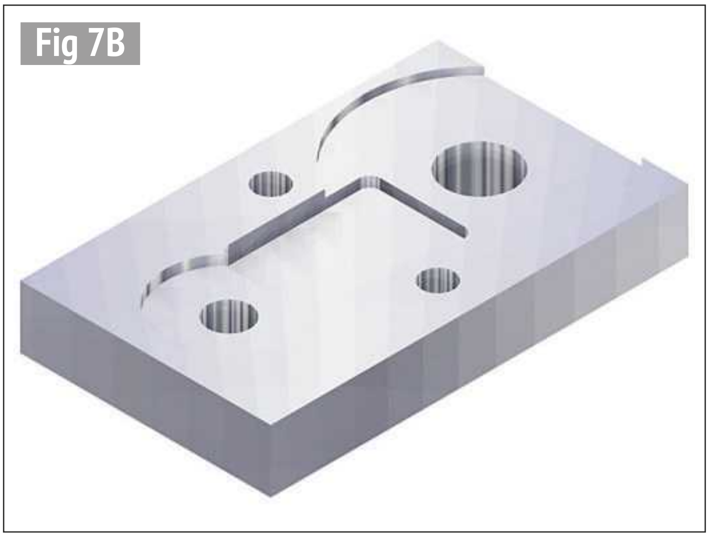




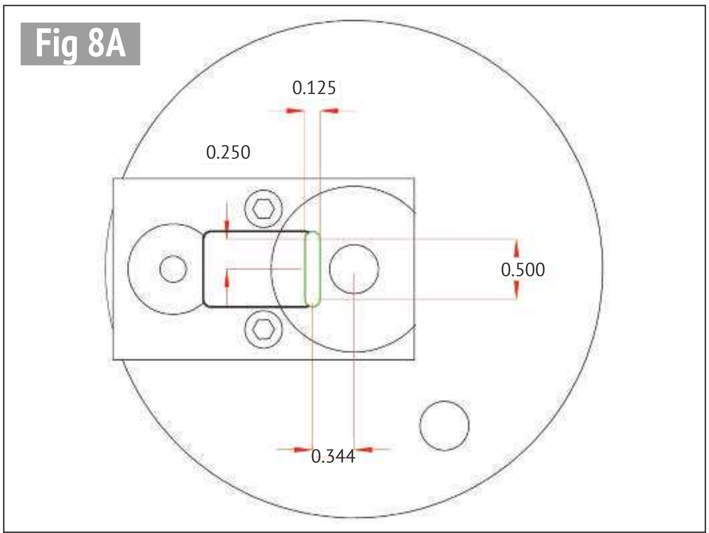
Stage 2 - The part was located on the 0.406 inch diameter fixed spigot and was rough drilled 7/32 inch diameter and bored to 0.250 inch diameter +0.0005 -0.0000 and faced to 0.750 inch diameter x 0.062 inch deep from the face of the blank. The blank was flipped in the fixture and the 0.750 inch diameter x 0.062 inch deep facing operation was repeated. Concentricity of the 0.250 inch diameter at this point is not vital as this part of the operation is only to set the width of the small end to the 0.250 inch dimension.

>>

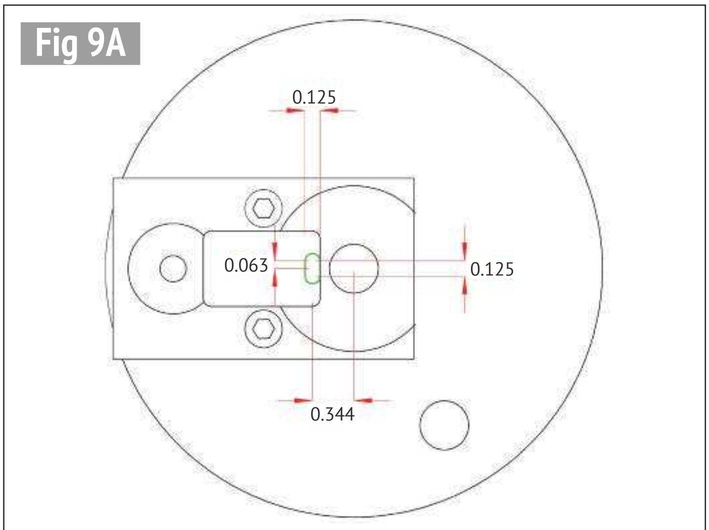




Stage 3 - The fixture was removed from the lathe and set up on a rotary table on the milling machine so that the axes of the fixture and rotary table were set concentric with the axis of the machine spindle. The 0.250 inch diameter removable spigot was loaded to the centre of the fixture. A parallel was held against the fixed and removable 0.250 inch diameter spigots and was clocked square with the machine X-axis by rotating the rotary table, which was then marked to denote the zero or datum point for further operations. The 0.250 inch diameter removable spigot was replaced with the 0.406 inch diameter removable spigot and the part was located on the 0.250 inch diameter fixed spigot and central 0.406 inch diameter removable spigot with the 0.250 inch spigot nearest to the body of the machine. A rectangular pocket was milled to the dimensions shown, and 0.109 inch deep from the face of the blank, with a standard square-nosed ⅛ inch slot drill. The part was flipped on the fixture and the machining operation was repeated on the other side. This produces the width of the central part of the conrod.

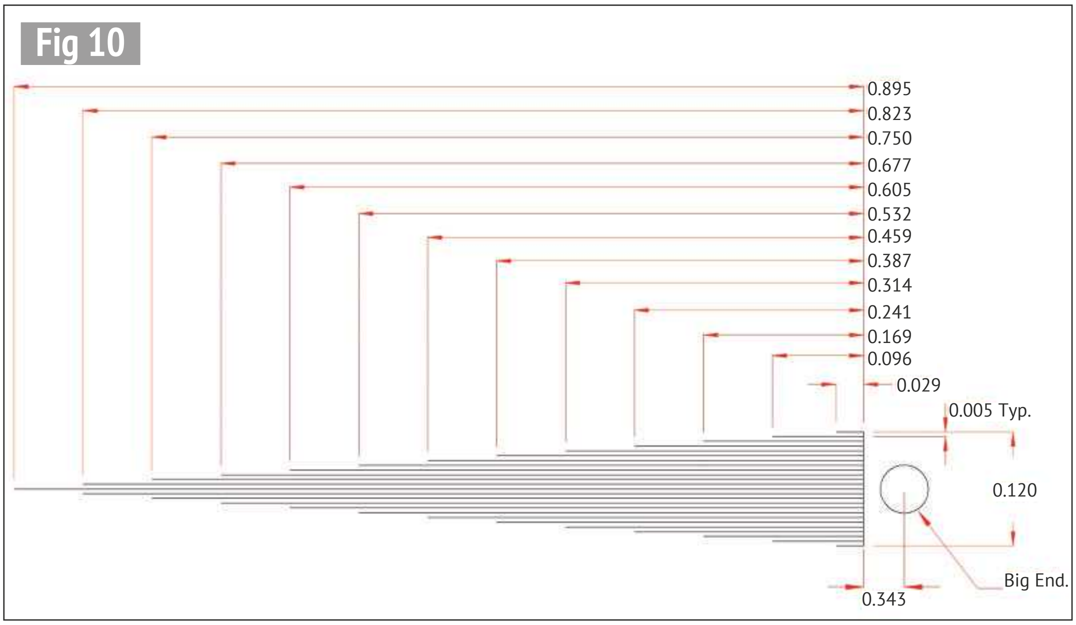


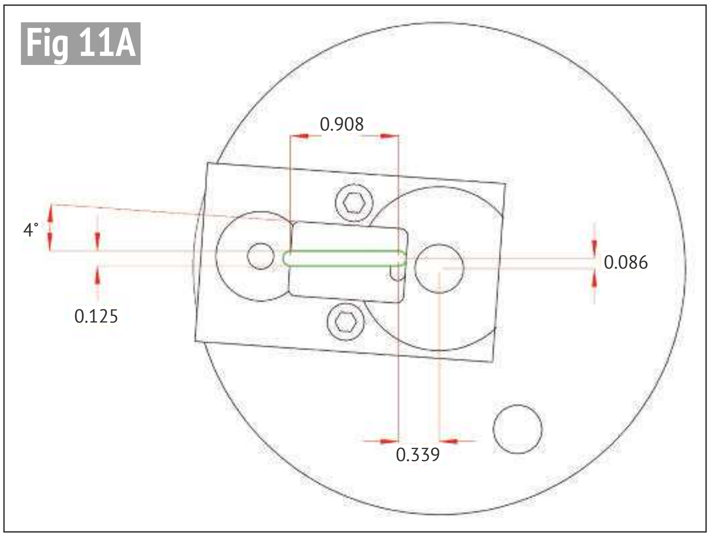
Stage 4 - The longer slot was milled parallel to the machine X-axis and to the dimensions shown, 0.109 inch deep from the face of the blank with an ⅛ inch ball-nosed slot drill. This produces the radius at the base of the central part of the conrod. The part was flipped on the fixture and the operation was repeated.



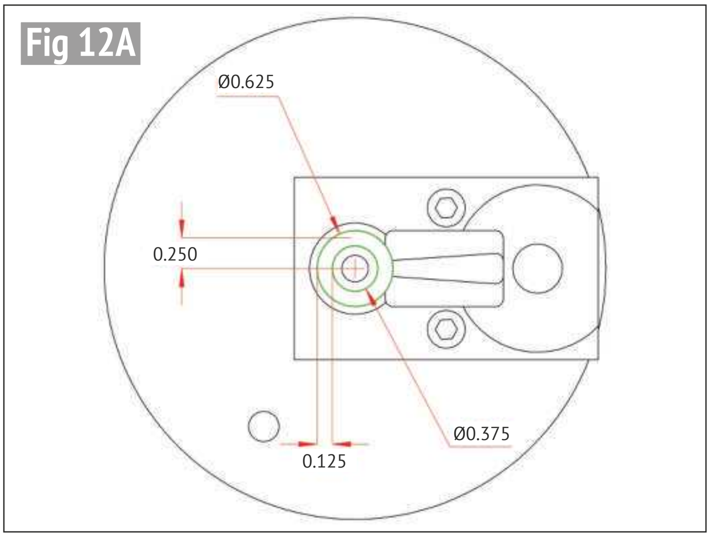
Stage 5 - The shorter slot was milled in the X-axis to the dimensions shown, 0.156 inch deep from the face of the blank with the ⅛ inch ball-nosed slot drill, to form the base of the triangular pocket. The part was flipped on the fixture and the operation was repeated

Stage 6 - The basic shape of the triangular pocket was milled in the Y-axis using the ⅛ inch ball-nosed slot drill, to the dimensions given, to a depth of 0.156 inch from the face of the blank. The 0.005 inch steps were needed to produce a surface as flat as possible. Steps of 0.010 inch would have left lines on the surface. I found it easier to start with the central long cut first and then work outwards in either direction. The part was flipped on the fixture and the operation was repeated.



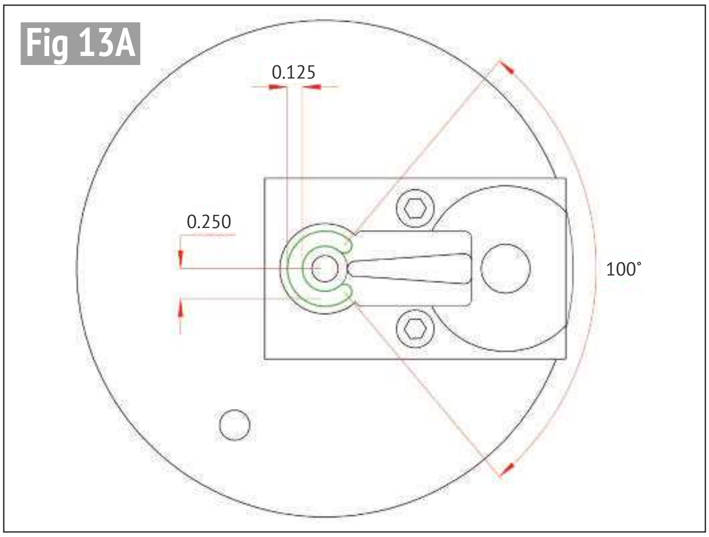


Stages 7 and 8 - The fixture was rotated by 4° clockwise from zero and the part was milled in the Y-axis to the dimensions given, 0.156 inch from the face of the blank, using the ⅛ inch ball-nosed slot drill. This operation and the next stage cleaned up the steps left by stage 6. The part was flipped on the fixture and the operation was repeated. The whole stage is then repeated with the fixture rotated 4° anticlockwise.

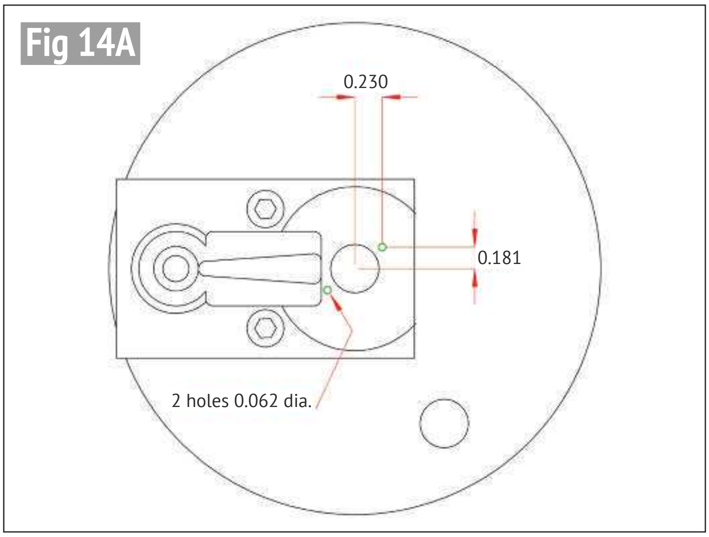


Stage 9 - The 0.406 inch diameter spigot was removed from the centre of the fixture and replaced with the 0.250 inch diameter removable spigot. The part was located on the 0.406 inch fixed spigot and 0.250 inch centre spigot. The rotary table was set so that its axis coincided with the axis of the machine spindle and was rotated 60° anti-clockwise from zero. The circular groove was milled through 360° to the dimensions shown, 0.109 inch deep from the face of the blank, with the ⅛ inch ball nosed slot drill. The part was flipped on the fixture and the operation was repeated.

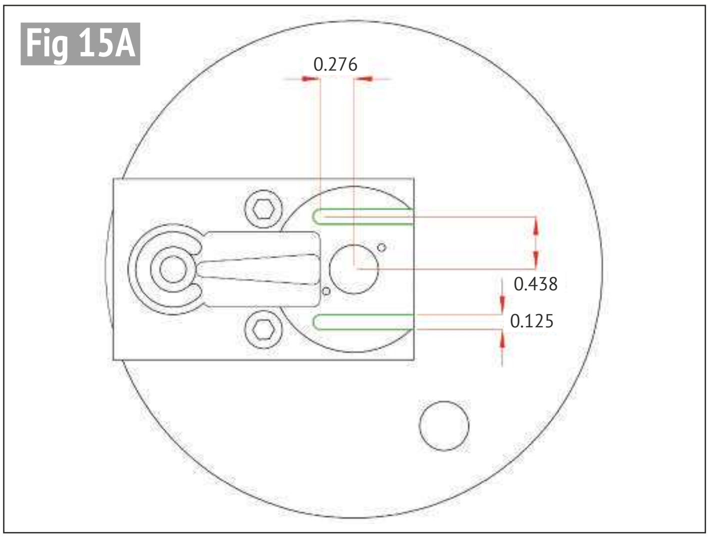
>>



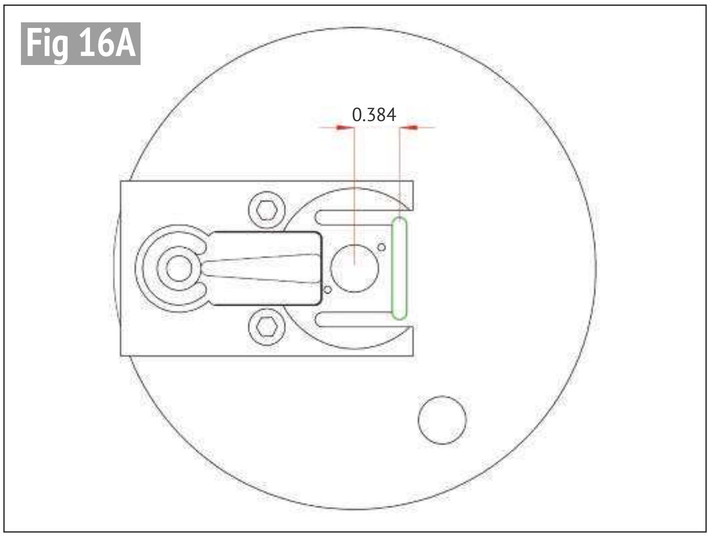
Stage 10 - A circular slot was milled right through to dimensions and angle with an ⅛ inch square end slot drill. There was obviously no need to reverse the part in the fixture on this stage. This produced the outside diameter of the small end.



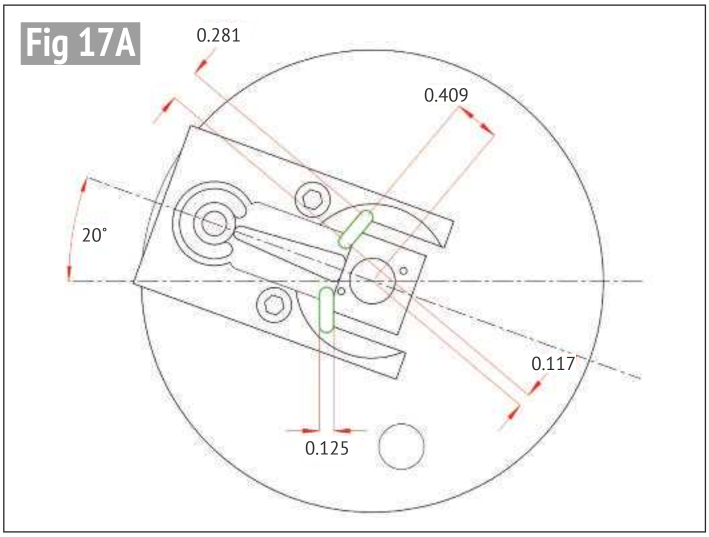
Stage 11 - The 0.250 inch diameter spigot was removed from the centre of the fixture and replaced with the 0.406 inch spigot and the part was located on the 0.250 inch fixed spigot and centre spigot. The fixture was rotated to zero. A hole 1/16 inch diameter was drilled through to the dimensions shown. The fixture was rotated 180° and a second hole was drilled on the same setting. These holes are to accommodate pins which are pressed in to retain the big end bearing shells to stop them from rotating on the crankshaft.



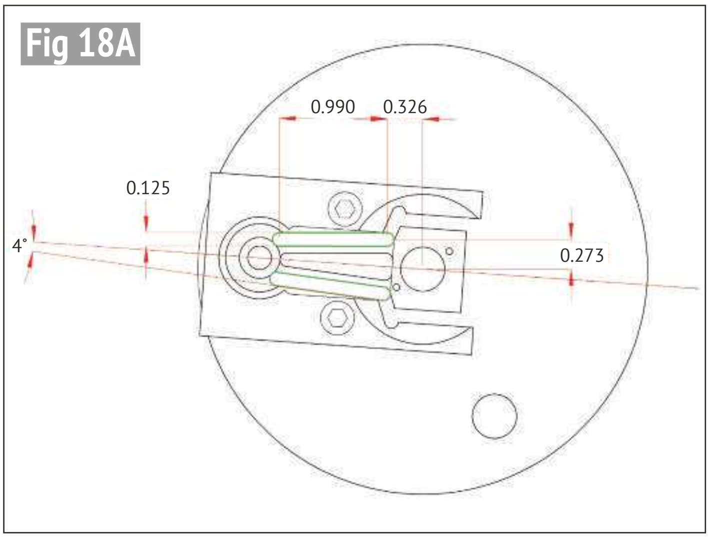
Stage 12 - A slot was milled right through to dimensions with the ⅛ inch slot drill in the Y-axis. The part was flipped on the fixture and the operation was repeated. This operation formed the sides of the big end.

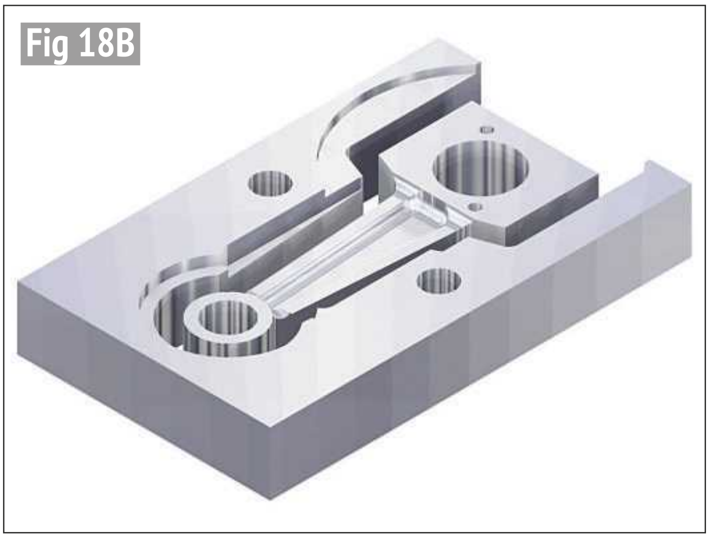


Stage 13 - The base of the conrod was milled in the X-axis to the dimension shown with the ⅛ inch slot drill.



Stage 14 - The fixture was rotated 20° clockwise from zero and a slot was milled right through to dimensions with the ⅛ inch slot drill in the X-axis. The part was flipped on the fixture and the operation was repeated. This operation formed the shoulder of the big end.





Stage 15 - The fixture was rotated to 4° clockwise from zero and a slot was milled right through to the dimensions shown with the ⅛ inch end mill in the Y-axis. The part was flipped on the fixture and the operation was repeated. At this stage the part and original blank were separated.

●To be continued.

Old girl all dressed up posing for the camera.

PART 12 - THE WOODEN CAB

WAHYA A 5 Inch American Type Locomotive

Luker builds an American 4-4-0.

Continued from p.314
M.E. 4659, 26 February 2021

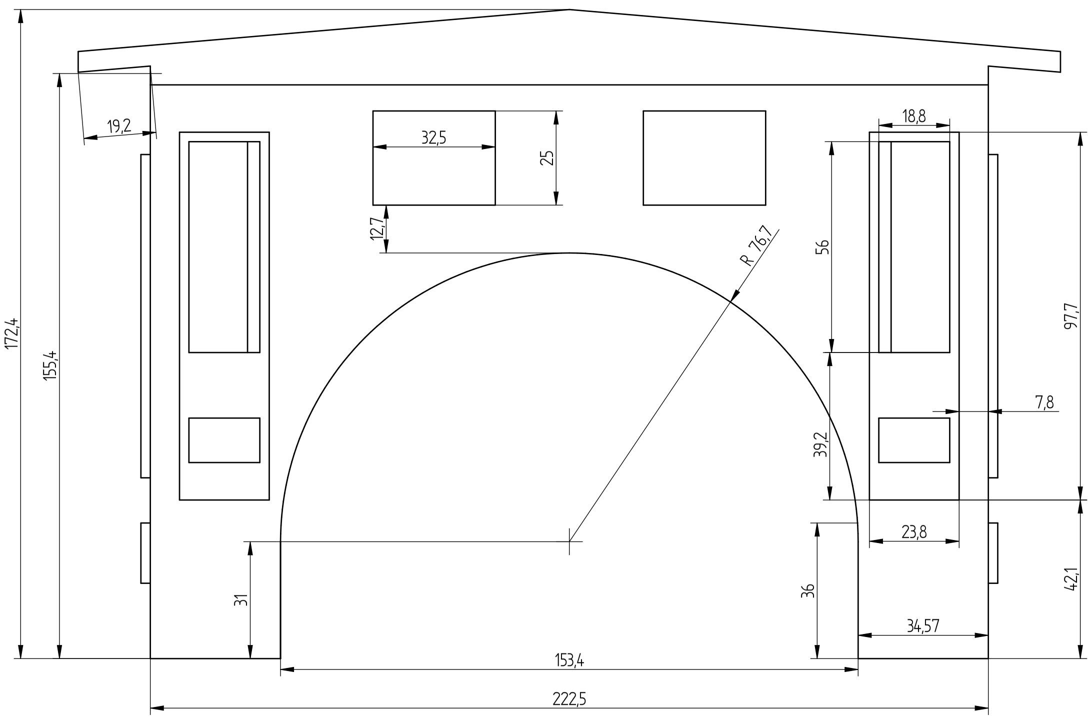
Wooden cab

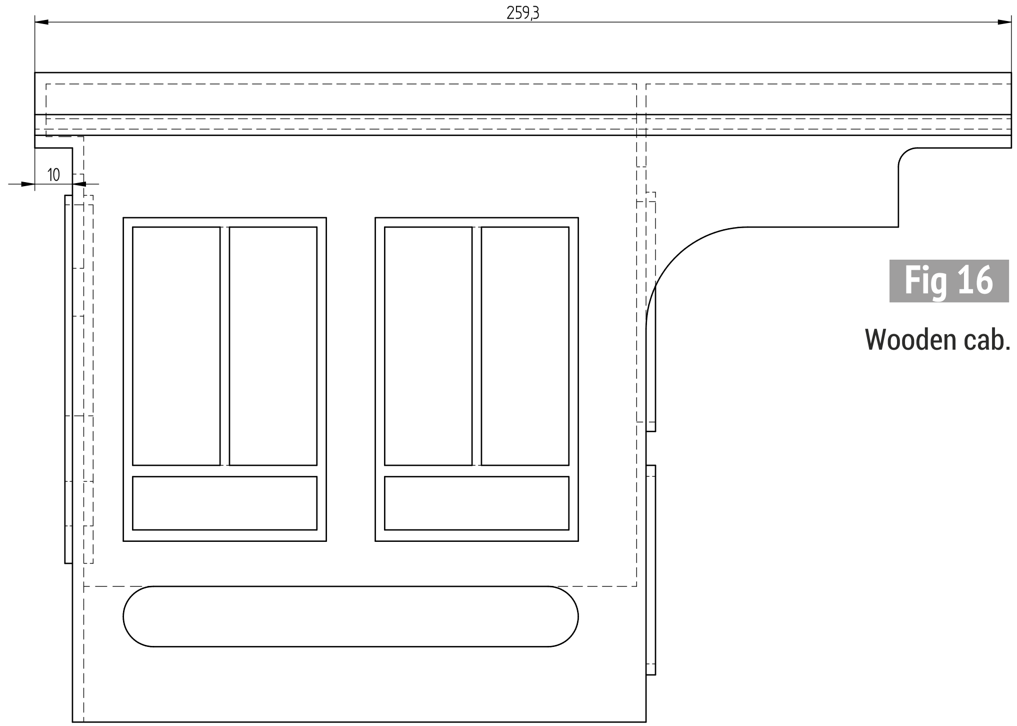
The earlier cabs were wooden houses and must have been a very comfortable place to work, provided it wasn't in the Texas desert! I used the same sleeper wood that I used for the pilot and running boards; it was a dense wood and easy to cut. A cheap table saw and a jig saw (that was initially purchased for pattern making) did the whole cab without any difficulties (**photos 77** and **78**). The front and back of the cab were made by laminating thin sections together, cross grain for strength. All single ply sections had at least one stiffener across the grain. The permanent connections were cold glued and screwed using small jewellery box screws available from most craft or bead shops.

The dimensions given (**fig 16**) are scaled from the original drawings I used but a little deviation will be required depending on what wood is used and how everything is fixed together. The area under the running boards inside the cab is also closed up with wood, and can be screwed to angles that are fixed to the running boards. I've been put off adding glass or plastic windows to the cabs. I went the whole way with my last locomotive with latched windows that can open - but they're always dirty! If the glass is left out I personally think the locomotive looks better on the display stand with all of the valves and fittings easily visible - and if anyone complains I just say the glass is so clean you can't see it... no touching!

The roof and back of the cab are not permanently fixed and are removed for driving on the track, but when on the stand the complete cab is assembled.

Wooden cab.





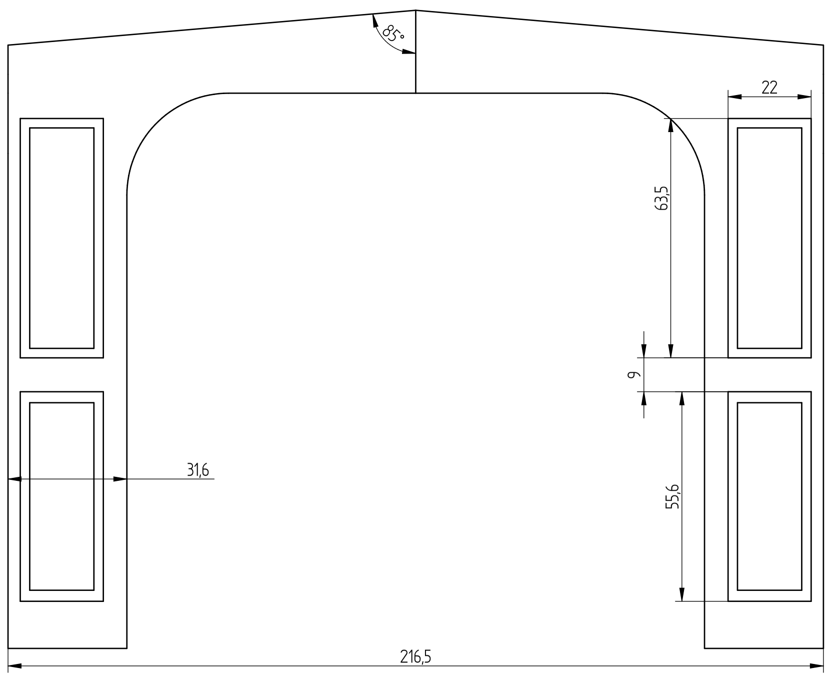
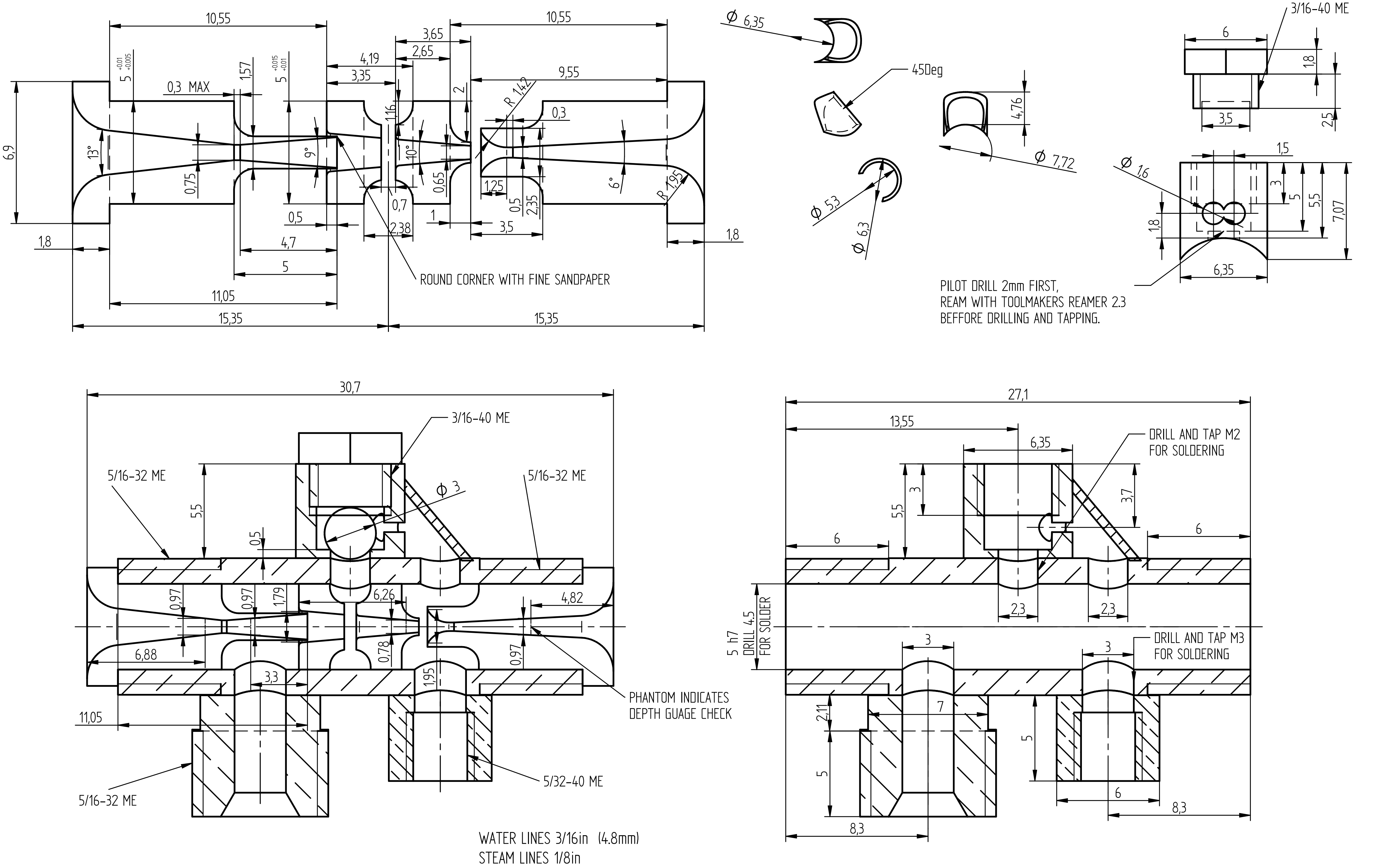


Fig 16

Wooden cab.

Wooden cab interior.



Injector.

Fig 17

Injectors

There have been numerous articles over the years describing injector design and manufacture, making it hardly worth repeating in a construction series. Nonetheless, I have added drawings for the injectors I designed and made for *Wahya* (**fig 17**). If you were wondering what on earth those odd dimensions were in the assembled view inside the cones, they are depth gauge positions to check the plunging depth of the reamer and these are typically standard 1mm drill bits. You'll notice I use a 10 degree taper on the combining cone and this is one of the places where I deviate from most of the published designs, for reasons that are probably outside the scope of this series. I also have a parallel section between the taper sections to simplify the manufacturing and allow a little tolerance when machining. When done with the cones I use a little polishing compound on a wooden toothpick to polish the internal flow surface and to blend this parallel section a little.

Any 8-10oz injector will do the job and at least two methods of feeding the boiler are recommended.

The steam plumbing lines

All of the lines from the backhead to the cylinders and smokebox are fitted under the running boards. This deviates from large scale, which ran on the boiler under the cladding, but on this scale that is unpractical. The water lines are fitted from the tender under the frames to the injectors which are placed between the coupled wheels on each side of the engine. A summary of the pipe sizes and couplings are as follows:

PIPING SIZES:
- DISPLACEMENT LUBRICATOR TANK TO CYLINDERS = 3⁄32 INCH
- VALVE TO DISPLACEMENT LUBRICATOR TANK= 2.5 MM
- PRESSURE GAUGE = 3⁄32 INCH
- INJECTOR STEAM LINES = 1⁄8 INCH
- BLOWER LINE = 1⁄8 INCH
- ALL WATER LINES = 3⁄16 INCH (4.8 MM)

COUPLING SIZES:
- DISPLACEMENT LUBRICATOR TANK TO CYLINDERS: 3⁄16 x 40 (6mm AF NUT)
- VALVE TO DISPLACEMENT LUBRICATOR TANK: 7⁄32 x 40 (7mm AF NUT)
- PRESSURE GAUGE: 7⁄32 x 40 (7mm AF NUT); 3⁄16 x 40 (1⁄4 INCH AF NUT) ON GAUGE.
- INJECTOR STEAM LINE: 1⁄4 x 40 STEAM VALVES (8mm AF NUT); 5⁄16 x 32 INJECTOR (3⁄8 INCH AF NUT)
- BLOWER LINE: 1⁄4 x 40 STEAM VALVES (8mm AF NUT)
- ALL WATER LINES: 5⁄16 x 32 INJECTOR (3⁄8 INCH AF NUT); 5⁄16 x 32 TENDER COUPLING.

Front nameplate.

If you want to be extremely pedantic with the water lines - true scale works out to 4.5mm. This is not a standard pipe size as far as I know but modifying some 4.8mm to 4.5 is relatively easy. One method is to make a set of draw dies and incrementally draw the line down in 0.1mm steps with some oil, annealing the copper between operations. But I'm far too lazy for that! My method is the brute strength approach and requires a stout vice and a large hammer. A length of standard 4.8mm copper piping is cut and annealed the normal way. One side is clamped in the vice and the other side using large pliers. By striking the pliers with the hammer the copper pipes can be drawn down to size. As each section stretches, it work hardens, and increases resistance to stretching, giving other areas of the pipe a chance to stretch. I was impressed by how uniform the pipes decreased in diameter, with the pipes I stretched varying by only 0.1mm at the points I checked. Because the copper work hardens, the pipes come out nice and straight and are easier to bend when fitting to the locomotive.

This method was actually discovered by accident. A friend and fellow builder gave me a box of scrap copper pipe, which had been bent incorrectly, for melting in my furnace. Not wanting to waste the pipes I used this method to try straightening the pipes and was pleasantly surprised by the results. Some of the kinks also came out. Nearly all of the pipes for *Wayha* were initially destined for the scrap pile or furnace - just goes to show sometimes things can be rescued.

Nameplates

The front nameplate (**photo 79**) should carry the engineering firm name that made the locomotive, the locomotive number and the name of the locomotive. If you have multiple locomotives with a short memory like me then it's worthwhile to mark confusing levers like the drain cocks. In my case it costs next to nothing to electro strip the plates, so I tend to add a few of these plates around the locomotive.

Painting and lining

The painting and lining on these types of locomotives can be anything the builder fancies. For my locomotive I used a very dark blue for the boiler cladding to match the natural dark blue hot rolled steel that would have been used in those days. This deep blue complemented the brass components and strapping very nicely. The wheels I painted to the standard red colour by mixing some 2K paint I had from previous projects. Normally the cab and pilot were painted as well, but some of the builders did leave them the natural wood finish (and to be honest, I think this is better). I'm not sure how well painted wood will last in SA with our climate and how we run our locomotives.

The gold lining on all of the wood and the front lamp were done with an acrylic metallic gold craft paint. Being an acrylic, it can be thinned with water. Using an open syringe, with the needle cut off and rounded like a bow pen, the lining can be done against a ruler that is slightly raised with a little masking tape to prevent the paint from being pulled under the ruler. This works on a similar principle to an art pen, just much cheaper, and it holds far more paint.

The frame was painted black, but I have seen examples of these locomotives with the frames unpainted. This will work if the frames are kept well-oiled and in a drier environment but it does look really nice if the rust is kept at bay.

●To be continued.

The Stationary Steam Engine

PART 19 - ALBION MILL AND ITS AFTERMATH

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

Continued from p.340
M.E. 4659, 26 February 2021

Beyond Cornwall, at least until the later seventeen-eighties, the most important market for Watt engines was London. Pumping London's water supply had been an early application for the Newcomen engine and just as the Watt engine was displacing the common engine in Cornwall, so it began to supplant the earlier generation of London's steam pumping engines. Another significant Metropolitan demand came with the rise of the great porter breweries and distilleries, which had been large-scale industrial enterprises for a century before the classical Industrial Revolution. The four-bar parallel motion was first used on an engine for Whitbread's brewery, drawings for which are dated November 1784.

Like brewing, the London corn and provender mills that supplied the Capital's needs represented a considerable trade but the consolidation that had created the giant porter breweries had yet to take place, the milling industry remained fragmented and in the hands of small scale enterprises. An opportunity presented itself for concentrating milling into large scale premises and in mid-1783, a company was formed to build a corn mill of unprecedented size and mechanical sophistication. The leading promoter was the architect, Samuel Wyatt. Wyatt, whose family lived in Weeford near Lichfield, began his architectural career in Birmingham where he had been drawn into the scientific circle that included Watt, Boulton, Small, Erasmus Darwin and Joseph Priestley, a group famed as the Birmingham Lunar Society (**ref 107**). Boulton's patronage had helped Wyatt to obtain the commission for the Theatre Royal in Birmingham in 1777.

Samuel Wyatt subsequently moved to London where his brothers were established in business both individually and as a family group. He was operating as a timber merchant and carpentry contractor by 1781 with several prestigious contracts including the chapel at the Naval Hospital, Greenwich and similar work at Somerset House. His Admiralty work expanded and in 1782 the Navy Board employed him to build and equip a flour mill and bakery at Weevil near Gosport. Two years previously Smeaton had been responsible for the design of the brewery in the same dockyard and it was in connection with Navy work that he had famously rejected the use of rotative engines in preference to pumping engines returning water over a waterwheel:

In the first place I apprehend that no motion communicated from the reciprocating beam of a fire engine can ever act perfectly steady and equal in producing a circular motion like the regular efflux of water turning a water wheel and much of the good effect of a water mill is well known to depend upon the motion communicated to the mill stones being perfectly equal and smooth, as the least tremor or agitation takes off from the complete performance.

Secondly, all the fire engines that I have seen are liable to stoppages and that so suddenly that in making a single stroke the machine is capable of passing from almost full power and motion to a total cessation … in raising water … the stoppage of the engine for a few strokes is of no ill consequence than the loss of so much time but in the motion of millstones grinding corn such stoppages would have a particular ill effect …

By the intervention of water these uncertainties and difficulties are avoided … as there will be a sufficience of reservoir or mill pond capable of keeping it going one minute without sensible abatement, it seldom happens that if by any inadvertance of the engine keeper the engine stops but that in less than half a minute … he can set it a-going, so that the mill will continue regularly at work and if anything should go wrong with the engine for a greater length of time and the mill will stop gradually no particular derangement can happen, further than so much loss of time as the miller will always be apprised thereof by the gradual loss of the mill's motion ….

Smeaton's comment related to work he was undertaking at Deptford Dockyard in 1781 and has often been quoted outside its context. At the time that he was advising the Admiralty, Boulton and Watt's rotative engine lay in the future. His view was based upon experience of the rotative atmospheric engine and although he may have known of Pickard and Wasborough's work, this was hardly calculated to reverse his opinion. Notably, in December 1782, when Wyatt suggested to Boulton that a rotative engine be used for the Gosport mill, Boulton recommended instead one of his firm's pumping engines returning water over a wheel, this despite the fact that Wilkinson's Bradley forge rotative engine was complete and running at the time that the matter was being discussed.

Notwithstanding his negative response to Wyatt's enquiry, Boulton had already broached the subject of a steam corn mill with his brother William whose rank in the world of London milling was marked by his position of Warden of the Baker's Company, one of the major City Guilds. Samuel had taken up the proposal and in June 1783 he had visited Soho to see the experimental 18 inch rotative engine at work. At this time the Wyatt brothers were involved in a speculative building venture on the south side of Robert Mylne's Blackfriars Bridge, completed in 1769. The development was named Albion Place and it was here that Samuel Wyatt and his partners located the steam corn mill venture that was to become the Albion Mill.

Albion Mill was not the first corn mill to attempt to rely on steam power; the atmospheric engine pumping water back over a waterwheel was already common and Wasborough had attempted to apply direct rotative steam power to corn milling in 1781. Albion Mill's claim to distinction comes through being the first to employ a rotative steam engine successfully to mill corn or provender and also because it was the first fully integrated factory style corn mill with multiple batteries of stones, each combined with the full corn range of ancillary dressing equipment. It was also, arguably, the first full scale factory of any kind to be designed around a steam engine.

The designs for the mill building were undertaken by Wyatt who employed the type of heavy warehouse construction common at this period; substantial brick walls and internal timber posts and beams. There was greater innovation in the foundations which used a series of brick inverted arches to form a raft supported by piles driven into the alluvium of the Thames river banks. The millwork was to be undertaken by Boulton and Watt but their experience in this direction was limited. Some initial work seems to have been undertaken by the Soho drawing office but in the second half of 1784 they enlisted John Rennie to take charge of the millwork. He arrived in Birmingham on 19 September. Thereafter Rennie assumed increasing responsibility for the design and installation of the mechanical engineering of the mill and the erection of the engines.

Rennie was 24 years of age when he joined Boulton and Watt. He had been apprenticed to the very eminent Scottish millwright, Andrew Meikle who continued to place work with him after his formal indentures had been completed. At the same time he attended Edinburgh University where he was a student of Black and Robison. In the months before he moved to Birmingham he had completed a tour of England which had familiarised him with engineering south of the border. Robison recommended him to Boulton and Watt as competent to undertake the Albion Mill work although biographical accounts vary in relating the way in which this took place.

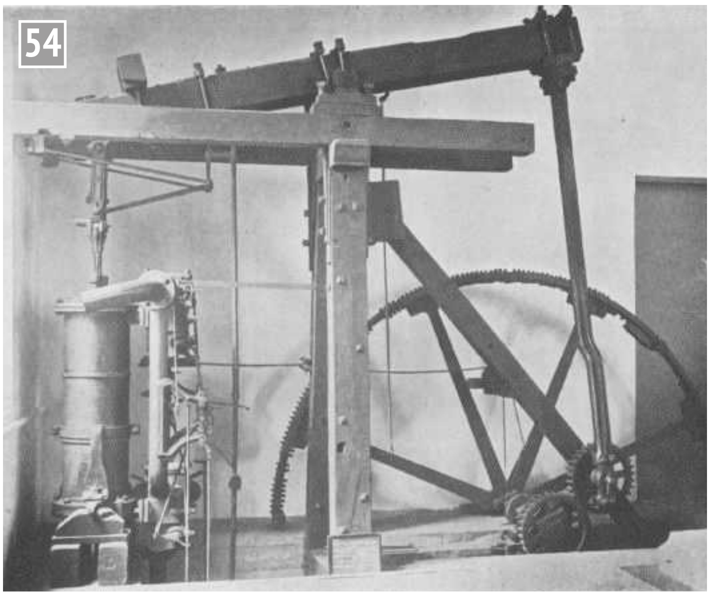
Notwithstanding his education and experience, Albion Mill was an extremely ambitious project to confront a young millwright but it was Rennie who proved to be the critical factor in the mechanical success of the project. To a certain extent the Albion Mill was to be conventional, following the established practice of grouping the stones around the periphery of a large crown wheel gear revolving under the stone floor. In the vast majority of mills the crown wheel drove up to four sets of stones mounted around its periphery but at Albion Mill the number was raised to between six and ten.

It was originally intended to house a total of thirty stones within the mill. Although the intended capacity was never achieved, the number that eventually ran was far in excess of anything previously known under one roof. It was this concentration of stones that gave rise to the principal difference between conventional corn mill construction and that used at Albion Mill. In a traditional water mill the vertical shaft carrying the crown wheel would be driven by a set of right angled bevel wheels, one of which was mounted on the waterwheel axle. The drive was thus relatively direct. In contrast, at Albion Mill an extended system of gears and shafting connected the flywheel shaft of the engine and the crown wheel. Cast iron gearing and shafting running in iron plummer blocks with brass bearings replaced the more usual heavy timber construction. It has been claimed that at Albion Mill Rennie was the first to use cast iron gearing but this is incorrect. Cast iron gears had been employed at the London Bridge Waterworks thirty years before the Albion Mill but nowhere else had such a comprehensive use of the material been made in power distribution machinery. For this Rennie appears to have been mainly responsible.

Two engines were ultimately installed but three and possibly four were originally intended (**ref 108**). The No. 1 engine was run for the first time on 15 February 1786 but it did not work under load until early March. It was largely similar to Cotes and Jarrett's engine and was originally designed with a rack and sector beam and piston rod but again the plan was changed and when erected on site it had a three-bar parallel motion. After a short period of running the sun-and-planet gear gave trouble. The gears each had double rows of offset teeth divided by a thin iron plate. Wilkinson had been responsible for making the gear and it was felt that he had carried out the work badly. There were other problems with the valve gear and the valve seats but by the end of March the engine was performing satisfactorily.

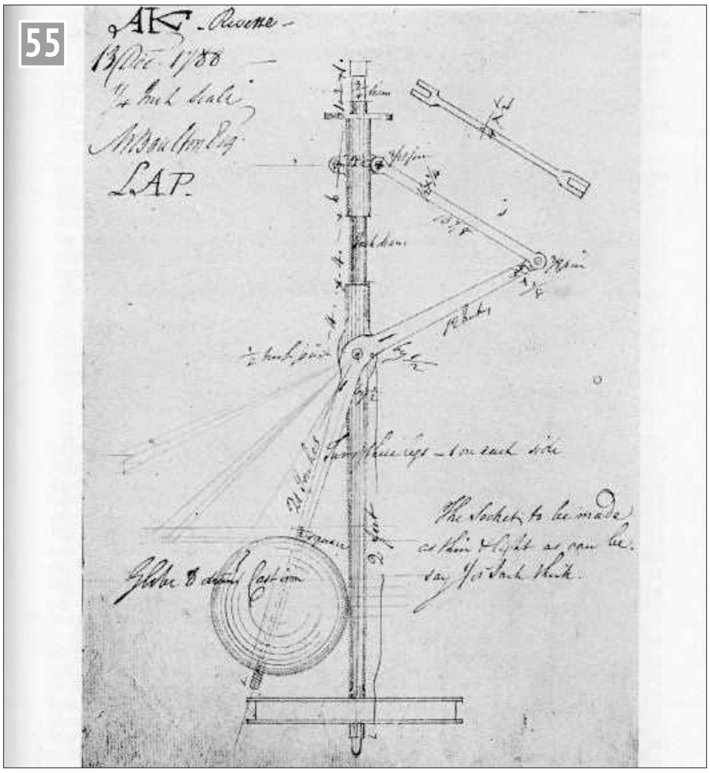
The second engine was installed three years later and benefitted from the experience gained with both the earlier corn mill engine and the engines which had been supplied to other customers. This engine is generally taken to represent the early maturity of the Boulton and

54



The Lap Engine of 1788.

»



John Southern's drawing of the centrifugal governor.

Watt rotative engine and, with a number of improved details, it was the pattern for all future mill driving engines built during James Watt's time as technical head of Boulton and Watt. Unfortunately no general arrangement drawing survives and the descriptions are all based upon written accounts but a near contemporary of the second Albion Mill engine is the Lap Engine, now preserved in the Science Museum. The Lap Engine (**photo 54**) was built in 1788 to power the lap grinding machines at Soho. Although it retains much of its original construction certain details are known to have been altered in the course of its life (**ref 109**).

It is smaller than the Albion Mill engine with a cylinder 18¾ inches in diameter by four feet stroke compared to the 34 inches by eight feet stroke of the Albion Mill machine. The interest that attaches to the Lap Engine is not merely comparative for it seems to have played a significant part in the introduction of the flyball steam governor although accounts of the exact course of events leading up to the first application are confusing. Cyril Boucher in his biography of John Rennie (**ref 110**) advances the claim that Rennie had introduced it as a steam regulator at Albion Mills but a closer reading of the evidence seems to suggest that the course of events was less direct than Boucher implies. What is not in dispute is the fact that the centrifugal governor was already used in corn milling for raising and lowering the stones to maintain the critical clearance that ensured that the grain was chopped rather than crushed. Dickinson and Jenkins (**ref 111**) quote a letter written by Boulton in London to Watt in Birmingham in May 1788 which stated that the governor had been applied to regulating the mill stones at Albion Mill. Rennie was almost certainly responsible for this development, almost certainly drawing upon his previous millwrighting experience. Boulton's description of a governor adjusting the millstones at the Albion Mill seems to have prompted Watt to investigate its possible use as a means of controlling the steam throttle in response to the engine's speed. A sketch drawing had been made, probably by Watt working from his home drawing office, and this was worked up by Southern and incorporated into the design of the Lap Engine (**photo 55**).

Both Boulton and Watt had taken shares in the Albion Mill in addition to charging a reduced premium for the use of the engines but gross mismanagement detracted from the technical success of the venture. Rennie, who had to contend with the problems on site, was engaged in constant disputes with Wyatt and attempted to sever his connection with the firm but Wyatt, to whom he was apparently contracted (**ref 112**), refused to release him. Both Watt and Boulton despaired and Brown, a trained bookkeeper was sent down from Birmingham in an attempt to instill financial discipline. He was soon begging to return to Birmingham after a corn factor was found to have defaulted with £3,500 worth of corn. Brown's efforts cannot have been entirely ineffectual as profits of £5,000 were showing by the third quarter of 1789 but this seems to have been at the expense of abusing the mill machinery which led to Rennie protesting to Wyatt by a formal letter. The situation could not be sustained and throughout 1790 the losses recurred.

Providence intervened in March 1791 when an overheated bearing led to a fire that destroyed the interior of the building entirely, leaving only the walls standing. The mill had not been well received by the established corn milling interests and they had fermented popular opposition which culminated in scenes of street jubilation as the fire raged, preventing the fire services from reaching the blaze. After the insurance had paid out Watt had lost £3,000 and Boulton £6,000 but they both conceded that had the fire not taken place their losses might have been even greater.

If the Albion Mill failed to satisfy its shareholders it was more successful in exposing the Watt steam engine to the public. Much against Watt's wishes, tours were regularly conducted through the mill and it was acclaimed in the newspapers. This may have played some part in the spate of London orders that followed in the second half of the seventeen-eighties but the Watt engine was now gaining a national reputation. All of the engine's characteristic features had now emerged. With skilled engineering allied to equally skilled engine management it was capable of equaling the regularity of a good waterwheel, although not yet capable of matching the power output of the most powerful water power installations. It's most convincing advantage however was that fact that it was not tied to the location of its energy source. This was to prove decisive in opening up its next and greatest market, the textile industry.

●To be continued.

REFERENCES

107. Named after its lunar calendar meeting dates.

108. *The Albion Mills, 1784-1791*. John Mosse. T.N.S. Vol. XL. January 1968. p. 47. Mosse maintains that four engines were intended but Dickinson and Jenkins say three, op. cit p. 165.

109. The nozzles were reconstructed in 1833 and the cast-iron connecting rod is almost certainly a later replacement of an earlier wooden one.

110. *John Rennie 1761-1821*. Cyril T.G. Boucher, Pub Manchester University Press 1963. Pp. 11 and 84.

111. Dickinson and Jenkins. op. cit. p. 220.

112. *The Albion Mills* …Mosse. op cit p. 52.

Book Reviews

The Welshpool and Llanfair Light Railway: the story of a Welsh rural byway

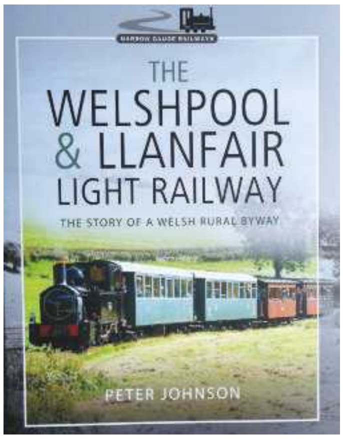
Peter Johnson

The Welshpool and Llanfair was the first line to be built under legislation to assist light railway construction and owed much to the major local landowner, the Earl of Powis. Detail of the line's long gestation and then about construction takes up much of the book but it is worthwhile.

After a ceremonial opening the line then enjoyed a quiet life. Mineral traffic was never the main purpose of this line and it carried agricultural products, coal and timber for many years. Passenger services were withdrawn in 1931 but goods traffic continued until 1956 when I saw one of the later trains crossing the road at Raven Square.

Preservation is copiously illustrated. The preservation society coped with difficulties including a lack of passenger carriages, the Banwy Bridge collapse and then the ending of services through Welshpool town. But it survived and even flourishes today. Besides the original locomotives *Earl* and *Countess* the W&L has added a variety of locomotives and rolling stock from abroad.

Whilst this book suffers from a lack of technical information it is a pleasant read with



enough detail to satisfy a lover of the Welsh narrow gauge. I enjoyed this history of an attractive line (on which I was once a volunteer) and at £30 it is very good value for money.

Roger Backhouse

Published by Pen and Sword Transport, 2020
ISBN 978-1-52674-477-7
£30. 232pp, hardback

Worcester Locomotive Shed: engines and train workings

Steve Bartlett

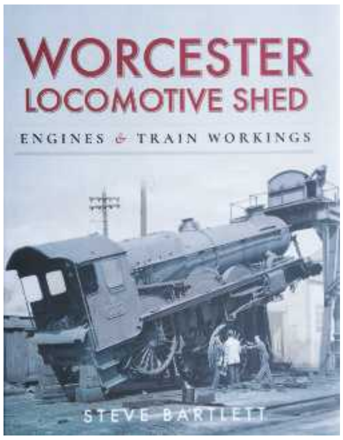
Reading through this excellent book is a reminder of just how labour intensive steam locomotive operation was. The author knew the shed well and has drawn on staff reminiscences and photographs to show the human side of shed operation, something often overlooked in railway books.

Worcester shed served scenic lines including that through the Cotswolds to Oxford and routes to Malvern and Hereford, Tenbury Wells, and Bromyard. Maybe scenery attracted good photographers and most of the images in this book are high quality, notably those of Ben Ashworth and F.A. Haynes, so it is an attractive read too.

For heavy maintenance and repair Worcester had the 'Works' alongside, also known as 'The Factory', originating with the Oxford, Worcester and Wolverhampton Railway. The cover image shows 5094 *Tretower Castle* at the engine hoist for wheel set removal. This works is a reminder that not all locomotive maintenance was done at Swindon.

If many pictures feature Worcester's 'Castles' there are others of the Great Western's Diesel railcars and the range of mostly ex-GWR steam locomotives. Few BR standard classes made it to the shed. Worcester's sub sheds feature too; it's hard to believe that Ledbury housed a 2-8-0 tank as banking engine at least up to 1962.

The author describes in detail how trains were worked from Worcester. Along with the author's earlier books



about Hereford shed (recently reprinted) and Gloucester sheds this isn't only an exercise in nostalgia but a useful contribution to railway history. We need more of this quality. Highly recommended.

Roger Backhouse

Published by Pen and Sword Transport, 2020
ISBN 978-1-52675-059-4
£25. 221pp, hardback

Brownsea Island provides the backdrop.

Topsy A 6 Inch Garrett 4CD Tractor

Paul Ritchie discovers that a Garrett tractor called *Topsy* is a familiar sight on Dorset roads.

An engine often seen out and about on the Dorset roads of Poole is an impressive 6 inch 4CD Garrett, owned and run by Ivor Vaile and his family. It makes a very pleasant sight frequently steaming its way along the streets when not on the local rally fields. The steam tractor was built over a two year period by Bob Whitehead of Syresham, Northamptonshire and was completed in late 2005, when Ivor purchased it. The boiler, with a capacity of 50 litres, was manufactured by Bells of Gloucester in 2004 and is number BB90. Its working pressure is 200 psi, and is hydraulic tested to 400 psi, and with a weight of 1100 kg this 4nhp compound engine is a powerful machine which makes easy work of the local gradients, running comfortably with a load of passengers at 6-7 mph.

Ivor named the engine *Topsy*, which is his pet name for his wife Jeanette, to whom he has been married for over 50 years. It is often a clever move by engine owners to name their engines after their 'better halves' to ensure they give their blessing to the hobby! Ivor's interest in steam began as a boy in the 1950s, as it did for so many in that era, with him building a static steam engine at the age of 16. Ivor's working life saw him employed at Poole Power Station for over 30 years in the maintenance department dealing with steam boilers and generators on a larger scale than his Garrett.

Sadly in 2004 Ivor suffered a stroke, which paralysed the left-hand side of his body, and is therefore supported with crewing *Topsy* by his son Tim. Tim takes control of the driving whilst Ivor takes control as steersman. Tim himself is an experienced engineman of miniatures having owned many over the last 20 years. He has recently built a Burrell single crank compound in 4 inch scale, which he named *Valiant* (a slight play on his surname), from a Steam Traction World kit which he started in 2014.

Since owning the engine they have covered over 1000 miles with it on the road (Ivor keeps a log book of each journey completed), often visiting Poole Quay, Sandbanks and the nearby Luscombe Valley Railway on the Sandbanks peninsular

Ivor Vaile.

Ivor achieves a superb shine on the engine's lamps.

The bespoke mechanical lubricator.

The cylinder detail together with steam siren and whistle.

to support the charity days there. Between Ivor and Tim, they have developed a good working partnership, allegedly with never a cross word!

It has been a very reliable and loyal engine over the years, with little work needing doing. The usual annual maintenance of replacing gauge glasses and a new fusible plug, with a few minor repairs such as new little end pins and bushes, being really all that has been required. Current work has seen Tim lapping the regulator valve in to try and stop the bypass of steam, adjusted hopefully to produce better responsiveness from the regulator. Ivor gets to work on the cleaning during the week between outings, whilst Tim tries to manage his time across his projects ensuring *Topsy* is in top form and ready for the next rally or road run.

The engine has a flap in the tender which makes visibility of the water level easy and replenishment simple. It has also enabled them to work out how much water is used on each trip and this averages out at a consumption of about a gallon a mile. They use a mix of coal, with both steam coal (which they tend to get from rallies) and standard house coal, which are separated in the tender. The smokeless steam coal is always used when lighting up from home to keep the neighbours happy!

A year or two back they steamed the engine down to the annual New Year's Day steaming at Poole Quay, a popular event with local miniature engine owners - a distance of 3 miles. All started well, but soon into the journey the injector stopped working, so they continued their journey with only the water pump as their method of putting water into the boiler. On arrival at the Quay, just as they were tucking into their packed lunches, they were met with a heavy rainstorm and received an absolute soaking. Deciding that the best course of action was to head home as they were so wet, they set off on the return journey. A mile or so into the journey and the water pump decided it had had enough too and failed on them. With no means of putting water in the boiler they had no option but to drop the fire there and then on the roadside. With the rain still coming down hard Tim left his poor mum and dad getting wet, whilst he called a taxi and returned home to get the Land Rover and trailer to pick the engine and his soaked parents up!

Water pump.

>>

It is often a clever move by engine owners to name their engines after their ‘better halves’ to ensure they give their blessing to the hobby!

In October 2012 the engine was involved in a more sombre occasion, namely the funeral of Maurice Bond. Maurice was also a local miniature engine owner and his family were keen for his last journey to be by steam. Ivor was happy to oblige so he and Tim steamed through the busy Bournemouth traffic to meet the hearse and take Maurice to Bournemouth crematorium. The traction engine trailer used to carry the coffin was borrowed from another local miniature steam traction engine owner, Bob Down. All in all they completed a 14 mile round trip in some heavy traffic conditions but it was a very important occasion that they wished to honour for Maurice and his family.

2020 has been a challenging year of course with a lack of rallies to attend but *Topsy* has had a few outings, when the rules and regulations allowed, and no doubt the local roads of Poole will continue to see this fine 6 inch Garrett in the months ahead.

ME

A flap in the tender makes visual checks on the water level easy.

A mix of steam coal and smokeless house coal is used, with them being kept separate on the tender.

A steep downhill incline at Ivor’s house means careful control and a boiler full of water on departure.

Superb standards of presentation.

Sandbanks properties in the background.

Topsy.

Machining Locomotive Cylinders from Solid Material

PART 1

David Earnshaw suggests an alternative approach to machining cylinders using the milling machine.

Many years ago, more than I care to remember, I made the decision that my next model would be a 'Duchess' 4-6-2 locomotive in 5 inch gauge. I sent for the drawings and studied them carefully and began to look at sources for materials and castings and started to gather together some of the necessary materials and a few castings. Where to begin?! When building a model locomotive the usual process is to begin with the frames and stretchers, then the wheels, motion and so on. But I didn't use that sequence.

Fully realising that this project was going to take a long time, I decided that I would begin by building the boiler. The reason for starting with the boiler was simply that I wanted to get it done whilst I had access to heating equipment; retirement wasn't that far away and once I left employment I knew that it would not be easy to get sufficient heating facilities to cope with such a large boiler.

I began by making some of the formers for flanged plates. These themselves were quite large and I was using half inch steel plate for them so each one was a substantial piece of work in its own right. There were also some large wooden formers to make for the inner and outer firebox wrappers. As I reflected upon the amount of work going into all these formers, which were only going to be used once, I began to consider making a *pair* of Duchesses. Setting up times for making other parts of the locomotives would be shared between the two models and there would be some repetition of parts so it was thought that considerable time would be saved by making two together! And so the die was cast, two locomotives it was going to be! Looking back now, I am very glad that I decided to build the boilers first as I am sure that if I were to be starting the project today the cost of the copper and silver solder would be prohibitive.

Machined cylinder blocks for a 4 cylinder locomotive.

However, this article is not about the boilers but to illustrate an alternative way of machining the cylinder blocks. There are three cylinder blocks for each engine, two for the outside cylinders and one large one for the twin cylinders inside the frames (**photo 1**).

I purchased a set of castings for one locomotive and, with an eye on the cost of such castings, decided to make the second set of cylinders out of solid blocks of cast iron. The following account is a description of the methods used to machine these cylinders

Equipment

I am fortunate to have a well equipped workshop. It has taken me somewhere in the region of 40 to 50 years to accumulate my machinery, tools and associated equipment. Most of it has been purchased second hand and needed renovation. Some has been rescued from the scrap bin and refurbished, rebuilt and sharpened as necessary. A lot of the smaller stuff has been bought from those wonderful exhibition stalls and some shops which deal in surplus or redundant equipment; I find that I spend a lot of time scouring the displays and rummaging through the boxes of these stalls, perhaps spending more time there than looking at the models in the exhibition. And, of course, there have also been some purchases of new items. My main machinery consists of a Myford S7 lathe, a Colchester Chipmaster lathe and a Harrison horizontal milling machine with vertical head attachment.

Where to begin?

Work began on the solid blocks of cast iron. I had ordered these with a little extra material on all surfaces to allow for machining to size but they came supplied with more generous allowances than asked for, partly due, I suspect, to the fact that the blocks had been cut from continuous cast bar and there were some rounded corners on the raw material, so the supplier had included the extra material to allow the round corners to be machined away.

>>

Initial set up of machine vice and angle plate in preparation for early stages of machining cylinder blocks. Photograph shows machine in vertical mode.

Carbide tipped face mill used for machining the flat surfaces. This photograph is posed and shows machining of one of the actual castings.

Opening out hole with large drill in milling machine.

The milling machine was set up in horizontal mode and a machine vice bolted to the table together with an angle plate (**photo 2**). The angle plate was used because some of the blocks were too big to fit in the machine vice and so the larger blocks were clamped direct to the angle plate. As some of the photographs show, the method of clamping the cylinder block to the angle plate was by the use of a single rack clamp (painted orange in the photographs). This may seem a rather insecure way of holding the material but these clamps are very powerful and it was found entirely satisfactory, safe and quick to use this method.

There are not many photographs of the preliminary machining as I had not decided to write this article at that point. Much of the excess material was cut away using a slitting saw of 3⁄32 inch thickness and 5 inches diameter. The 3⁄32 inch width provided a more rigid cutter and the 5 inch diameter ensured a good depth of cut was available; a cut of about 3⁄16 inch deep was used for each pass of the cutter until maximum depth was achieved. However, due to the size of some of the cast iron blocks it was necessary to unclamp the block, turn it over, reclamp and finish the cut from the opposite side. A small amount of material was left on all faces for final sizing; slitting saws don't always leave a good finish and can also wander slightly. On one or two faces the amount of material to be removed was small and did not require the use of the slitting saw.

With all three cylinder blocks brought to near final size the vertical head was fitted to the milling machine and a carbide tipped face mill (bought from a surplus store) of about 2½ inches diameter fitted in the spindle.

The top surface of the inside cylinder block is a plain flat surface so this was given a light cut all over with the face mill. Making full use of the angle plate set-up to ensure accuracy, the inside cylinder block was then clamped with the top, newly machined surface against the vertical face of the angle plate and then a light cut was taken to clean up one side. The block was unclamped, the machine table carefully cleaned and the block turned over and re clamped to the angle plate whilst tapping it down gently with a hide mallet to maintain contact with the machine table. The new upper surface was then machined with the face mill until it was parallel and an accurate size to fit between the frames of the locomotive.

From this condition, the end faces of the block were machined square to the sides but not quite to finished length as this would be finalised when the cylinder bores were created later. A similar set-up was used to bring the cylinder block to correct depth. The same operations were then carried out on the *casting* for the inside cylinder block of the other locomotive. **Photograph 3** shows one of these operations being carried out but machining one of the castings with cored holes rather than one of the solid blocks. The outside cylinder blocks and cylinder castings were then machined to size using similar operations to those used on the inside cylinders. Incidentally, this work was to prove a really good test for the milling machine. The machine is very sturdy and well-built but relatively compact and is a real metal mincer when it needs to be. In some cases cuts in excess of 0.080 inch (2mm) deep, full diameter of the cutter and through the skin on the iron castings were taken without chatter, vibration or troubling the machine in any way and, even at these depths of cut, the set-up remained rigid with only the one rack clamp securing the work.

Initial drillings

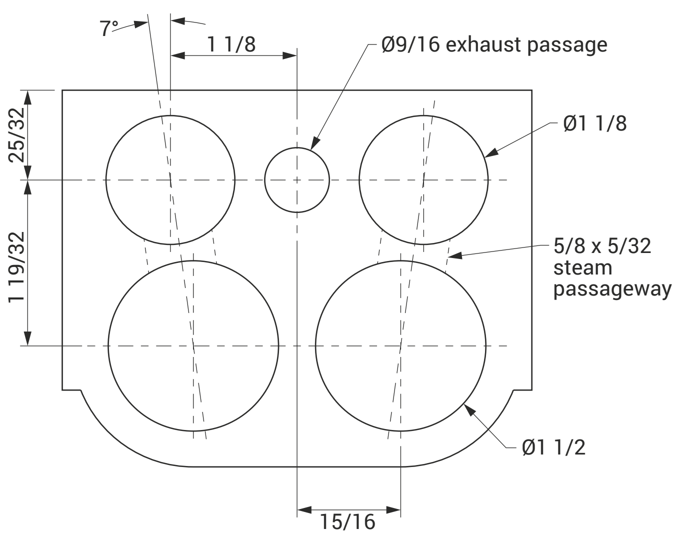
The *castings* had cored holes in them but before any boring could begin on the solid blocks some large holes had to be drilled to pass the boring bar through them. The ends of the blocks were marked out and centre punched on both ends of each block and the initial holes were drilled on the bench drill - first, started with a centre drill and then followed with a drill bit of ⅜ inch diameter. The reason for marking out both ends was because of the length of the bores. At around 3½ inches deep these would be very deep holes to drill from one end so drilling from both ends simplified the work somewhat. These holes were then opened up to ½ inch diameter, again using the bench drill.

To enlarge the holes further the work was taken to the milling machine, still with the vertical head on, and clamped against the angle plate (**photo 4**) with parallels underneath (which cannot be seen in the photograph) to lift the block off the table. Using the X and Y axes to align the already drilled holes a 25/32 inch diameter drill was fitted and used to drill all the holes out to that size. I would have liked to have used a slightly larger drill but the height under the head of the machine and the top of the work would not permit a bigger, and therefore, longer drill. However, 25/32 inch diameter would allow my ¾ inch diameter boring bar to pass through and be alright for the piston valve bores as they were to finish at 1⅛ inch diameter.

The holes for the main cylinder bores were to finish at 1½ inch diameter so quite a lot of material still remained to be removed and it was decided to use a large slot drill to bring the hole nearer the finished size. I selected a 1¼ inch diameter slot drill from a box of cutters picked up from a surplus sale and fitted it to the machine. Running at about 250 rpm, the cutter was fed straight in to the 25/32 inch hole and the result can be seen in **photo 5**. The cutter could be fed quite rapidly and the material was removed in no time. Of course, the short length of the slot drill meant that the blocks required turning over and machining from both sides to drill all the way through. Unfortunately, the Harrison machine does not have a quill in the vertical head so for all the drilling operations the feed was put on by manually winding up the Z axis - quite a bit of handle mangling!

The next task was to bore the cylinders and the piston valve chambers to size. **Figure 1** indicates the sizes involved and I gave a lot of thought as to how I would machine the bores. The usual recommendation is to clamp the cylinder block to the cross slide of the lathe and use a between-centres boring bar. I have used this method on my Myford several times in the past with complete success, as have countless other people, but I have never felt really comfortable putting a hefty strap over the cylinder block and clamping it with bolts or studs down to the cross slide. There is always the possibility that the strap may distort the casting slightly or that the tee slots may be damaged. To machine both the cylinders and piston valve chambers would mean packing up the block at two different heights or turning the cylinder block over and resetting it parallel with the lathe axis. Also, with such a large casting, it would mean that it would be very tight to get a complete facing cut across the end of the cylinder after boring. Automatic feed is available for both longitudinal and cross feeds.

Fig 1



End Profile Of Cylinder Block

5

Removing bulk waste with 1¼ inch slot drill.

6

Initial set-up on milling machine to assess how much space was available.

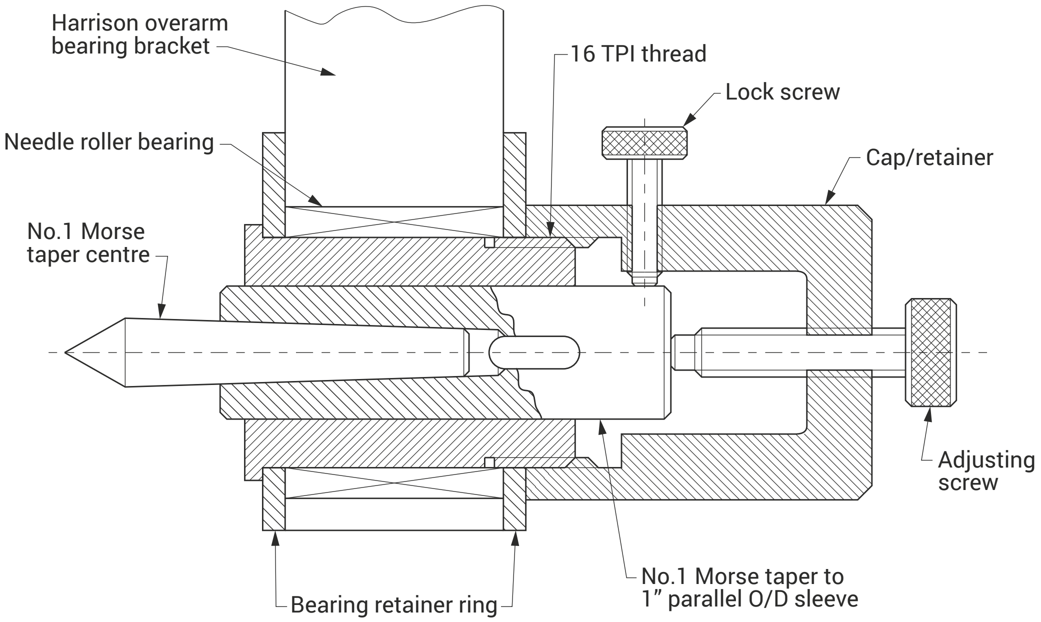
As mentioned previously, I also have a Chipmaster lathe and this would provide more working space, has auto feed for the saddle and cross feed, and more power to drive the boring bars but it does not have a tee slotted cross slide so either an additional plate would need to be made to fit on to the existing cross slide or a special fixture would be needed to bolt castings and materials to the machine. Even then, there was the two differing heights for cylinder and piston valve chamber to accommodate so the castings would still have to be set at the different heights and reset parallel to the lathe centreline each time.

My attention then turned to the Harrison milling machine and I began to look at how this could be used. In horizontal mode with the milling arbor removed it becomes similar to a lathe with the milling table being a very large cross slide and with rise and fall to that table via the Z axis. This meant that the cylinder blocks could be bolted directly to the mill table using the hefty tee slots therein. Once set, the blocks would not need to be unclamped until all the bores had been completed. What's more, the mill has digital read out fitted. Unfortunately, it does not have power feed to the Y axis. However, it was decided to explore this method further.

Photograph 6 shows the initial exploratory set-up and it provided a few surprises! Prior to this set-up I had imagined that I would need to

>>

Fig 2



Section Through ‘Tailstock’

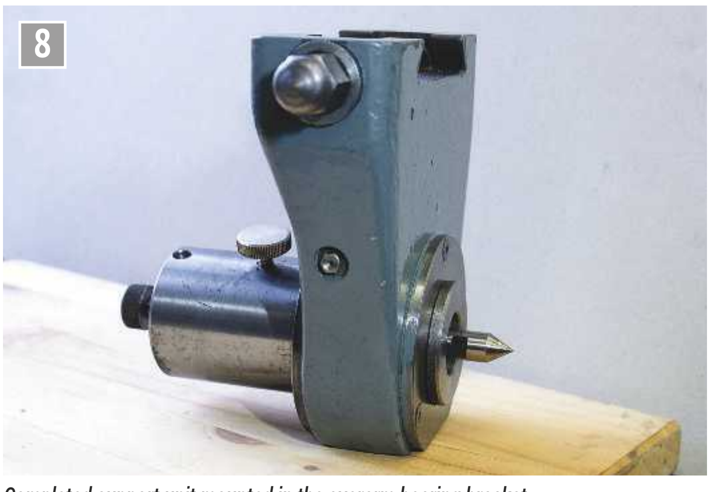
build some sort of ‘tailstock’ to slide along the underside of the overarm in place of the usual overarm bearing bracket. The underside of the overarm has a dovetail slide and this could be used to align some sort of fabricated ‘tailstock’ to support the outer end of the boring bar. The initial set-up also indicated that travel on the Y axis of the machine was somewhat limited but with careful positioning would provide enough movement to bore the cylinder blocks. I also had to find some method of fixing the boring bars into the spindle of the milling machine. As photo 6 shows, the fitting of the boring bar was achieved by machining the end of the boring bar down to 20mm and then gripping the machined portion in an ER32 collet chuck in the milling machine spindle, which solved that particular problem. The photograph also shows that, even with the overarm extended from the machine as far as safely possible, there was not much room at the other end for any form of ‘tailstock’. It became obvious that some sort of modification to the actual overarm bearing bracket would be necessary if I was to pursue this method.

On the Harrison milling machine the cutter arbor is supported at its outer end by a substantial bracket which contains a large needle roller bearing. An oversize spacer collar on the milling arbor runs inside this bearing giving the required support to the arbor. **Photograph 7** shows just how little space there was between the end of the boring bar and the bearing bracket and, rather than make drastic modifications to the overarm bracket, I decided, as far as possible, to use it without any dismantling. My solution was to make use of the roller bearing for location and alignment but not as a rotating feature.

Photograph 8 shows the finished modification mounted in the bearing bracket. In order to get to this stage the first requirement was for a centre of some sort. A rotating centre would have been the preferred choice but this was too bulky and there simply was not enough room (photo 7 again). Looking through my lathe centres I found an almost new No. 1 Morse taper, hard, centre which I fitted into a No. 1 Morse taper sleeve with a 1 inch diameter parallel outside diameter (as used in capstan lathe tooling). To mount this into the milling machine bearing bracket, another sleeve was required, the idea being that the 1 inch diameter MT sleeve should slide snugly in the bore of this new sleeve and the outside diameter of the new sleeve should be a close fit in the bore of the roller bearing. This sleeve would be clamped into the bearing bracket by a large ‘cap’, using the roller bearing as location only.

Figure 2 is a sketch showing an assembled section through the main parts of the support unit. The roller bearing has an inside diameter of 44mm so a piece of 2 inch diameter mild steel long enough for the job

Showing just how little space there was between the end of the boring bar and the overarm bearing bracket.



Completed support unit mounted in the overarm bearing bracket.


Close up view of the internal screwcutting operation of the retaining cap.


Component parts of the support unit before assembly.

was mounted in the lathe and centre drilled, drilled through, bored and finally reamed to 1 inch diameter. To maintain concentricity, the steel was then mounted on a mandrel between centres and the outside diameter reduced to exactly 44mm whilst leaving 0.125 inch at the left hand end of the material at 2 inch diameter. At the right hand end a thread was cut. This was a random choice thread having an outside diameter of 44mm and a pitch of 16 threads per inch (because my lathe has an English screwcutting gearbox and I have chasers for that pitch). Next, another piece of steel was required to clamp the sleeve in place in the bearing bracket. I will refer to this piece as the 'cap' so a piece 55mm diameter was gripped in the three jaw chuck and faced, drilled, and bored to allow cutting of an internal thread of 44mm diameter x 16 threads per inch (**photo 9**). Further behind this thread the material was bored deeper at 1¼ inch diameter to allow clearance for the 1 inch diameter Morse taper sleeve to retract into. Finally, a ⅜ inch BSF thread was tapped through the bottom of the 'cap' for an adjusting screw. All the separate parts for this modification are shown in **photo 10** and the parts assembled together in **photo 11**.

Readers may also notice in photo 11 that there is a ⅜ BSF thumbscrew in the back of the fitting which is used for adjusting the inner sleeve/centre forward and a second thumbscrew added to the top/side of the fitting to clamp the inner sleeve in place when making final adjustments to the centre in the machine - acting like a tailstock barrel and its clamp on a lathe. The final hole in the 'cap' (top right, photo 11) is for a tommy bar to tighten the sleeve and cap into the bearing bracket.


Parts assembled together, ready for fitting in the overarm bracket.

●To be continued.

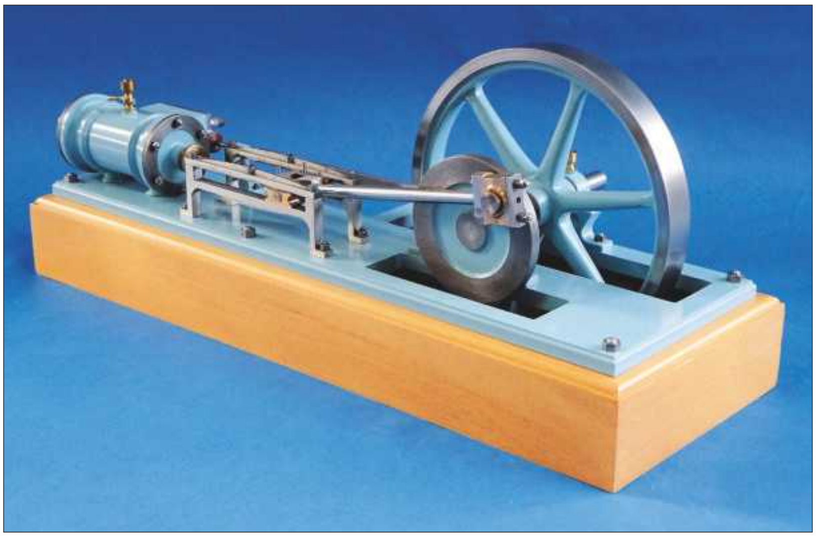
NEXT ISSUE

Thompstone Engine
Another stationary engine from Jason Ballamy – this time the Thompstone horizontal mill engine.

We Visit the Isle of Wight
Roger Backhouse takes a trip over the Solent to visit a small but perfectly formed steam railway.

Pattern Making
Luker explains how he uses his 3D printer to make patterns for castings.

Content may be subject to change.



ON SALE 9 APRIL 2021

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Class 20 at SSMEE.

No preamble this time, I present to you, dear reader, the Club News column, naked and unashamed…

In this issue; spelling, front wheel drive, subcutanaeity, owls, a clandestine collection, silver swarf against the lathe (with apologies to Eben Rexford), Newton's Third Law of motion and when is a kilogram not a kilogram?

Sheffield & District Society of Model & Experimental Engineers' *Steam Whistle*, January, shows Alan Cooper's continued work on secretary, Rose Francis' 7¼ inch gauge *Anna*. Plus, Mick Savage rails against the cost of imported coal, which will produce greater pollution than coals available here, if planning permission for a new mine is refused. (Stop Press – PP was granted.) Mike Peart continues his series with an explanation of the GWR Bug House (a disinfecting plant, M'Lud). Mick also noted (and photographed) a blue heron which appears to have consumed most of the fish in the Limb Brook alongside our site. It probably came from the heronry part of the bird sanctuary in the adjacent woods. Not the same sort of establishment as a Wrennery, which my Naval readers may remember…. Bob Barton writes on the Metropolitan Vickers factory in Sheffield. It made electric motors and drives before closure in 1984, with a last order from the Seoul Metro. This well presented miniature version of Class 20 20137 (D8137) - now privately preserved at the Gloucester & Warwickshire Railway - was 'copped' by yours truly at a Sheffield Fun Run in December (**photo 1**). The original was bought from BR in 1994.
W. www.sheffieldmodelengineers.com

The Link, Jan-Feb (there was no December issue) from **Ottawa Valley Live Steamers & Model Engineers**, is begun by editor, Graham Copley, who is pleased to see that all 12 members of recent Zoom meetings are the same people who are active in their workshops and making things. Whilst Graham has been working on his Emett locomotive, secretary, David Hayman has been building up his 7¼ inch gauge 'switcher' and Steve Miller records his return to model engineering after a ten year hiatus. Steve details the metals used in his project, including aluminium, which prompted editor, Graham, to compliment him on spelling the word correctly… (British spelling)
W. www.ovlsme.com

Murray Lane writes from **Model & Experimental Engineers, Auckland**, with details of recent events including a barometer brought by Graham Quayle, which was uneconomic to repair. It lacks a dial and front cover and has an unknown movement but the case is nice. This is having to wait until a suitable donor item becomes available. (Hmm, could not a dial be downloaded from the Internet, suitably adjusted for size and printed on card? Such items are not hugely accurate in a domestic environment so does it matter? – Geoff.) Graham was also sporting two large sticking plasters, acquired in separate mishaps but although the meeting was informed, we remote readers are not privy to the cause. Edgar Salwegter has been cutting clock wheels, converting a clock designed for wooden parts and trying plastic (too much friction) and aluminium (*spxxx!*) which was similarly afflicted. Dave Watt has been modifying two Myford ML7s to metric standards.

Chingford & District Model Engineering Club *Newsletter* has little to report, although the chairman says that in preparing items for future newsletters, taken from the post-WWII period, he observes that the then editors were appealing, as now, for more volunteers and contributors. He also mentions that son, Luke, is a locksmith and includes several photographs of lock entrails for our delectation.

W. www.chingfordmodelengineering.com

Stamford Model Engineering Society editor, Joe Dobson, has good news. He bought a 1957 Citroen TA (Traction Avant – front wheel drive) which appeared well preserved. Mechanically, it was neglected and needs some *tendresse.* Keith Hansell's lockdown activity was a newly-acquired 1 inch scale Minnie traction engine. This also looked quite attractive but proved to have subcutaneous problems too. Meanwhile, John Hennessey specialises in the restoration of old radios. He therefore expects them to have faults but they are usually quite easily sorted. The latest is a PCR receiver, a 'ruggedised' domestic radio, intended to be taken by troops after D-Day to allow them to receive domestic BBC broadcasts. John is being considered for a talk later, at which he may bring some radios and enthral members with tales of ITMA and John Snagge.

On Track, December, from **Richmond Hill Live Steamers,** relates how a load of coal has been obtained at a good price. If it is good for firing locomotives, more will be procured. Member Joe Foster has died. He was a dentist and claimed to be able to repair almost anything. He built boats, aircraft, steam engines, jets, musical instruments, buildings and motorised vehicles. His skills will not be lost as he brought up his sons in the same tradition. A steam gathering in Hamilton was cancelled but three members assembled for a steam-up and their creations, a Clayton undertype, a Greenly traction engine and an Atkinson steam waggon toured the neighbourhood. *On Track*, February, in its regular spot recommending interesting URLs, suggests a Monster Moves video regarding the movement of a 100 ton 15F locomotive, built in Glasgow for South African Railways, which was recently returned to its home city for a museum. The engine is notable for hauling the prestigious Blue Train and its move to Glasgow saved it from the Bloemfontein scrapper's torch. That city, once a railway hub, is now a repository for old railway engines being cut up.

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

Bournemouth & District Society of Model Engineers' B&DSME News' Road, Rail etc. column continues the story of hired in buses with some pictures, including the 'Ying Tong' demonstrator and one of five bought from the Isle of Man, still with the triskelion and *Bus Vannin** etched on the stairs glass. The Minerva Owls of Bath was a public art 'happening' in 2018. One of them is *Isambird Kingdom Brunowl.* 61 owls were auctioned, raising nearly £140,000 for charity. (This should go down well in parts of Sheffield – think football.)

W. www.littledownrailway.org.uk

Blast Pipe, February, the joint newsletter of **Hutt Valley and Maidstone Model Engineering Societies**, says they are planning for 'real' meetings, which are currently still permitted in New Zealand. David Turner collected some items for his locomotive in Palmerston North but the directions for finding the location were straight out of a spy novel. Meet his vendor at an obscure place, take them to somewhere unspecified and *have his pickup backed into the building for him,* before loading the items required. Peter Anderson reports that Australian Model Engineering magazine has closed, citing the usual problem - declining sales - despite high production values and interesting news and content. Times change and the Internet has made great intrusions into magazines in general, although I recall a previous editor of *Practical Wireless* telling me that print magazines were in decline, fully 20 years ago.

W. www.hvmes.com

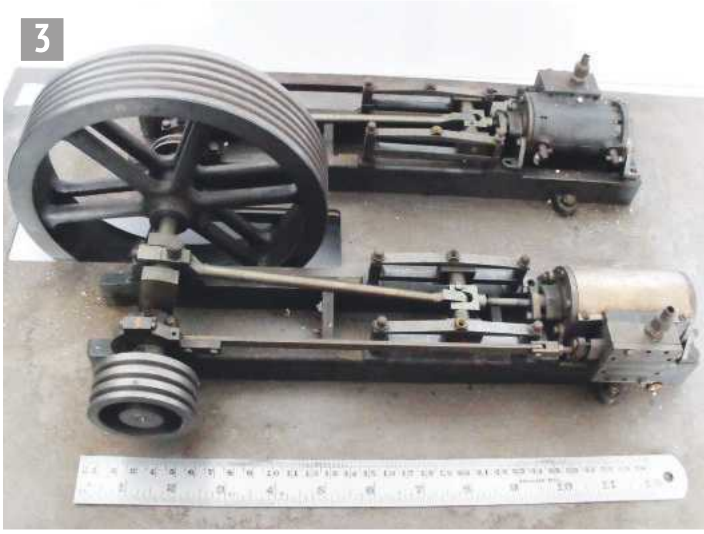
The Bristol Model Engineer, January, from **Bristol Society of Model & Experimental Engineers**, has this fine picture of a ⅛ scale 1918 Morgan Runabout, made by Terry Phelps, who writes about his Morgans, big and small (**photo 2**). John Whale writes on his *Yorktown*, with an addendum by editor, Richard Lunn, saying he now knows why John buys so much 'junk' at the club auction - it returns as something entirely different some time later. There is more about Trevor Chambers' wooden propeller and details of Alan Hooper's vertical boiler, his first.

W. www.bristolmodelengineers.co.uk

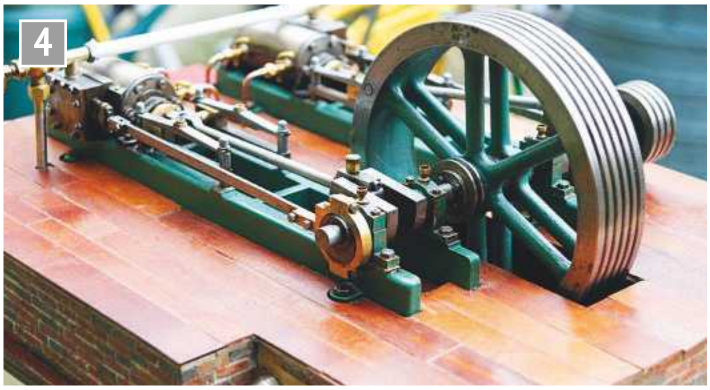
Leeds Lines, February, from **Leeds Society of Model & Experimental Engineers**, has a picture of chuck on the front cover. What? Oh, 'A' chuck, mounted on Mark Batchelor's rotary table. In an explanatory article Mark explains that it is not geared but is turned by hand to the required angle, as marked by a 360 degree protractor glued to the base. (Hmmm, that sounds as though even I might be able to make one – Geoff.) Chairman, Jack Salter, referred to his 'normal' friends, i.e. those without a workshop, who feel that in the lockdown, they should be more creative. Well, my fellow engineers and clubs, there's an opportunity!

2

Terry Phelps' ⅛ scale Morgan Runabout. (Photo courtesy of Terry Phelps.)



The soon to be refurbished Twin Victoria at PM House ... (Photo courtesy of Alan Wragg.)



... and after refurbishment by Owen Bird. (Photo courtesy of Owen Bird.)

Alan Macdonald (he of the silver rocking chair) was asked to make some silver garden tools. No, not spades, rakes or forks but starting with a roller. (*Starting with...!?*) Mark made the drum from aluminium and the handle from ebony as a contrast. In comparison with the long curls of swarf resulting from turning aluminium, ebony only produces a little black dust. Treasurer, Nigel Bennett, expresses his thoughts on threading with a tailstock die holder.

W. **www.leedssmee.btck.co.uk**

Bradford Model Engineering Society's *Monthly Bulletin* for February, features president, Jim Jennings indulging in a little philosophy. What is the attraction of steam power? He thinks the raw elemental materials used helps us connect with the planet (I paraphrase) though it went deeper than that, citing Earth, Fire, Wind and Water. (I cleave to the idea that onlookers can see it working – but what do I know? I didn't study philosophy – Geoff.) In 'and now for something completely different', David Watts discusses the machining of wood and associated techniques.

W. **www.bradfordmes.uk**

The Journal, February, from the **Society of Model Engineers**, begins with a picture of the bridge on the Royal Yacht, *Brittannia*, now moored at Leith docks, Edinburgh. The Society is to receive a five-figure sum as the London Power tunnels pass below their HQ at Percival Marshall House. Newly-joined Graham Astbury adds his practical experience of soldering tinplate to the previous discussion. David Coney solved a problem concerning enlarging an internal bore on an item too large for his lathe, by mounting it on a piece of hardwood and gripping this latter item in the four jaw chuck. Adrian Garner reminisces about his father, a model boat builder, who made some models out of tinplate using a 65 watt Henley Solon iron. (Ears prick up...) A steam tug was tested in the bath, leaving an oily 'tidemark', to the wrath of Mrs. Garner... On another occasion, the steam tug was being run on a large pond when a passing duck used it as a convenient perch. At that point, the boiler safety valve opened just below the bird, which took off in a panic. Isaac Newton's Third Law of Motion functioned as expected and the tug rolled over and sank! Darius Coombes found an old drill in his workshop, marked 'LNER', which came from a company in Kent. He wonders about the journey it must have had to arrive there. Gareth Hughes invented the transfer punch and was rather pleased, until he found out that he was not the first... In this respect he shares the situation with Sir Clive Sinclair who invented binary maths as a child, only to discover... Jim Cahill writes on thermodynamics in a lengthy article from which I will select one intriguing item. Quite recently, the Standard Kilogram, which was defined using a precision balance, was redefined by reference to time, as generated by a caesium Clock. This was because the SK seemed to vary in weight when tested on the latest equipment. We now know that this was a gravitational effect and the move to a caesium Clock was not necessary as the Time so generated is ALSO subject to gravitational effects. In the case of a balance, since the test item and its balancing counterpart are both acted on by gravity, the effect does not occur. Any more detail is above my pay grade! Jim concludes by claiming that Sir Isaac was right in his conclusions regarding falling apples but missed a trick by not realising that the Earth came up to meet it (if ever so microscopically). A part-finished Stuart Twin Victoria was found in a neglected state and finished by Owen Bird. These before and after pictures show what a good job he did (**photos 3** and **4**).

W. **www.sm-ee.co.uk**

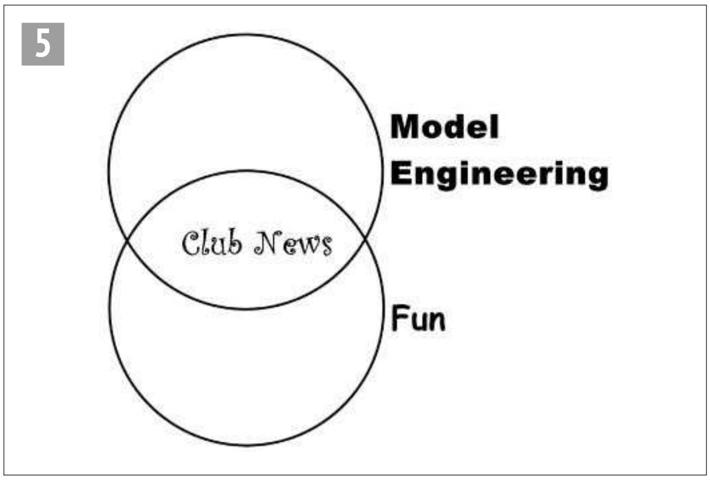
I saw a drawing somewhere, which I thought was apposite; I have redrawn it (**photo 5**).

And finally: how many engineers does it take to change a light bulb? One; we know what we are doing.

* Bus Vannin is the Isle Of Man government-owned bus company. The song *Ellen Vannin* is often known as the island's alternative national anthem.

CONTACT

geofftheasby@gmail.com



Venn diagram for Club News!

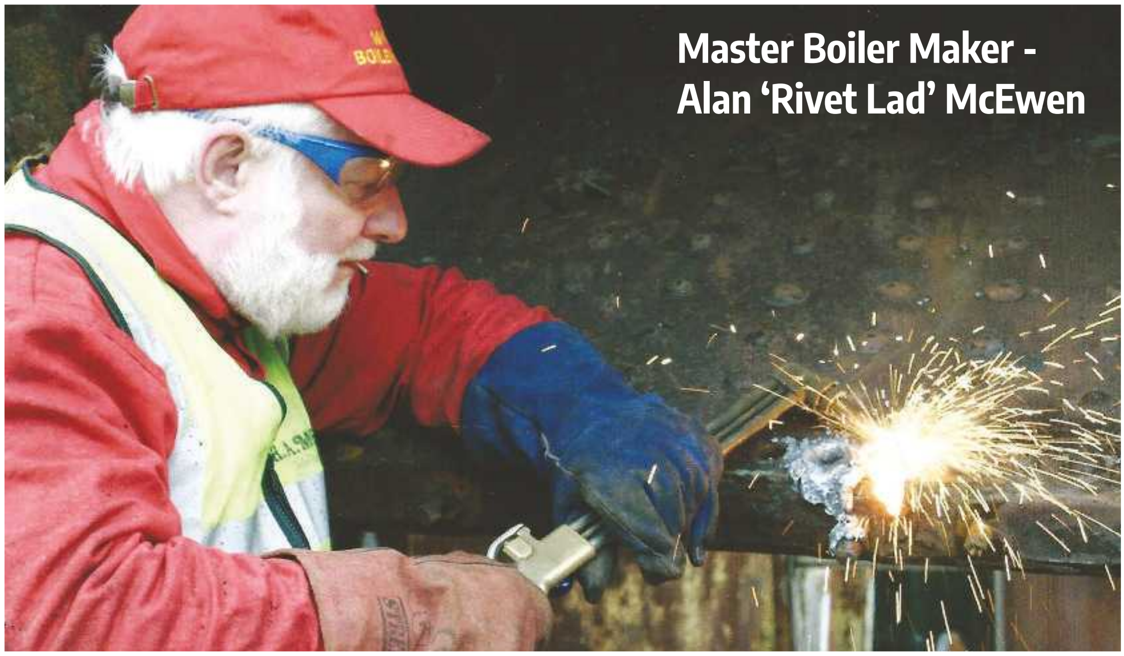
Model Engineer *Classified*

Complete home Workshops Purchased
Essex/Nottinghamshire locations
Distance no object!
Tel: **Mike Bidwell**
01245 222743
m: 07801 343850
bidwells1@btconnect.com

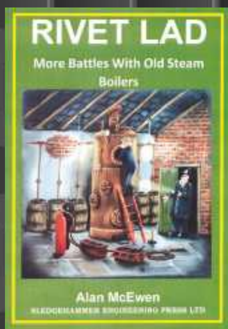
THINKING OF SELLING YOUR LATHE, MILL OR COMPLETE WORKSHOP?
and want it handled in a quick professional no fuss manner?
Contact Dave Anchell,
Quillstar (Nottingham)
Tel: 0115 9206123
Mob: 07779432060
Email: david@quillstar.co.uk

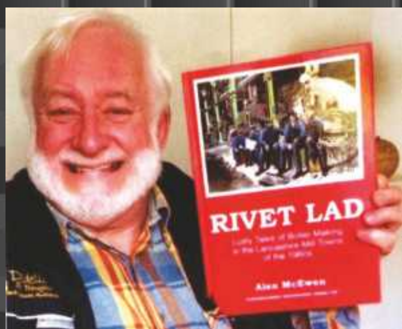
To advertise here please email Angela Price at angela.price@mytimemedia.com

Bringing British industrial history to life



Master Boiler Maker - Alan 'Rivet Lad' McEwen





When Master Boiler Maker and author, Alan McEwen was a young sprog, he loved banging and hammering on rusty old boilers; now that he is an old hog, he just prefers others to bang and hammer!
Alan McEwen's Boiler Making adventures and also 'potted histories' of several Lancashire and Yorkshire Boiler Making firms, can be read in RIVET LAD - *Lusty Tales of Boiler Making in the Lancashire Mill Towns of the 1960s.* The book is crammed with 'hands on' technical information of how Lancashire, Locomotive, Economic, and Cochran Vertical boilers were repaired over 50 years ago. The book's larger-than-life characters, the hard as nails, ale-supping, chain-smoking Boiler Makers: Carrot Crampthorn, Reuben 'Iron Man' Ramsbottom, Teddy Tulip, genial Irishman Paddy O'Boyle, and not least Alan himself, are, to a man, throw-backs to times gone by when British industry was the envy of the world.

Alan McEwen's first RIVET LAD book: *RIVET LAD – Lusty Tales of Boiler Making in the Lancashire Mill Towns of the Sixties* published September 2017 is now priced at £25 plus £3.00 postage and packing to UK addresses.

Alan's second RIVET LAD book: *RIVET LAD – More Battles With Old Steam Boilers* was published in September 2018. **Now priced** at £25 including postage and packing to UK addresses.

BOOK BUNDLE SPECIAL OFFER

Both RIVET LAD books can be purchased together for £40 plus £5 postage and packing to UK addresses.
To place an order please telephone 01535 637153 / 07971 906105. All our books can be ordered on our website www.sledgehammerengineeringpress.co.uk or email: lankyboilermaker@btconnect.com.
Overseas customers contact Sledgehammer by email for postage costs.
We accept payment by debit/credit card, cheques, cash and postal orders made out to SLEDGEHAMMER ENGINEERING PRESS LTD.
World From Rough Stones House, Farling Top, Cowling, North Yorkshire, BD22 0NW.