ASTT Newsletter No. 14

July/August 2020

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[1] For those members who don't know him, John Duncan is an ex BR Locomotive Engineer (1948-1994), Locomotive Superintendent K&WVR (1979-1990) and CME to SLOA later MSLOLtd (1993-2002). He is a founding member of ASTT. A brief "bio" of John can be found on AST's website at https://www.advanced-steam.org/ast-group/organisation/john-duncan/.

Chairman's Piece – John Hind

Like everyone else, we are learning to live with 'new normal' and adapting what we do – there are examples of this in the newsletter, so I will not say much about them here – please read on.

In the last newsletter I wrote about Cedric Lodge stepping down as Secretary and David Nicholson will be taking over from Cedric as Secretary. This leaves a vacancy for the Editor of the Newsletter. At time of writing no-one has stepped forward to take on the Editors role – there is still time to volunteer!

We aim to publish 3 newsletters a year and the main role of the Editor is to coordinate all the inputs. If you would like to take this on please contact me on john.hind@advanced-steam.org .

Stapleford Miniature Rly – Saturday 19/9/2020 – John Hind

Everyone should have already received a notification for our 'alternative' to the annual conference. We have 15 who have signed up to attend, which makes it worthwhile holding - provided that the everyone, who said they can come does. As Stapleford charge a flat fee for the day, we have flexibility to add more, but if fewer come then we will end up running at a loss.

If anyone has a last minute change of mind and would like to come along, there is sufficient space for social distancing, so please let us know as soon as you can.

Revolution Update

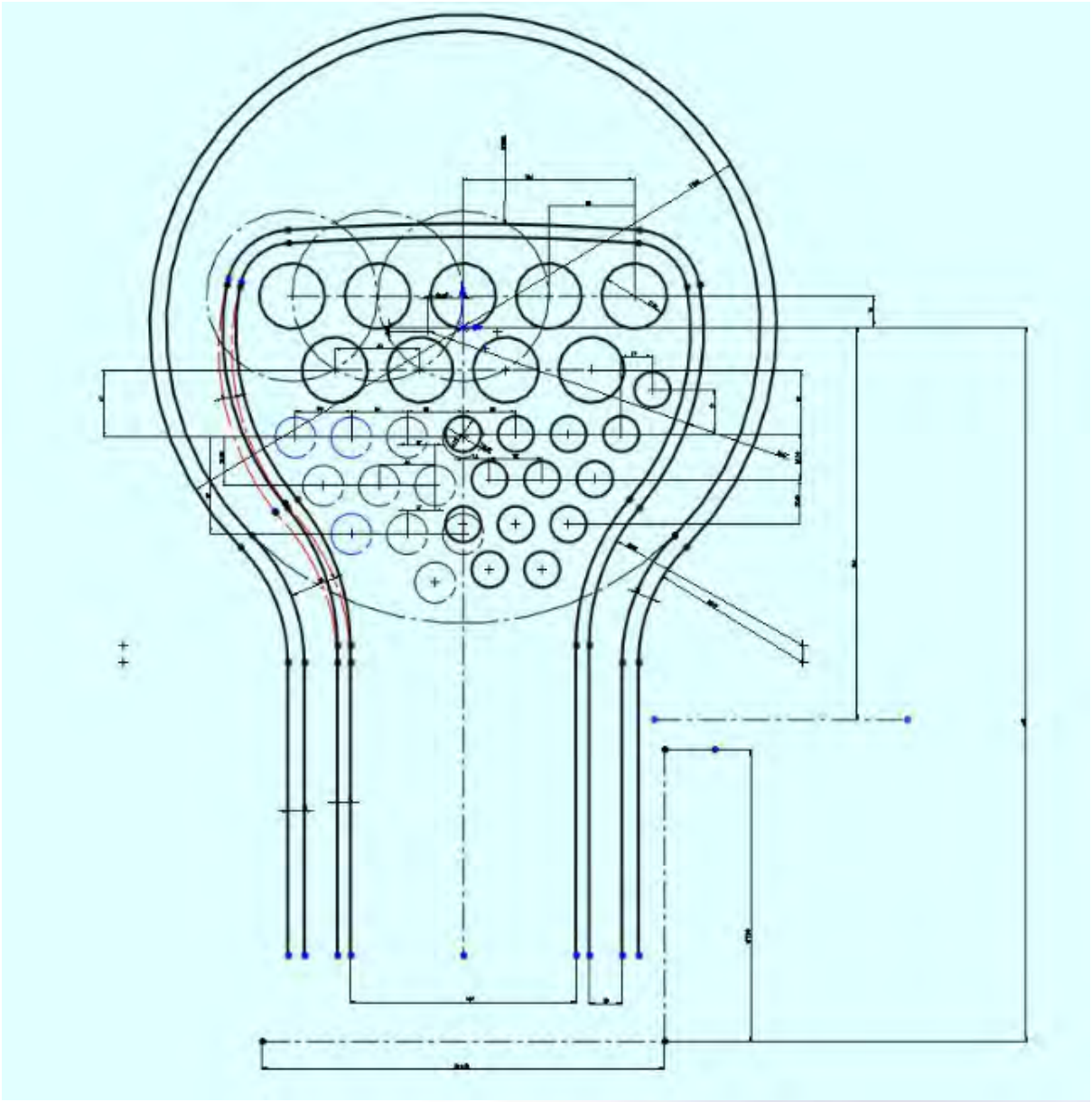
Even in our locked down world we things have progressed on a number of topics. Each of the items in the newsletter, could warrant much more than the few sentences here.

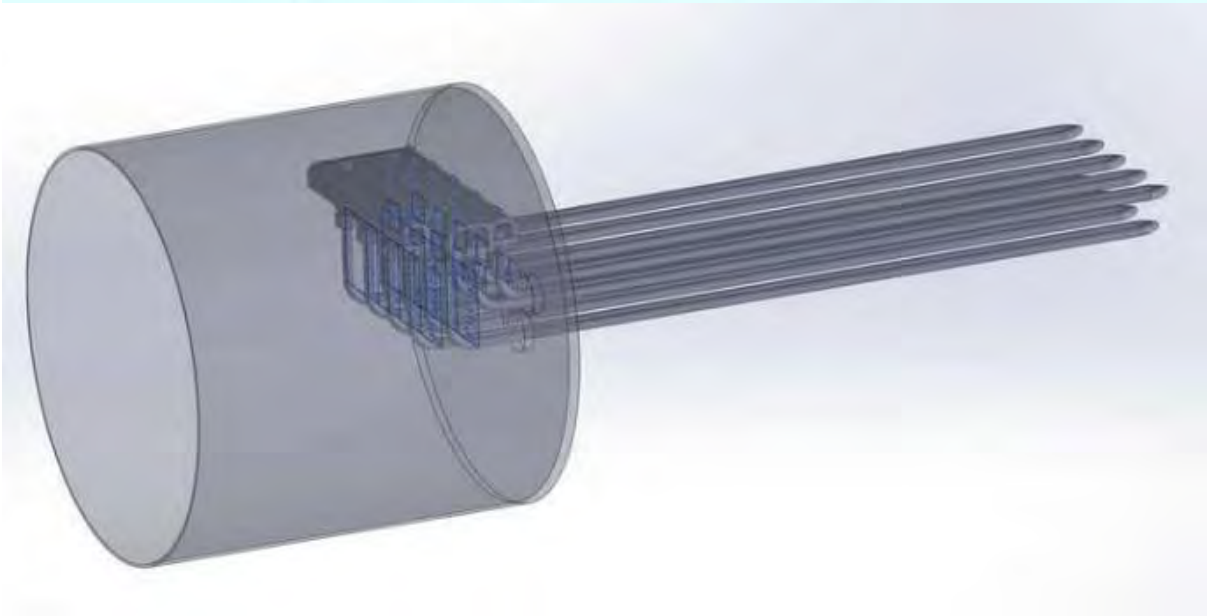
Designing Steam Locomotives is no different to designing anything else - in that design is an iterative progress starting with a blank sheet of paper and going through several iterations before a design is ready for manufacture. We are seeing this with the boiler where five tubeplate layouts have been investigated and we will see it with other features.

What we must not forget is that all other new builds are copies of an existing design. We are starting from a blank sheet of paper, which is far more difficult.

Boiler - Martin Johnson and Alex Powell, (with guidance from Richard Coleby on constructional aspects of 10¼" gauge boilers) have been developing proposals to optimise the superheater and firetube layout, to maximise steam production and conditions for minimum pressure loss through the superheater. They have prepared five layout options with different combinations of superheater flues and fire tubes. The layout shown on the right hand side of the drawing (overleaf) is the final version.

In parallel with this, Richard and Jamie have been looking at options for the double row superheater and crucially the superheater header. Again, this has meant looking at different options on superheater element diameters.



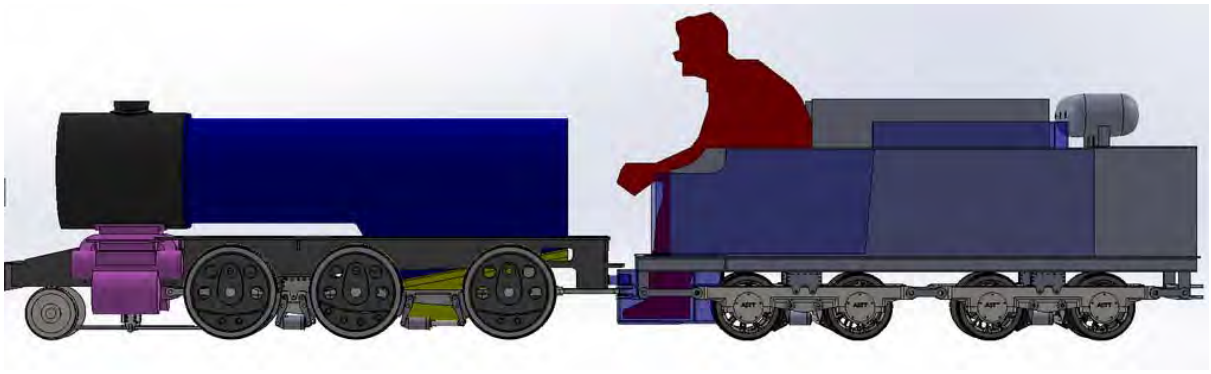


Martin is pressing on with further iterations in design to optimise firebox volume and carry out sensitivity studies on firing rate and its effect on steam production.

All this would not be possible without Martin's boiler performance software, which was described in ASTT Newsletters 12 and 13. Boiler designers from the 20th century would envy Martin's programme.

Tender - Grant has produced the first CAD models for the tender. The tanks at the back are a space claim for the air reservoirs for the air braking system. The CAD Mannequin gives an impression of size of the finished engine.

Before anyone says anything, we have spotted the three styles of wheel on the CAD!. As we progress with the design we will rationalise this.



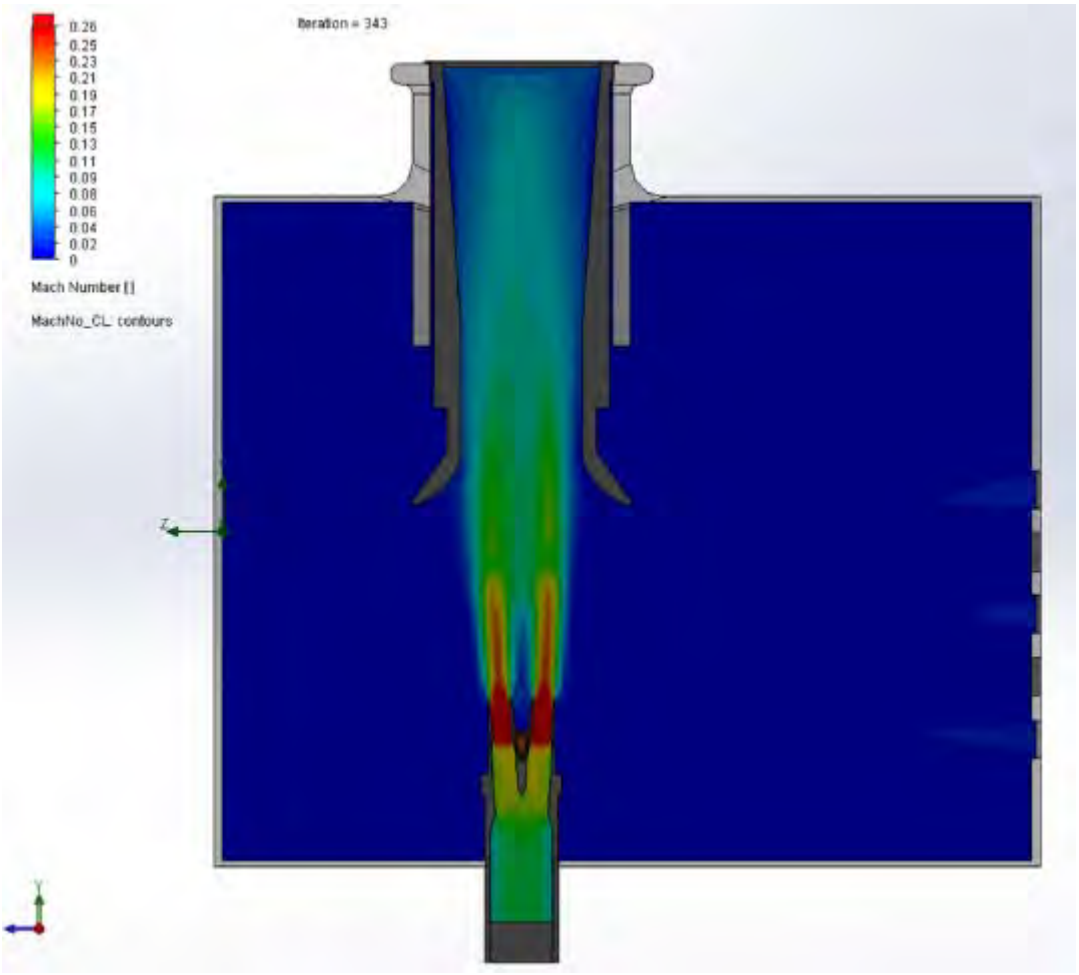
Exhaust System

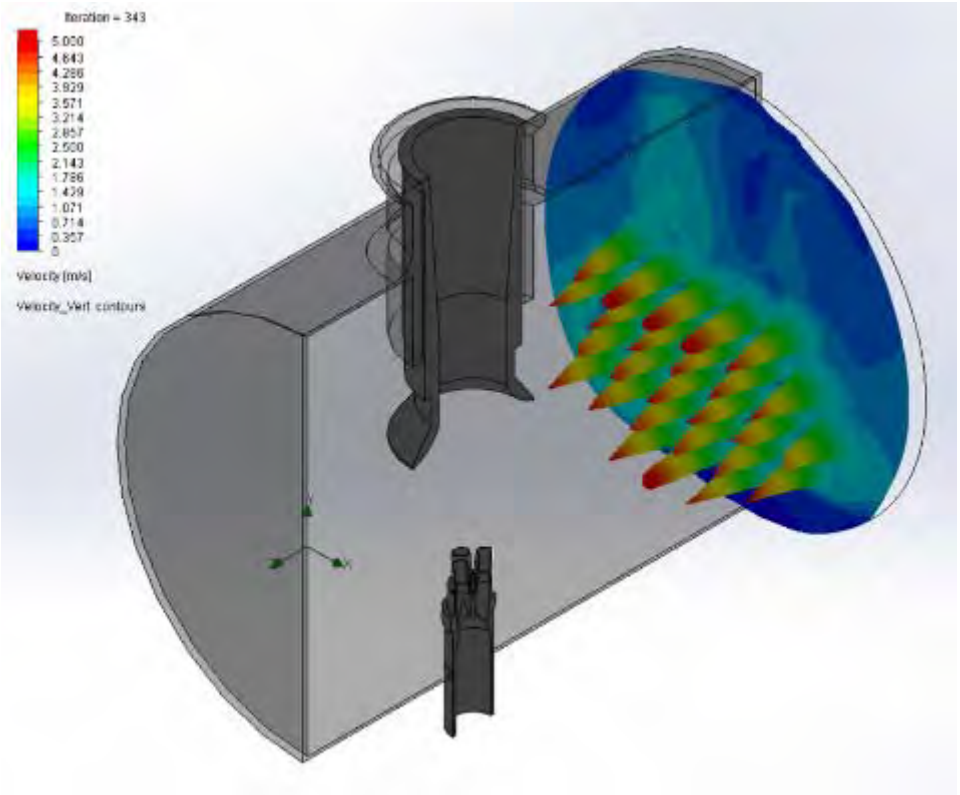
I am happy to take on the design of the Exhaust System and Smokebox with Chris Corney assisting me. We can start work on the design of the exhaust using existing empirical data to make 'space claims' in the smokebox, but I would then like to follow that up with a more analytical approach.

Sam Peck has offered to carry out CFD studies using the CFD package on Solidworks. Sam's employer has agreed to our using the software. This is a great win-win' for everyone as Sam gets to understand how it works in a 'real life' situation - this benefits us, as we get see the results from a software package worth circa £15,000 for free and Sam's employer will get the benefits of his experience with the package.

Richard Coleby has asked us to investigate the exhaust system on the Curwen Atlantic on the Stapleford Miniature Railway so we have a chance to start using CFD on an actual engine. The Curwen is the engine we plan to do the leakage tests on.

The images below are some from the first CFD runs on the exhaust currently fitted to the Curwen locomotive.


Iteration = 343
0.26
0.25
0.23
0.21
0.19
0.17
0.15
0.13
0.11
0.09
0.08
0.06
0.04
0.02
0
Mach Number []
MachNo_CL contours


Iteration = 343
5.000
4.643
4.286
3.929
3.571
3.214
2.857
2.500
2.143
1.786
1.429
1.071
0.714
0.357
0
Velocity [m/s]
Velocity_Vert contours

Seeing the CFD of the existing exhaust system has allowed us to make suggestions, and Richard recently fitted a Lempor Exhaust to the engine. Previously it needed support from the blower to steam properly unless it was being worked hard. At the end of the day, Richard's smile was a good measure of success – a sign of a happy driver.

Richard made the exhaust and on Thursday 23/7/20. He, Mike Horne, Jamie Keyte, Alex Powell and myself went along to the Stapleford Miniature Railway to carry out measure its performance and carry out the long-delayed leakage tests on the engine. Suffice to say it no longer needs blower support and was able to make steam climbing the bank. With more of us being there on 19/9/20, there will be a chance to try it with a heavier load!

There will be a separate article on these in a future newsletter. This was a complete contrast to last time we had used the test instrumentation – which was on an S160!.



Mike Horne fitting the Instrumentation

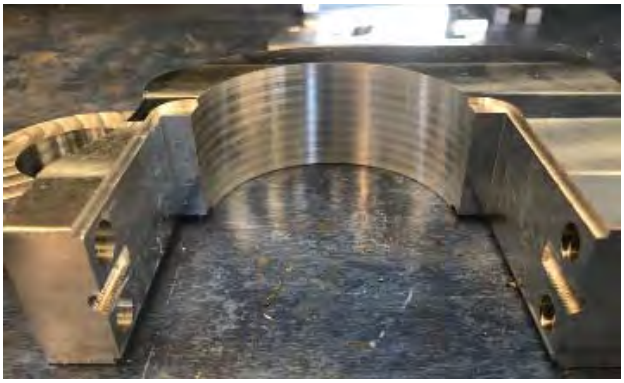


Test train – en route

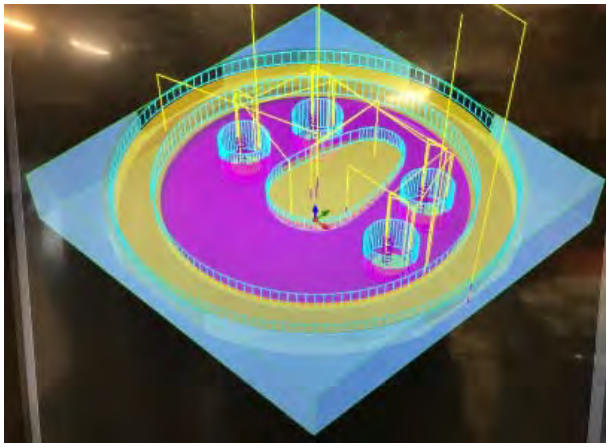
Wheels & Suspension

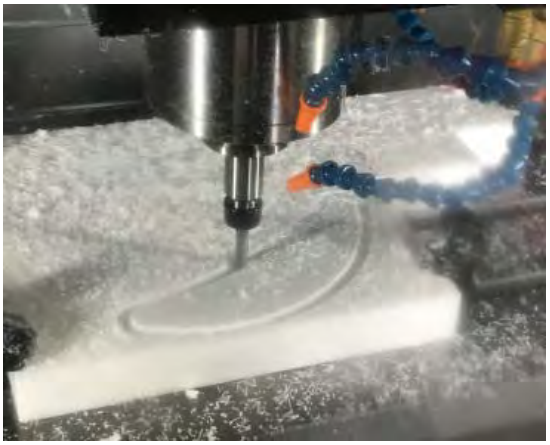
To prove the concept of the suspension Jamie has made some parts for trials. They are in aluminium rather than steel. It certainly helps if the company you own has a CNC miller and stocks of material!





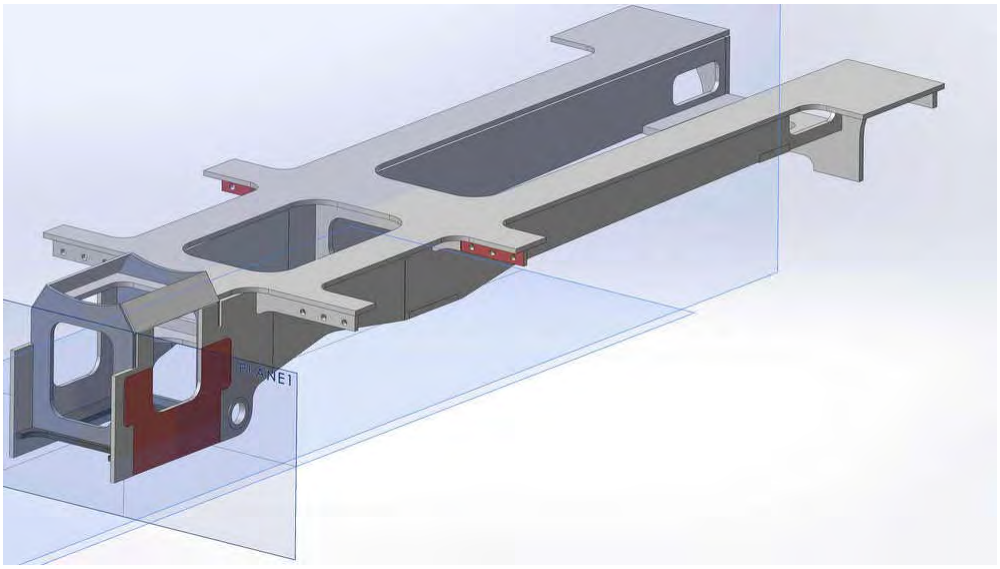








Frames - In parallel with the work on the suspension Jamie is developing designs for the frames.



Zoom Meetings - like the rest of the country we have had to find ways of making progress and we have had a couple of Zoom meetings on the boiler, suspension and exhaust, allowing us to progress and critique the designs.

Funding and Ownership - I have been busy preparing papers for ASTT's committee on how we can fund the locomotive and an ownership structure. We already have funds within ASTT to start the locomotive and an offer of additional funding from a member, but we do not have sufficient to finish it. Taking full advantage of Gift Aid and if we register for VAT then potentially we need to raise circa £50,000 to complete the locomotive - not an outrageous sum, but we do need ideas on how to raise it. Having hardware to show will help the task.

Design Work Packages - to date, we have not had anyone volunteer to take on the design of the 'Bolt on Front Framing' and the 'Pony Truck and Suspension'. If anyone would like to get involved with these please let me or Jamie know.

There will be other Design Work Packages - Braking, Pipework, Lubrication, Superheating and Ashpan. If anyone is interested please contact myself or Jamie. It’s a great way of getting involved in a unique project.

Membership and Publishing – Chris Newman

Membership

Upgrades to Full Membership

Since the last Newsletter, **Ian Gaylor** has joined the ranks of our Full Members. Ian has been an Associate Member since 2016, since when he has attended several of AST's AGMs and conferences. Ian is the author of ***Steam Locomotive Design Specifications and Calculations for New Build Baldwin 2-4-2T 'LYN'*** published by ASTT in 2018.

Associate Members who are interested in taking a more active role in the Trust are encouraged to apply for Full Membership by notifying the Membership Secretary at memsec@advanced-steam.org.

The main advantage of upgrading is that Full Members are entitled to a vote at general meetings, giving them the opportunity to participate in decision-making.

Membership Numbers

Four new members have joined since April.

- **David Clowes from Victoria, Australia**. David is a professional mechanical engineer with a background in railways and mining. He is currently the Workshop manager for the Puffing Billy Railway near Melbourne.
- **Frederick Rich from East Sussex**. Frederick did a 5 year apprenticeship with BR at Ashord and Brighton, that included working on the Leader Project. He then worked in BR drawing offices at Brighton and Derby before moving on to the Rugby Testing Station where he worked from 1957 - 1958.

  In his career, he travelled over 40,000 miles on the footplate and became and accomplished fireman. In 1958, he authored an I.Loco.E paper titled "Some Details of Steam Locomotive Design affecting the Footplate Man", and in 1996 he published a book titled "Yesterday Once More: A Story of Brighton Steam". He has also written articles for several steam magazines.
- **Wolfgang Fengler from Colorado, USA**. AST conference attendees will know Wolfgang who, with his wife Jenny, flew over to the UK to deliver papers at our 2017 and 2019 conferences. In consequence, most of us associate Wolf with the Coalition for Sustainable Rail (www.csrail.org) and the work it's doing in developing biofuel for locomotive use based on torrefied wood.

  However Wolf's expertise extends to other spheres. He has a Master's degree in Mechanical Engineering and is a member of ASME (American Society of Mech Engs). His professional experience includes work on fuel cells, physical vapour deposition, railway carriage design and the design of CNG and hydrogen powered locomotives. He has also worked as fireman and maintenance engineer on several preserved Santa Fe steam locos. In recent years he made use of his German language skills when he was commissioned by the HSB (Harz Mountains Narrow Gauge Railway) to advise on improving the performance of some of their older locomotives.

- **Stuart Thomas from Wales**. Stuart has a BSc in Chemistry and works in the water industry; he has expertise in fluid dynamics (including modelling) and hydrodynamics. He is the owner of Avonside 0-6-0ST No 1421 Pontyberem, built in 1900 for the Burry Port & Gwendraeth Valley Railway. Stuart is involved in developing this railway as a heritage operation. Stuart is also developing a new-build Double Fairlie project, and has various other projects in the pipeline.

Membership now stands at 82, broken down as follows:

Full Members:	19	UK members:	59
Associate Members:	58	EU:	12
Student Members:	6	USA	4
		Australasia:	6
Total Membership:	82	China:	1

Publications

Book Sales

Book sales have picked up a little since April. They are listed as follows:

- **Volume 1 of Porta's Papers – Tribology and Lubrication** (pub. ASTT): 8 sold including 6 to Camden Miniature Steam (total sales 100);
- **Volume 2 of Porta's Papers – Adhesion, Compounding and the Tornado Proposal** (pub. ASTT): 9 sold including 7 to Camden Miniature Steam (total sales 97);
- **Steam Locomotive Design Specifications and Calculations for New Build Baldwyn 2-4-2T 'Lyn'** (pub. ASTT): 5 sold including 2 to Camden Miniature Steam (total sales 74);
- **The Red Devil & Other Tales by Dave Wardale** (pub. Camden): 2 sold (total sales 259, including 233 sold pre-2015 through the 5AT Group);
- **5AT Feasibility Study** (pub. ASTT): 2 sold including 1 to Camden Miniature Steam (total sales 37);
- **5AT Fundamental Design Calculations** (pub. ASTT): 4 sold (see note below) including 2 to Camden Miniature Steam (total sales 195 since 2015);

Note - 5AT FDCs: Camden purchased the last 2 "stock" copies that had been printed by the Edinburgh Copyshop in 2019. The content and cover files for the book have now been uploaded to Lightning Source "on-demand" printers which produces all of ASTT's other titles. In consequence, there should be no need for ASTT to hold any book stocks in future.

Members are reminded that they can claim a 20% discount on titles published by ASTT, and 10% on other titles sold by ASTT.

New Titles

Work continues slowly with the transcription Porta's manuscripts. The 19 papers that will form Volume 3 of Porta's Papers (covering Boilers, Fireboxes and Combustion) have now been transcribed and are undergoing proof-reading. Work is also progressing with the help of Martyn Bane on Volume 4 covering Water Treatment, Feedwater Heating and Boiler Water Circulation.

Preliminary progress has also been made in assembling a number of reports, recollections and magazine articles about Porta and his works. These are planned to form part of a "Porta Anthology" or "Porta Tribute" that will be separate from and additional to the planned 5 or 6 volumes of papers. The contents of the anthology are expected to include:

- A listing of known papers by Porta (currently over 250 and still increasing);
- An 83 page UNIDO report written by John Click (a senior BR engineer) in 1977, describing Porta's achievements in modifying the 2-10-2 locomotives that operated the 750mm gauge 255 km Rio Turbio Railway in Patagonia, and commenting on his plans for the future development of the railway - plans that included design studies for:
  - a four-cylinder 2-10-10-2 compound Mallet ;
  - a four-cylinder 2-12-12-0 compound Mallet; and
  - a two or three cylinder 2-12-0 compound.
- Several magazine articles published between 1972 and 2003 describing Porta's work on the Rio Turbio and other railways in South and Central America.

There is already enough material on-hand to fill over 200 pages. **ASTT members are invited to send in any articles that they have relating to Porta and his work, and also suggestions for any other "content" that might be included in the anthology.**

Series on Mechanical Lubrication - Part III.

B.R. Cylinder & Valve Mechanical Lubrication.

[During shed training at Chester MPD (6A) under Mr Rhyll, the District Motive Power Superintendent for the No. 6 District from 1952, described in Part II.]

The introduction of new BR Standard locomotives came about. First the Class 4 & 5 4-6-0 tender locomotives. We all had training on the new features. The lubrication was given to the Fitters Mates with numerous greasing points and the filling of the Cylinder and Axlebox mechanical lubricators. I noted that there were 4 atomisers per cylinder, not 2 as on LMS locomotives. I was told it was the 'modern' way of getting oil to where it was needed, assisted by steam enveloping small drops of oil. Then you believed what you were told. It was different to the way Ken Williams previously described the LMS Caprotti cylinder lubrication, 44738 to 44757 and 44686 & 44687. Direct from the mechanical lubricator to back pressure valves on the cylinders. NO atomisers.

It was only later as the mileage built up that we noticed reports on some of the higher mileage Standard Class 5s of cylinder cocks blowing and pieces of piston rings rolled into balls in the cylinder cock traps and smaller pieces trapped in the cylinder cock itself, hence the reports of blowing. Why did not this seem to happen on LNER and GWR locomotives that had an atomised feed to the centre top of each cylinder?

Opening up the cylinders we found parts of broken piston rings, the liners were well lubricated but there were blue marks the length of the bore and the same on the piston rings as though lubrication had stopped at some periods. The D.M.P.S. did contact the CM&EE Derby and we were told to check the lubrication, fit new piston rings and release the locomotive to traffic.

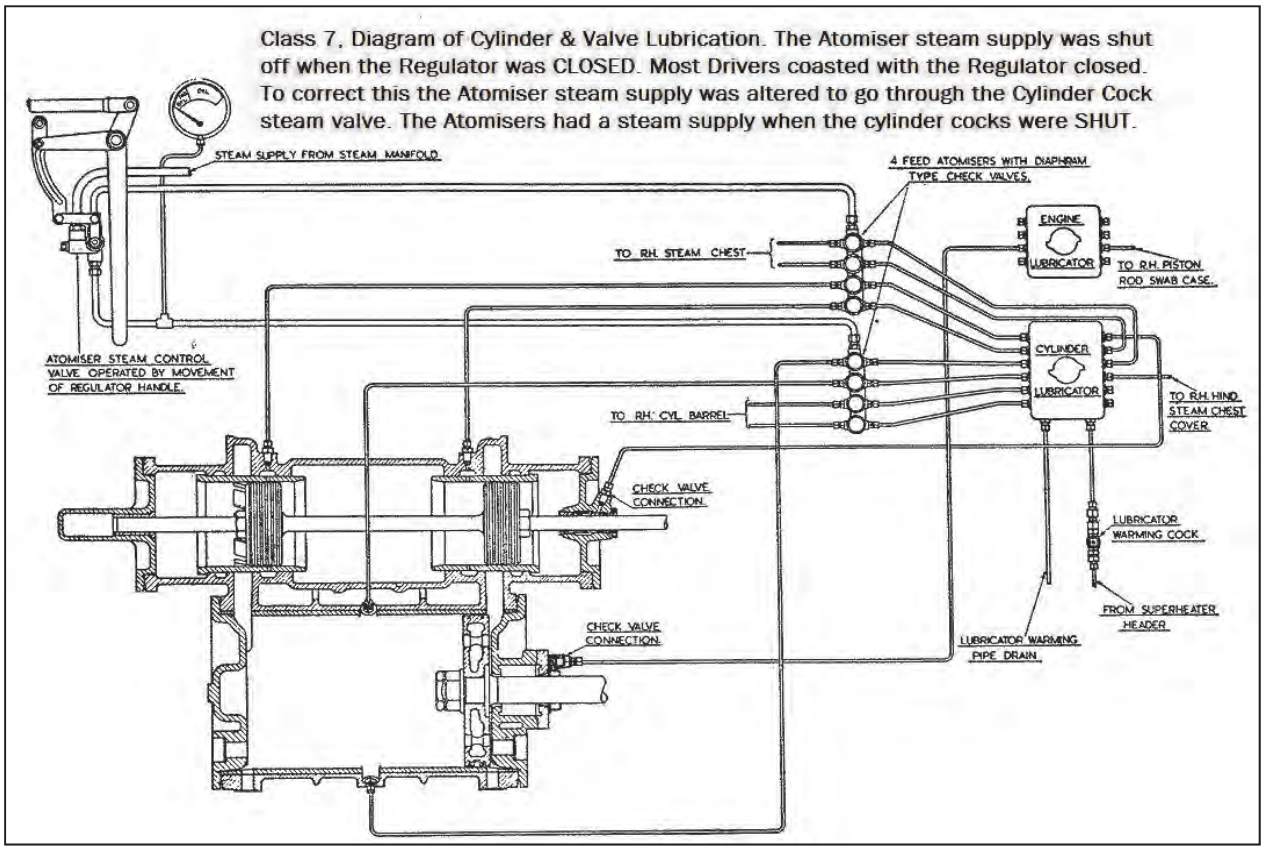
Many years later in 1978, I met Bill Harvey at Vickers Barrow. 4472 was coming off overhaul and I was sent to do a 'Fitness to Run' exam, which we did together and we became firm friends. He told me all about the lubrication problems in the cylinders on the fleet 7MT Pacifics at Norwich MPD, very similar to the Standard 5s we had at Chester. I talked about multiple valve regulators on the saturated side of the superheaters and my experience with the regulator valves on the superheated side. He remembered the five V2s 4804 to 4808 fitted with the regulator valves on the superheated side and how easy they were for Drivers to handle and the long life of the superheater elements. He later allowed me to use the relevant page from his book, below:-

BILL HARVEY'S SIXTY YEARS IN STEAM - THE BRITANNIAS

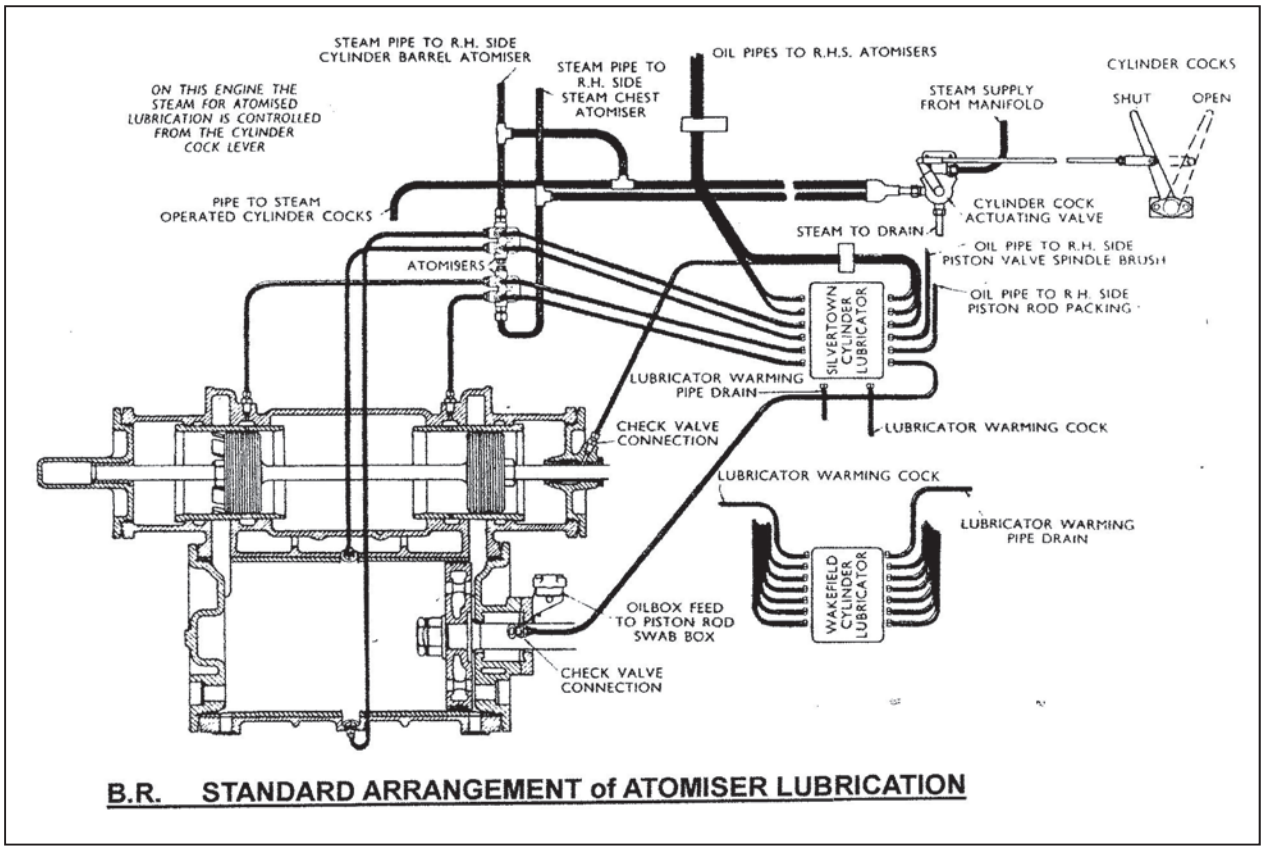
A phenomenon that **I** tried in vain to solve was erratic cylinder lubrication. Suddenly for no apparent reason the front cab windows would become spattered with drops of neat oil, and these were also to be seen on top of the glossy boiler barrel on arrival at Norwich. It was obvious that for a few moments the oil was not being atomised but why I never discovered, despite setting up a special rig for testing and adjusting the spring-loaded diaphragm type atomisers.

In consequence the life of piston and valve rings on the Class 7MTs was abnormally low; 10,000 to 12,000 miles was the average, more often than not it was 5,000 to 6,000 miles, and sometimes less. It was frequently observed on opening-up a cylinder that although the bore had a good coating of oil, the surface of the metal underneath was bright and scored, while the rings were tempered a deep violet blue from heat generated by friction. Valve rings were similarly affected, and on several occasions it was found that the exhaust cavities in the steamchest instead of being a dull black had a coating of limewash, clearly indicating heavy priming. Despite the removal of the Melesco steam drier and raising the inlet of the dry pipe in the dome and interposing a perforated baffle plate, priming occurred to a greater or lesser extent throughout the life of the locomotives and was also responsible for a thick deposit of lime in the superheater elements, which had to be frequently renewed on account of distortion or burning out of the torpedo ends which when sawn through revealed a thick deposit of lime similar to that found in the furred-up **end** of an injector internal delivery pipe.

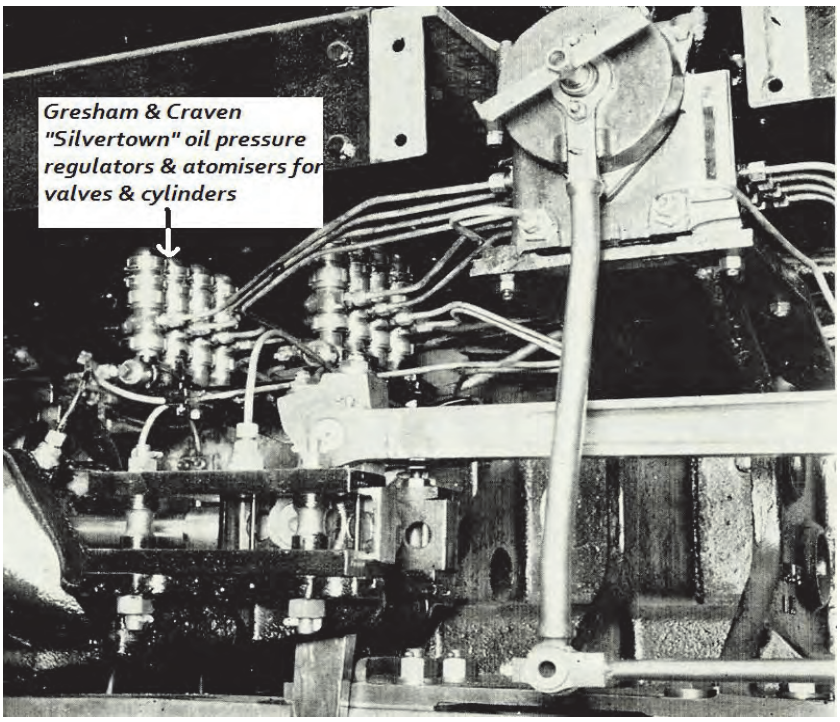
By permission of Bill Harvey to John Duncan. 1980



The Gresham & Craven spring and diaphragm atomisers were replaced by the LMS/GW Swindon-type atomisers in pairs, and operated by the cylinder cock valve.



Schematic from ES Cox's BR Standard Steam Locomotives.
Bottom BTC Handbook for Railway Steam Locomotive Enginemen.

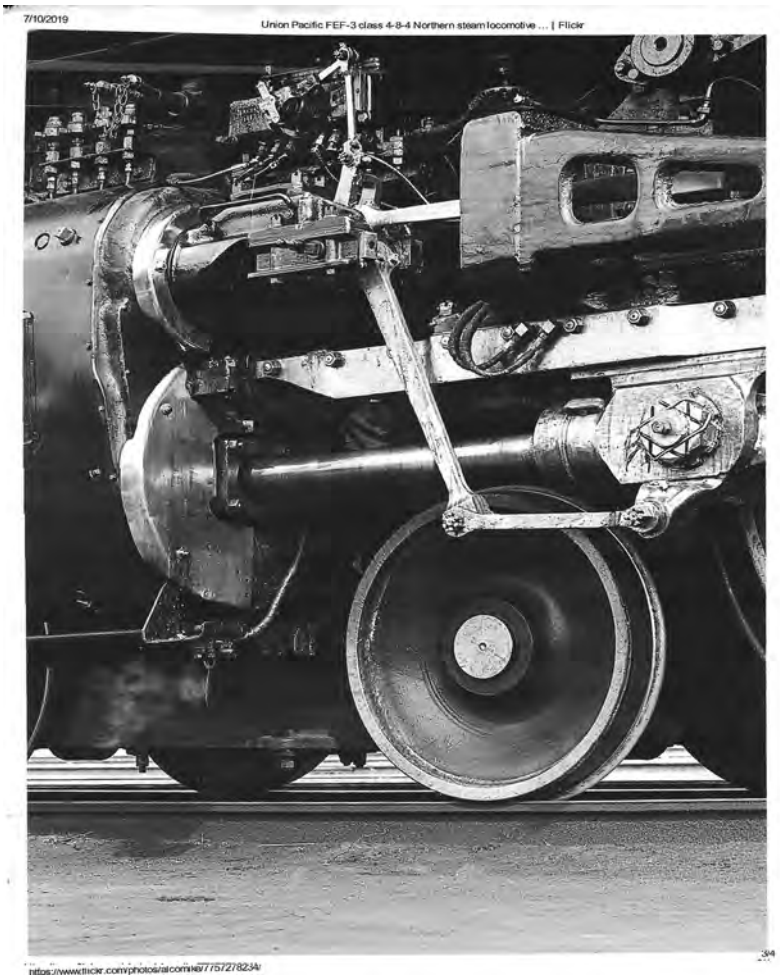


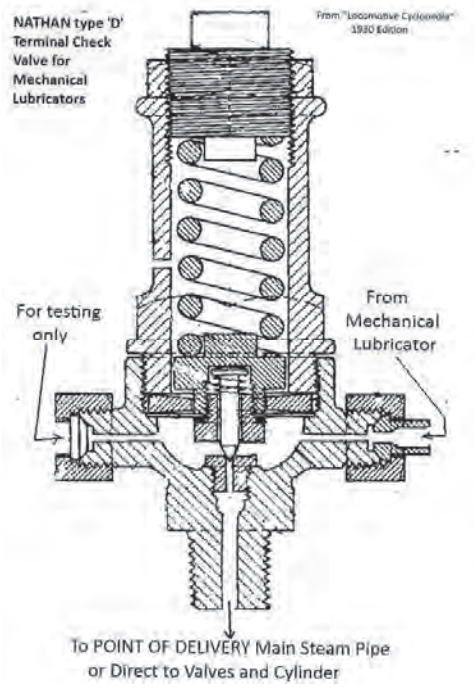
The photo is the original scheme as on the first ten locomotives that Bill Harvey was talking about in his book. Note in the photo all the Pressure Regulators and Combined Atomisers are all together on the LH side and long pipes to the RH cylinder.

The problem with a pressure regulator combined with an atomiser is that it is difficult to regulate the atomiser steam pressure variation against the constant oil pressure from the pressure regulator. Would this cause the phenomenon Bill Harvey saw?

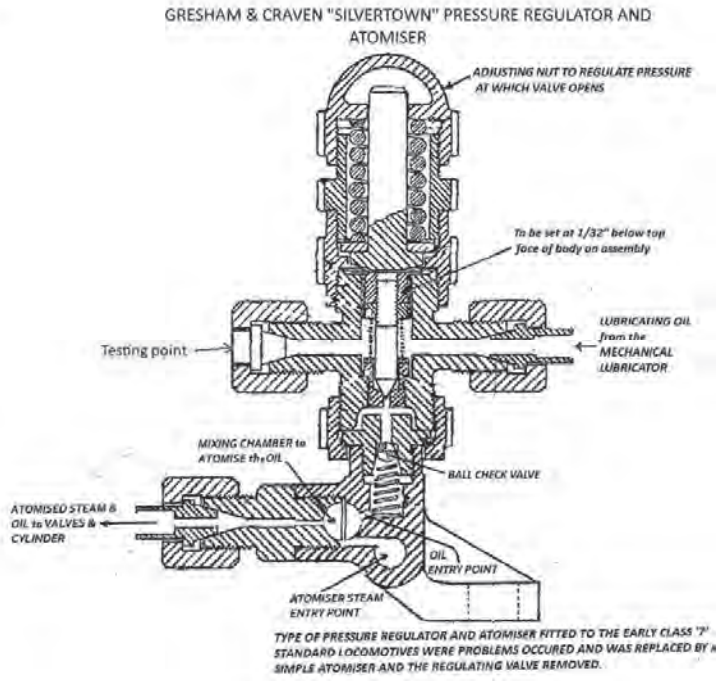
The pressure regulator is designed to work on a direct oil feed from a mechanical lubricator as close to the entry point to the valves or cylinder, to make sure there is always pressurised oil available direct to where it is needed.

The pressure regulator is similar to the terminal check valves used in Canada and USA as a direct feed from the mechanical lubricator to the valves & cylinder without atomisers as shown on U.P. No. 844 (right), which shows four terminal check valves on top of the cylinder and the lubricator drive off the combination lever.





Left: The American Terminal Lubricating Check Valve

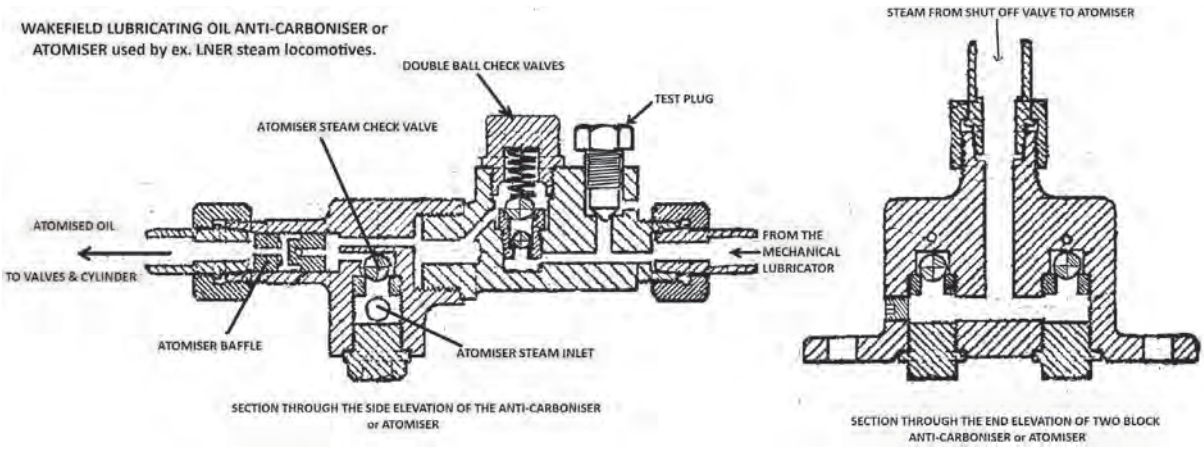


Right: Gresham &Ceaven "Silvertown" pressure regulator and combined atomiser used on early BR class 7 locos.



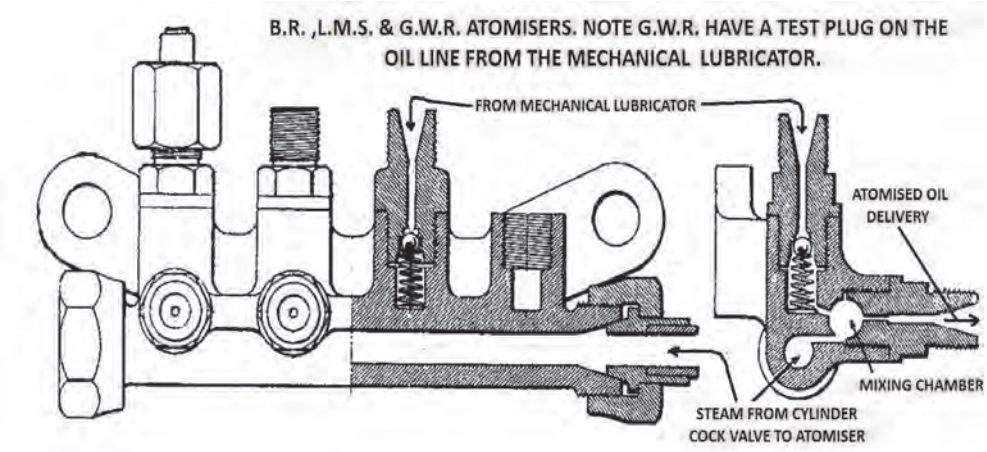
Above: LMS/GW type atomisers presently fitted to No. 70000. The outer pair are on the steam-side valve liners to lubricate the piston valves. The inner pair are to the top and bottom of the cylinder liner to lubricate the piston as it passes the midpoint of the cylinder liner. The atomiser has only one ball check valve between the mechanical lubricator ball check valve and the atomiser, and none on the atomiser steam supply to stop back flow up the steam pipe line, except when the cylinder cocks are open. Compare this to the LNER mechanical lubrication described in Part One using a Wakefield anti-carboniser or atomiser with two ball check valves on the inlet from the mechanical lubricator and one on the steam line to each atomiser.

On the scientific thought that went into design on BR Standard steam locomotives for cylinder lubrication it was more 'Historic'. The training was for oil atomisation with steam at boiler pressure or just below. "It gets the oil to where it is needed", so the Instructor said.



Above :- The Wakefield anti-carboniser or atomiser adopted by the LNER is far better than the simple Gresham and Craven Atomiser used by the LMS, GWR and BR for the following reasons:-

1. It has a ball check valve in the steam line to the atomiser to stop back flow.
2. A better mixing of oil and steam in the atomiser baffle.
3. It has two ball check valves to stop back flow to the Mechanical Lubricator.
4. It has an oil test plug to check oil has flowed to that point and can be used to test pressure.



Above: The atomiser used on BR and LMS has only one ball check valve between the mechanical lubricator and the atomiser, nothing on the atomiser steam line from the cylinder cock valve. The GWR atomiser is similar but has a test cock.

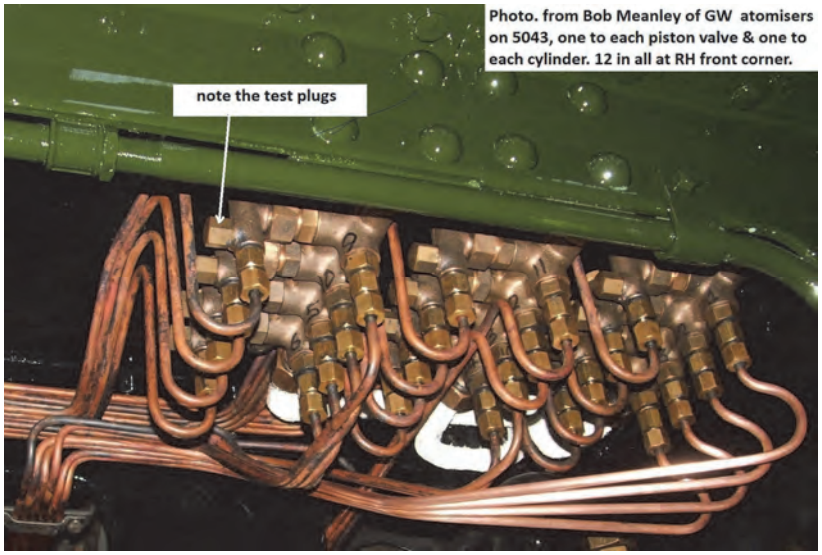


Photo. from Bob Meanley of GW atomisers on 5043, one to each piston valve & one to each cylinder. 12 in all at RH front corner.

Right: GWR atomisers on locomotive 5043.



Above: The Locomotive that was modified without authority at Chester MPD in 1960.

It was hauled in to Chester on a Willesden to Chester Fitted Goods with suspected loose tyres. The repair card said, "Driving wheels turn but engine doesn't move."

Tested in steam against the brake and the driving wheels did a full turn without the engine moving. Eventually CM&EE Engineers came from Derby and it was decided to take each pair of driving wheels out on the wheel drop and leave the locomotive on its bogie and a support bogie at the back end. We were asked to do a 30000-35000 mile exam which included valves and piston ring change and the DMPS decided that we would do a 'little modification'.

We blanked off the two inner atomisers on both cylinders and joined the inlet and outlet oil pipe to each line to the top and bottom pipes on both cylinders. At each entry points on both the cylinders we fitted check valves (as fitted on LMS Class 5s), these all being hidden under the foot plating valances and cylinder cladding.

CM&EE Derby were informed and we were told to put it all back to normal. 73033 was by that time on its way south on a Chester to Willesden fitted goods. I believe the home depot was informed but I had left Chester for other types of traction. 'The writing was on the wall for steam'. It probably carried on by arrangement with DMPS Willesden, although the works overhaul would put it back to standard. There wasn't much interest in steam at that time and the mounting problems with Diesel traction.

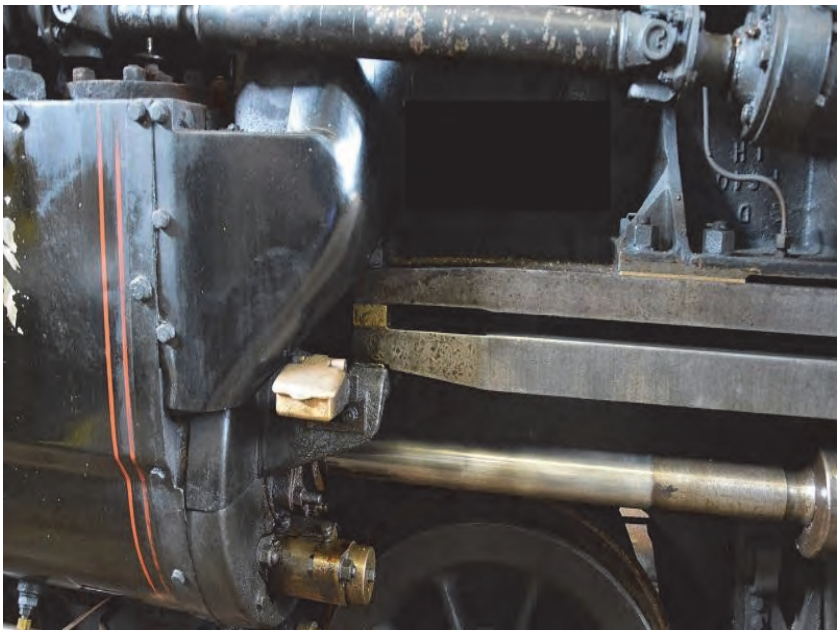
B.R. Standard steam locomotives under private ownership

The problem of rapid piston ring wear continued. The B.R. Locomotives fitted with British Caprotti poppet valve gear, 71000 and 73125 to 73154, built between 1954 and 1957 suffered with high piston ring wear, as described by Bill Harvey in his book. When you look at the work of L.D.Porta on tribology and lubrication, the engineers on B.R. designed the cylinder lubrication systems purely on historical grounds. In the particular case of locomotive 71000:-

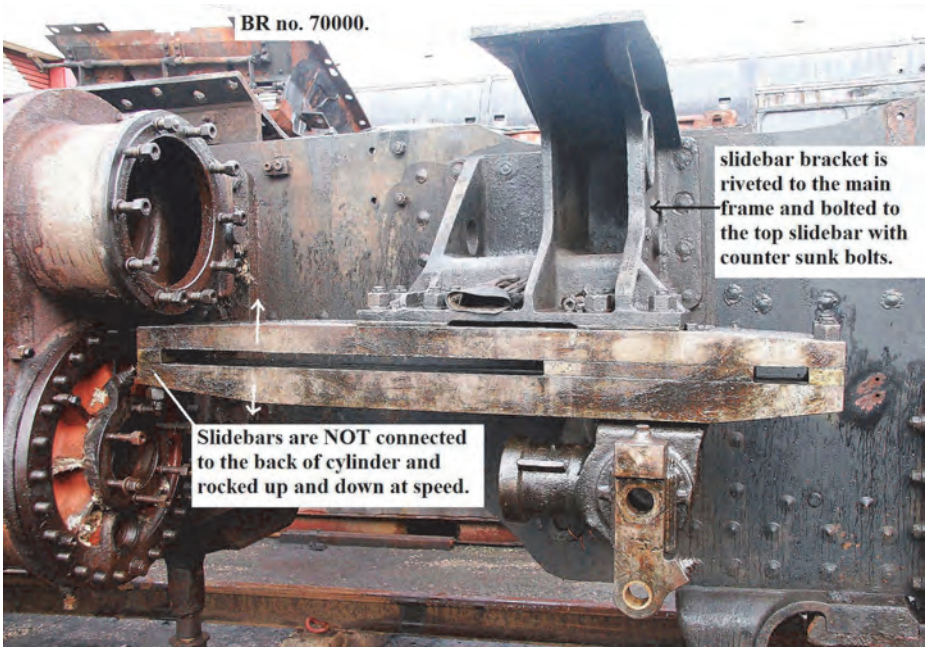
a) Oil supply from the mechanical lubricator is doubled, then atomised into the top of the cylinder in a SINGLE pipe! A double pipe from the mechanical lubricator merging into a SINGLE pipe into the bottom of the cylinder. And NO CHECK VALVES? Did the oil get to where it was needed?
b) The large diameter boiler combined with large regulator valve can result in a very high rate of steam flow to fill superheater and cylinders if the regulator is opened suddenly, with a high risk of water carry-over that will wash away any lubrication that's managed to get to the cylinder walls.
c) The slide bars are anchored to a bracket attached to the main frames by fitted bolts and the lubricators sitting attached to the top of the slide bar bracket with NO attachment to the back

of the cylinder. (The BR Standard Class 5 Caprotti's slide bars were attached to a bracket on the back of the cylinders.) With the 28 inch stroke, at reversal in direction of the crosshead is a force upwards at the end of each stroke. The brackets rocked and fractured around the fitted bolts. The "Rocking Brackets" were observed by Bill Harvey on the Norwich 'Britannia's'. He told me this was one of the problems with ring wear. The same arrangement is on 71000.

Though the BR Standard Steam Locomotives were brilliant performers and economical to run, their problem was their design under E.S. Cox which was done by committee of the LMS, LNER, GWR and SR design teams. The slide bars were LNER three bar; the anchorage was SR as on the Bullied Pacifics, the V and LN classes.

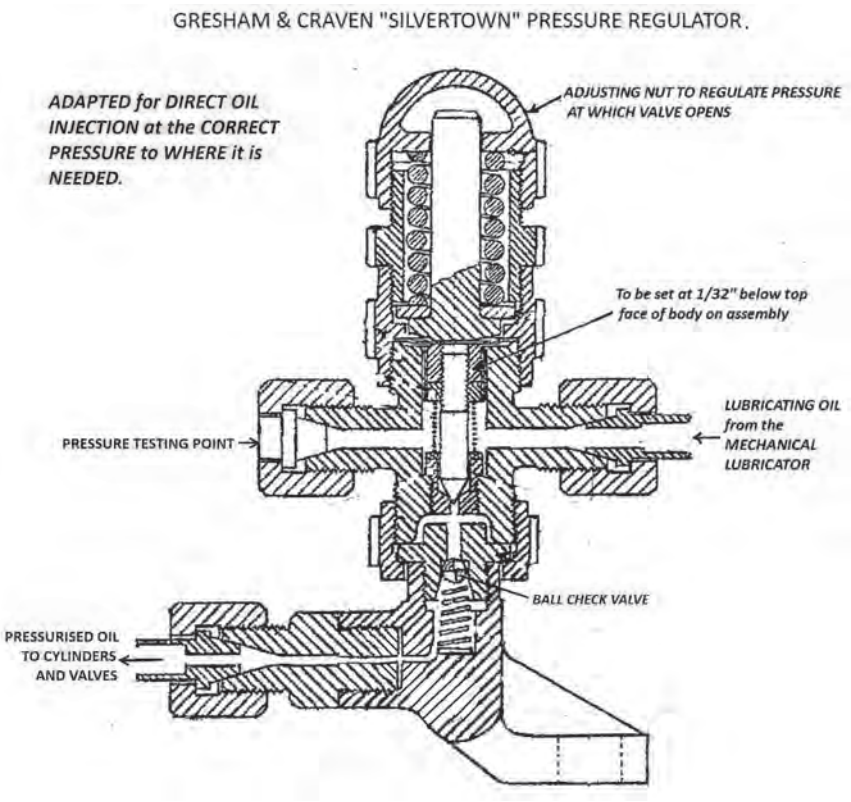


Above: The BR Standard Class 5 Caprotti showing the slide bar support bracket part of the back cylinder cover. The slide bar bracket can be seen at top behind the poppet valve drive shaft. It was known that when 71000 was tested, the ends of the side bars moved up and down, so it is probable that this revised arrangement (c.1955) was a belated attempt to reduce slide bar flexing.



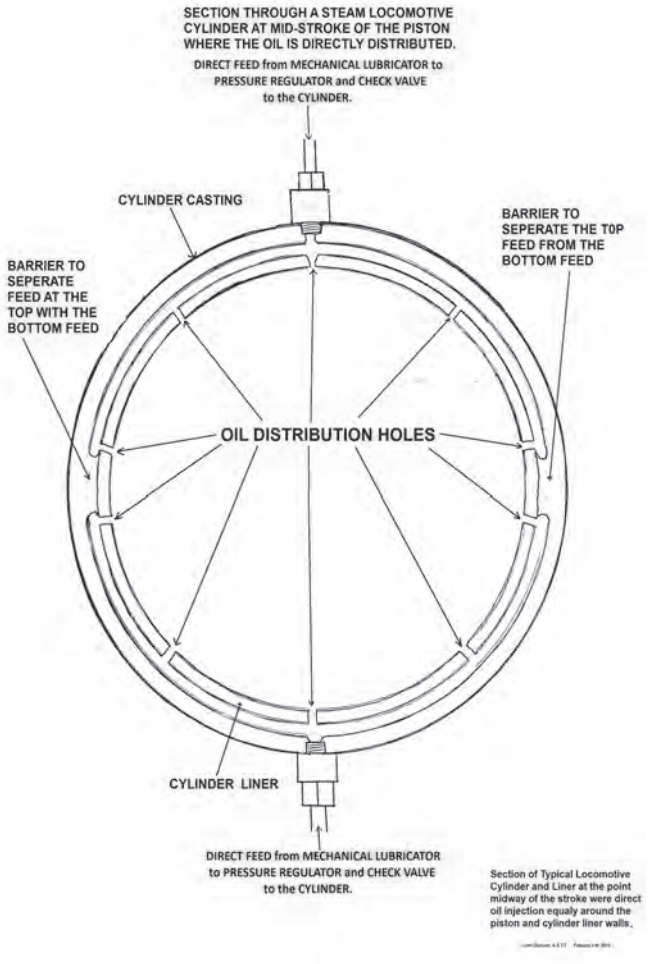
Above: Original slide bar support arrangement for BR Standards, in this case for Britannia Class.

Right: The pressure regulator and check valve as shown in the following proposed schematic drawings for locomotives 71000 & 73129. These valves were to be fitted as close to each cylinder as practicable. The test points needed to be accessible to fit a test gauge in order to set the oil pressure being delivered to the cylinder bore. Six check valves were to be fitted to 71000 and four to 73129.



The drawing on the right Is a section through the middle of a cylinder showing the two oil passages at top and bottom, the oil holes through the liner giving uniform distribution of oil around the cylinder liner bore.

The oil pressure and size of oil holes needs to be determined by the amount of oil required to give the best possible lubrication for the cylinder bore.

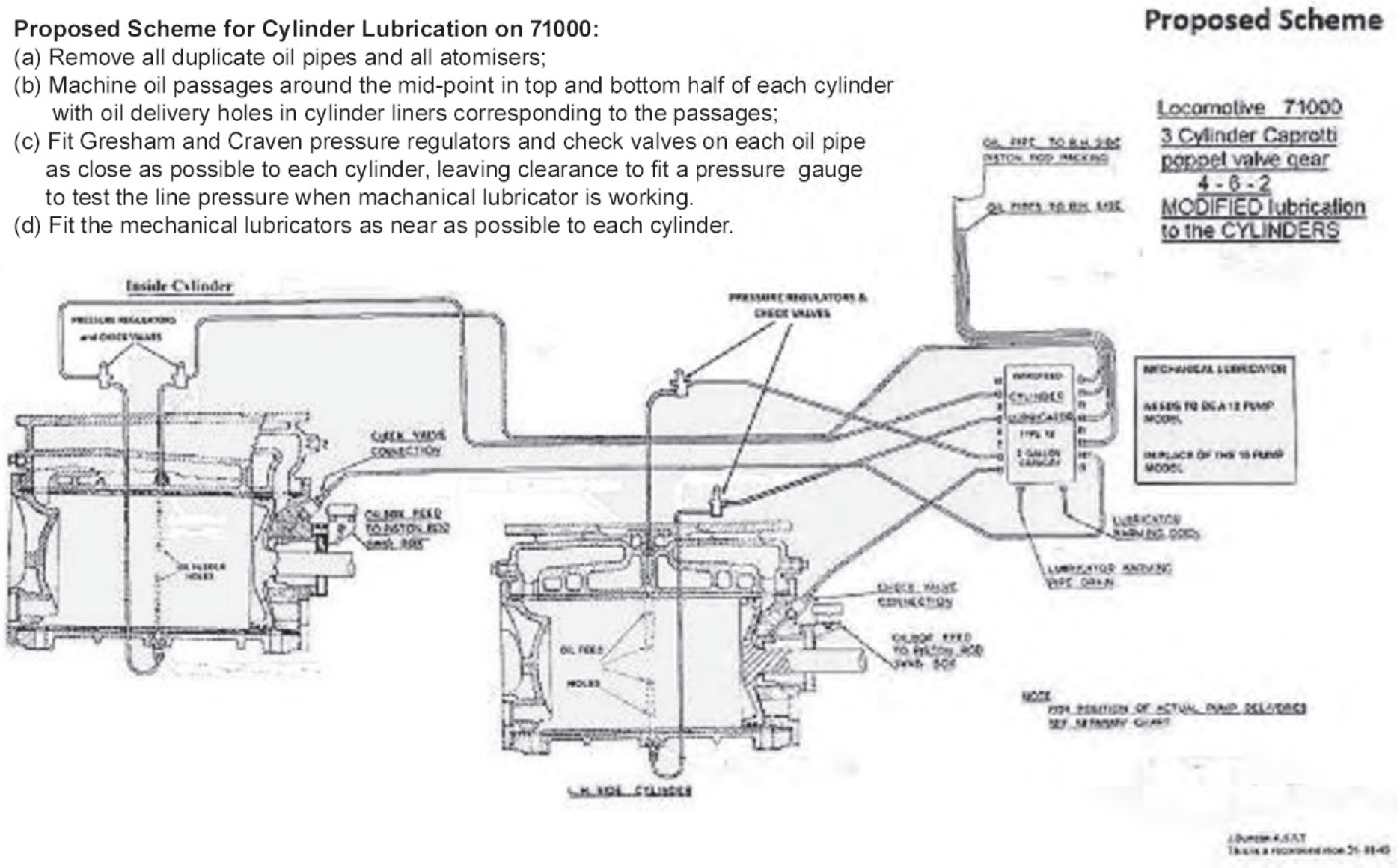


The remaining schematics (overleaf):-

(a) Schemes 1 & 2 for 71000 supplied by Mr Keith Collier and
(b) the original ones for 73125 to 73154 supplied by Mr J.Arthur, Seach Engine Assistant of the NRM, York.

Proposed Scheme for Cylinder Lubrication on 71000:

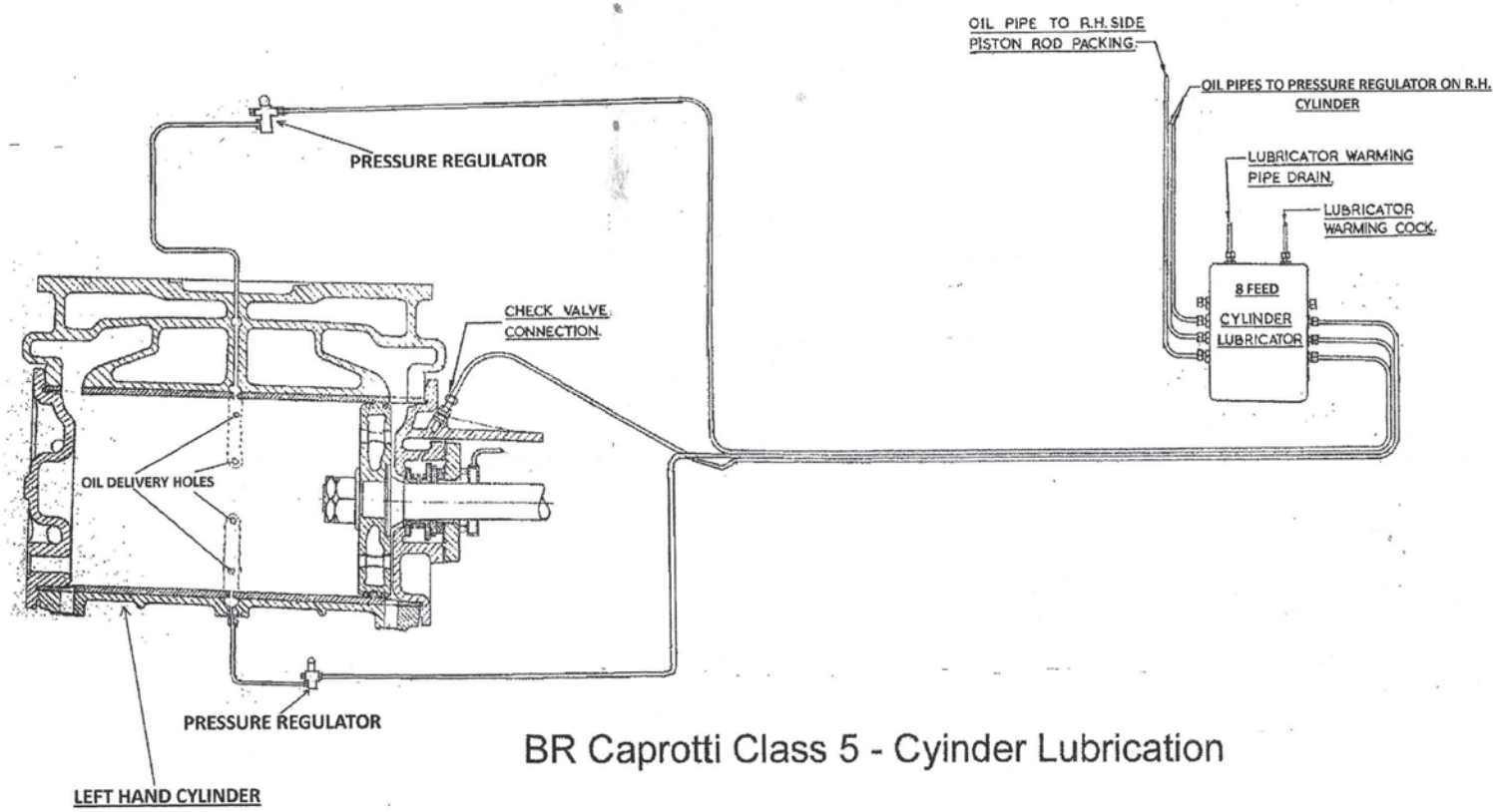
(a) Remove all duplicate oil pipes and all atomisers;
(b) Machine oil passages around the mid-point in top and bottom half of each cylinder with oil delivery holes in cylinder liners corresponding to the passages;
(c) Fit Gresham and Craven pressure regulators and check valves on each oil pipe as close as possible to each cylinder, leaving clearance to fit a pressure gauge to test the line pressure when machanical lubricator is working.
(d) Fit the mechanical lubricators as near as possible to each cylinder.



Proposed Scheme for Cylinder Lubrication on 73129:

(a) Remove all duplicate oil pipes and all atomisers;
(b) Machine oil passages around the mid-point in top and bottom half of each cylinder with oil delivery holes in cylinder liners corresponding to the passages;
(c) Fit Gresham and Craven pressure regulators and check valves on each oil pipe as close as possible to each cylinder, leaving clearance to fit a pressure gauge to test the line pressure when machanical lubricator is working.
(d) Fit the mechanical lubricators as near as possible to each cylinder.

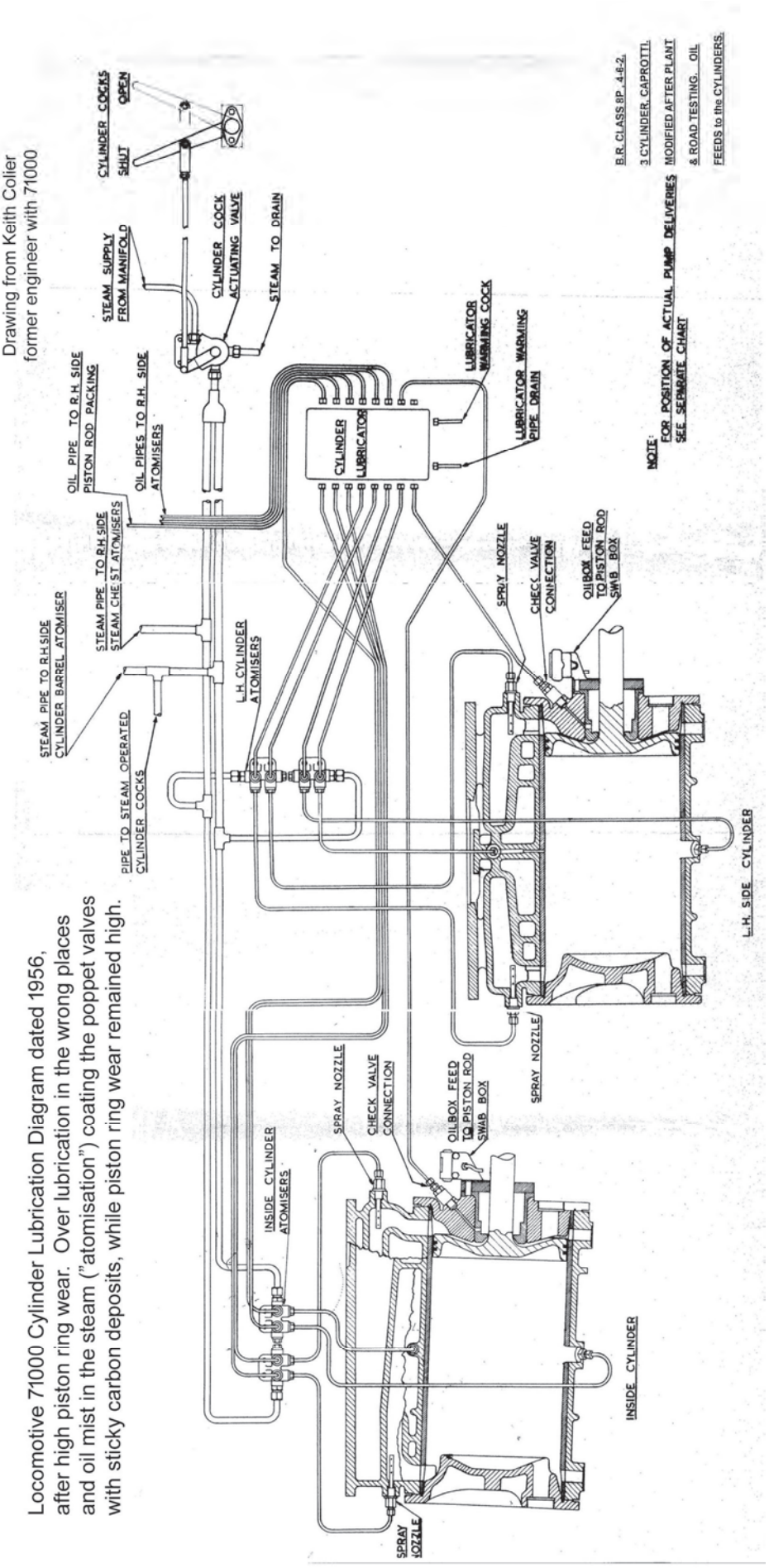
PROPOSED SCHEME



BR Caprotti Class 5 - Cyinder Lubrication

1st Scheme

Drawing from Keith Colier former engineer with 71000



Locomotive 71000 Cylinder Lubrication Diagram dated 1956, after high piston ring wear. Over lubrication in the wrong places and oil mist in the steam ("atomisation") coating the poppet valves with sticky carbon deposits, while piston ring wear remained high.

The final scheme adopted by British Railways for 71000 and 73125 to 73154 Standard Steam Locomotives fitted with British Caprotti Poppet Valve Gear. Double atomised oil into a single pipe at the top mid point of each cylinder.

A double pipe direct from the mechanical lubricator merging into a single pipe at the bottom of each cylinder, no check valves. The excessive piston ring still exists.

2nd SCHEME

Drawing from :-
Mr K. Collier, Former Engineer on 71000

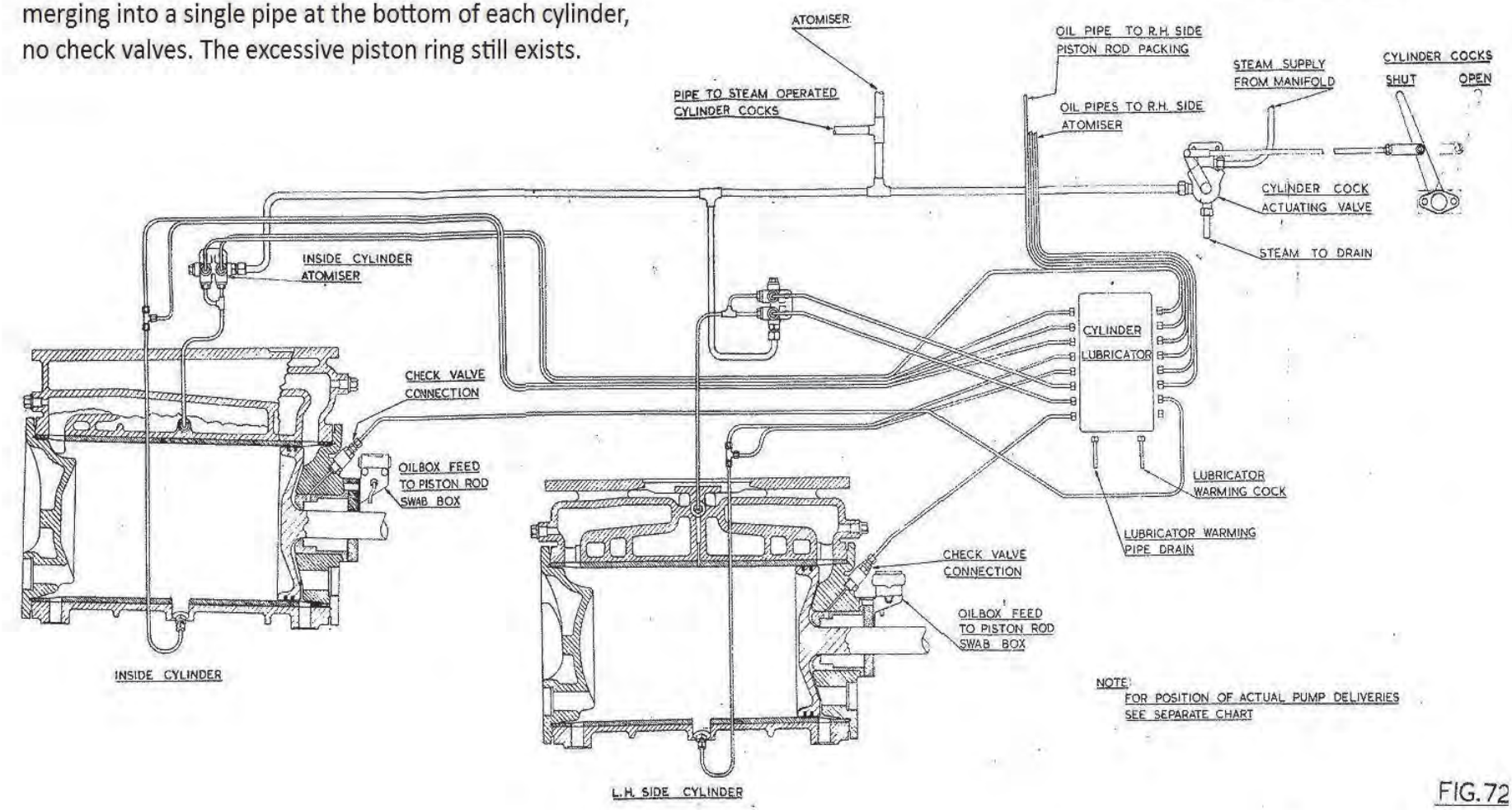
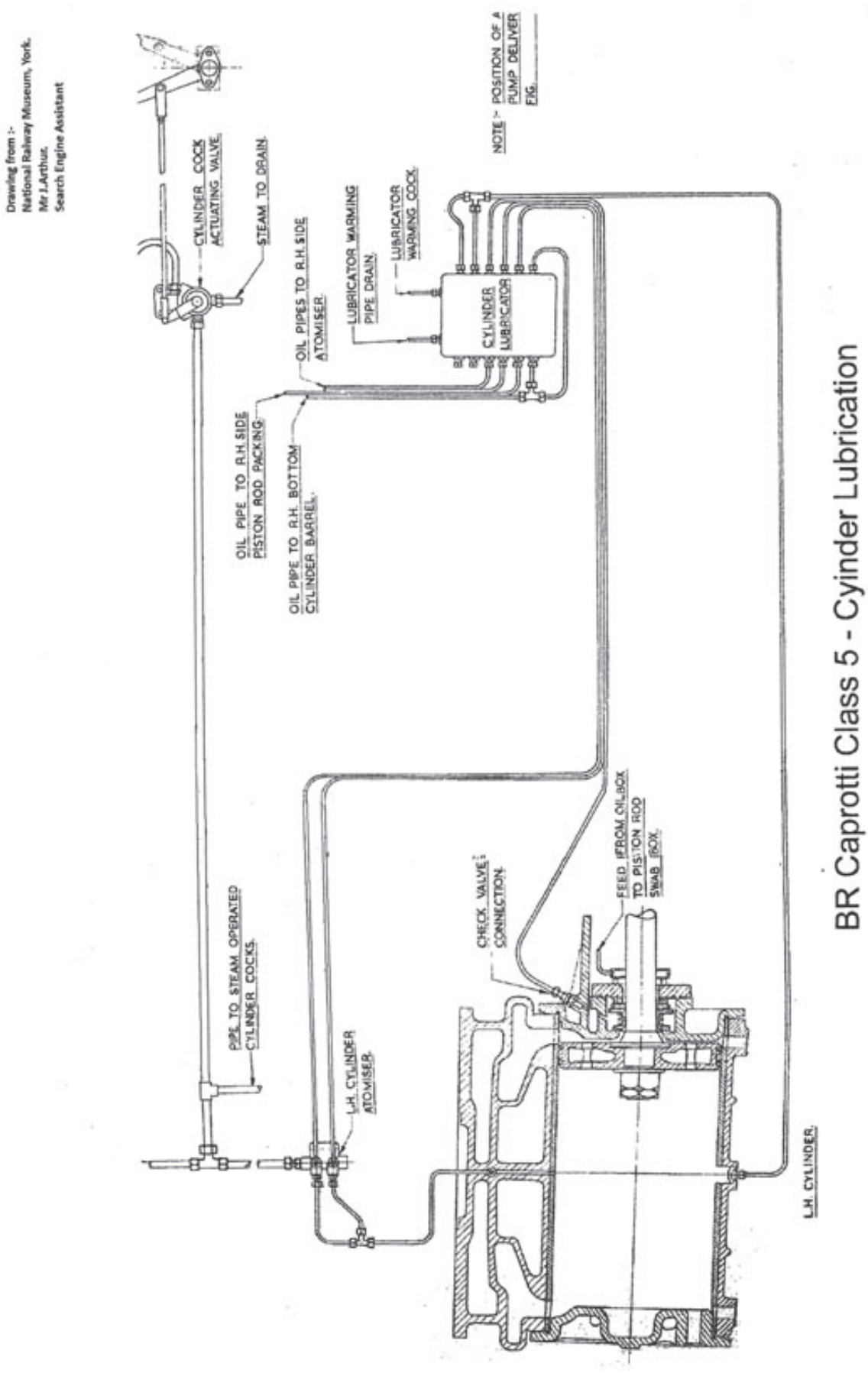


FIG. 72
AMD. 1956



BR Caprotti Class 5 - Cyinder Lubrication

Taken from:- "The Red Devil and Other Tales from The Age of Steam".
by David Wardale. Part 7.3 The Modified QJ, part 19, page 442.

19. Improved Cylinder Tribology

Most of the modifications for improved tribological conditions within the cylinders have been listed already, for example valve and cylinder liner cooling, improved liner, ring and valve head materials, lighter valves, articulated valve spindles, use of drifting steam, and improved oil delivery holes. Others included the use of cylinder oil with the addition of 0.2% colloidal graphite, the use of diaphragm type high pressure terminal check valves, and fitting low pressure check valves close to the piston rod and valve spindle oil delivery points. The standard QJ's had entirely separate oil feeds to each valve liner with a high pressure terminal check valve at each end of each steam chest right over the valve oil delivery hole and this good feature was retained, obviating the need for atomizers and any possibility of the back flow from one end of the steamchest to the other mentioned on p. 177. The check valves were insulated by cloth covers on the standard QJs to keep the oil viscosity down in very cold weather but it was doubtful if these flimsy covers helped much and I advised that if insulation was really necessary then it should be done properly using a steel cover with insulating material inside.

The QJ lubricator drive was taken from an extension of the top of the combination lever and gave approximately 15% more oil in full gear than in mid gear. For various reasons it was decided not to change this drive on the modified locomotive but because of the altered valve motion the full gear : mid gear oil delivery ratio decreased to about 1,09 : 1. All oil feed rates were proportioned from those of the SAR 25NC class with due allowances for differences in the surface areas to be lubricated, whether or not cooling was employed, etc., and the lubricator pump settings were to be adjusted accordingly.

As an example of the combined effect of all alterations to improve tribological conditions, the target figure for the period between piston valve inspections was 200 000 km.

Looking at the future on steam locomotive cylinder lubrication as recommended by David Wardale (above) and in Chris Newman's ***Selected papers by L.D. Porta, Volume 1 - Tribology and Lubrication*** published by ASTT, both books are a "must" for Owners and Engineers of preserved steam locomotives, both on private railways and those certificated to run on Network Rail's main lines .

NEXT in this series on past mechanical lubrication I worked on with the C.P.R. (1956-1959), Calgary, Aylth Round house.

John Duncan – April 2020

John Duncan is an ex BR Locomotive Engineer (1948-1994), Locomotive Superintendent K&WVR (1979-1990) and CME to SLOA later MSLOLtd (1993-2002). He is a founding member of ASTT. See https://www.advanced-steam.org/ast-group/organisation/john-duncan/.