ASTT Newsletter No9

Chairman's Piece

John Hind

Thanks to everyone who came along to the AGM. As someone said it's rare to see such a large proportion of the membership at an AGM. Our format of mixing the formal business of the AGM with a chance to learn something and socialise seems to work.

We have tried a number of venues over the last couple of years – Haworth, the NRM at York, the East Lancashire Railway at Bury and now the Heritage Centre at Crewe. I'd appreciate any comments on using Crewe again as a venue for future AGM's.

One of the things that we announced at the AGM was our intention to carry out a Feasibility Study into building a 10¼" gauge locomotive to demonstrate Jamie Keyte's Revolution concept. Things are moving on fast and we held a Kick Off Meeting in Doncaster on Saturday 30/3/19 and there will be an Engineering Meeting on Tuesday 4/6/19. Later on, Jamie Keyte gives a recap on the history of Revolution and the concepts behind it and I give an update on the Kick Off Meeting and the next steps out of it. Our intention is to report back at the October Conference.

This month's Steam Railway has the last of a series of articles on Standard Gauge new build projects. A telling finding is the successful ones have *'a robust and aggressive fund-raising strategy, competent project management and clarity of purpose'.* The article goes onto quote one of the projects that is on track to raise sufficient funds '*if you are launching a project, you need to make sure that there's a good reason for people to be part of it and use that to your advantage'.* Although we have sufficient funds to start a project, we do not have sufficient to conclude and the lessons of successful standard gauge new builds, applies just as much to us.

We'll be returning to Crewe for our two-day, conference in October. Later in the newsletter, Chris Newman writes in greater detail on the programme. The conferences have proved to be a great event for learning about steam, networking and socialising. For many the highlights of the conference are a chance to see locomotives close up and this year we have secured a visit to Jeremy Hosking's overhaul facility at Crewe (known as Locomotive Storage Ltd) which is the operating base for his Saphos Trains – locomotives in his fleet include Britannia 70000, Royal Scot 6100, Blue Peter 60532, Nunney Castle 5043 and Lord Dowding/Braunton 34052. We are also having a talk on the Patriot New Build and provided the engine is still at the Crewe Heritage Centre in October, there will be viewing of it as well – the ideal visual aid!

There is one thing that you could do to help us - that is book up, as soon as you decide to come along, to secure your space on the package deal that we are negotiating with the hotel.

We will let you know final details in May.

AGM – 2019 Chris Newman

ASTT's 2019 AGM was held at the Crewe Heritage Centre on 2nd March and was very successful in that almost half the current membership attended, plus an additional three visitors. Those in attendance can be seen in the photo above: -

Committee Members: 1: John Hind, 2: Cedric Lodge, 3: Mike Horne, 4: Richard Coleby, 5: Paul Hibberd, 6: Jamie Keyte, 7: David Nicholson, (missing, Chris Newman holding the camera).

Full Members: 8: Dave Pawson, 9: Chris Corney, 10: Doug Landau, 11: John Duncan, 12: Iain Jack.

Associate Members: 13: Alan Barnes, 14: Adrian Tester, 15: Grant Soden, 16: Joe Cliffe, 17: Vyvyan Vickers, 18: Dave Reynolds, 19: Les Turner, 20: William Powell, 21: Owen Jordan, 22: Geoff Ayres.

Student Members: 23: James Conway, 24: Chali Chaghila, 25: Alex Powell.

Visitors: 26: Keith Collier, 27: Neil Cadman, 28: Gordon Heddon.

Minutes of the Meeting will be circulated to members in due course.

The meeting was followed first by a talk given by Jamie Keyte who outlined his proposal for a "10¼" gauge "Proof of Concept / Demonstrator" that he introduced in a paper at ASTT's 2018 conference. Following his talk, it was agreed that a Kick Off meeting for a Feasibility Study into the build of a demonstrator will be held at the end of the month. Jamie brought a model chassis incorporating some of the novel concepts that he has in mind for the demonstrator *(see photos overleaf)*.

Joe Cliffe then gave a most informative talk on "Locomotive Lubrication", the subject of ASTT's latest publication - "Porta Papers Vol 1 Tribology & Lubrication". A copy of Joe's slides and a recording of his talk will be made available to members through the website.

Following Joe's talk, attendees moved across to the Heritage Centres visitors' area where Keith Collier provided an explanation and demonstration of the British Caprotti valve gear fitted to the Duke of Gloucester. The Patriot chassis (sitting on its wheels minus the centre drivers) was also on show.


Jamie's model chassis incorporating features planned for his 10¼" gauge demonstrator

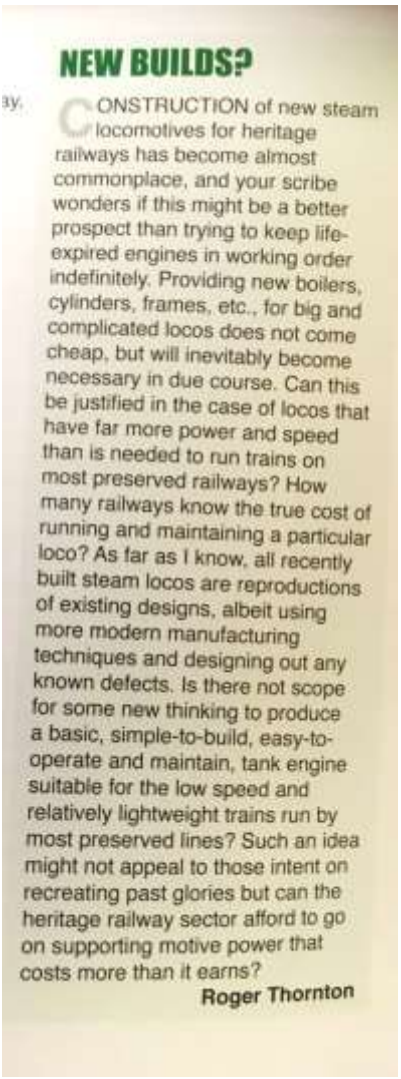
Patriot Chassis


Caprotti valve gear demonstration

The Revolution Concept

Jamie Keyte

There are many new build Standard Gauge ongoing in the UK today. These range from the NER 'G5' 0-4-4 project to the LNER P2 Mikado "Prince of Wales". Whilst some projects put themselves forward as the "ideal" locomotive for use on heritage lines (e.g. the BR3 tank 82045), what they all have in common is that they are all replicas. Some of them have detail improvements and employ modern manufacturing techniques, but the essence of each design remains as when first built. Even the most "modern" of these designs – the BR Standards – perpetuates a design philosophy over 60 years old. Though these builds will be "new" locomotives it cannot be expected that the costs, reliability and operation of them will be significantly different from the rest of preserved steam.



NEW BUILDS?

CONSTRUCTION of new steam locomotives for heritage railways has become almost commonplace, and your scribe wonders if this might be a better prospect than trying to keep life-expired engines in working order indefinitely. Providing new boilers, cylinders, frames, etc., for big and complicated locos does not come cheap, but will inevitably become necessary in due course. Can this be justified in the case of locos that have far more power and speed than is needed to run trains on most preserved railways? How many railways know the true cost of running and maintaining a particular loco? As far as I know, all recently built steam locos are reproductions of existing designs, albeit using more modern manufacturing techniques and designing out any known defects. Is there not scope for some new thinking to produce a basic, simple-to-build, easy-to-operate and maintain, tank engine suitable for the low speed and relatively lightweight trains run by most preserved lines? Such an idea might not appeal to those intent on recreating past glories but can the heritage railway sector afford to go on supporting motive power that costs more than it earns?

Roger Thornton

In 2013 the 5AT Group made a presentation to the HRA on possibilities for new build steam in the heritage railway sector. Whilst enquiries[1] with the key heritage railways suggested there was little interest in new build steam (at that time) certain members of the steam fraternity were concerned about the sustainability of steam operations. In the 2018 Spring edition of the Mid-Hants news Roger Thornton wrote (see panel right):

It should perhaps be added that the Mid-Hants has a relatively robust long-term motive power policy with a rolling programme of overhauls. This probably places the MHR in a better position than most, yet still there are questions raised over the long-term viability of steam operations.

Part of the presentation made to the HRA was an outline concept for a modular locomotive. This was "Revolution"

What is "Revolution" for?

The mainline steam market is well catered for by the likes of "Clan Line", "Tornado" and other large locomotives. Which engine is at the front of the train is often part of the attraction, and the ability to run at high speed and high power are necessary to fit in with scheduled services.

Heritage lines and scheduled steam services on Network Rail secondary routes (e.g. Fort William – Mallaig) operate lower speed services and often the scenic route and the fact that it is steam hauled by *something* is the attraction. When operating a regular daily service through the summer months the running costs, reliability and availability are of great importance to the operator. The customers are rarely concerned about what is pulling their train as long as it goes "Chuff". It is this market that "Revolution" is aimed at.

[1] New Build Survey jointly promoted by the HRA and the 5AT Group in 2013.

What is "Revolution"?

1. The concept is for a "core" locomotive incorporating the essential components for it to operate, namely:

- A boiler
- Frame
- Cylinders and motion
- Three driving axles and a leading pony truck.

2. The locomotive would nominally be Class 4, with power and tractive effort capable of being down-, or up-graded (within limits) by:

- Changing the cylinder liner bore
- Altering the ballast, hence the adhesive weight
- Tuning the draughting

By using the same set of basic components, it will be possible to build a locomotive tailored to the loads, range and axle load limits without creating a machine which is unnecessarily heavy or uneconomical.

It is recognised that with a common grate area/boiler covering a range of power outputs will lead to greater unburnt fuel losses at the higher power outputs. However, on most heritage lines the length of any sustained high-power output is unlikely to exceed 10-15 minutes at a time so the loss of efficiency over this small time will be compensated by gains in other areas.

3. The principle components / sub-assemblies are modular in that they are bolted together at defined interfaces.
4. The modular interfaces allow front and rear ends to be added to suit the operator. This would permit the same core locomotive to be configured as a tank or tender engine with water and coal capacity to suit the operator.
5. The external outline (e.g. boiler cladding) of the locomotive can be altered by the operator to represent the style of their choice (e.g. one of the Big Four, BR Standard).

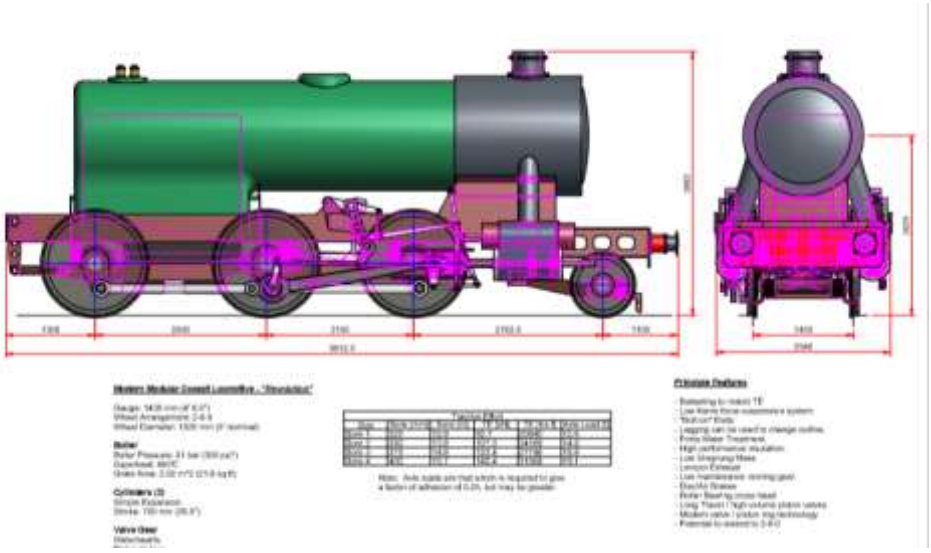
"Revolution" in More Detail

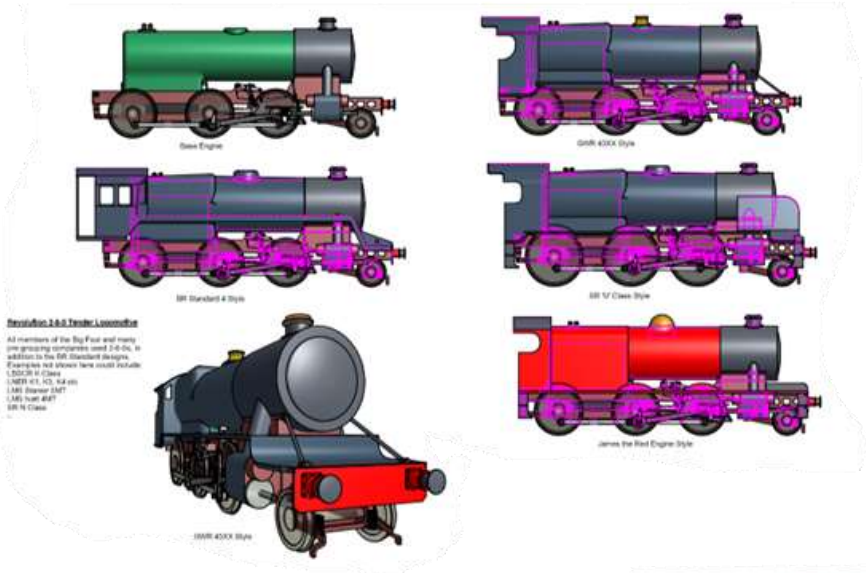
"Revolution" Drawings

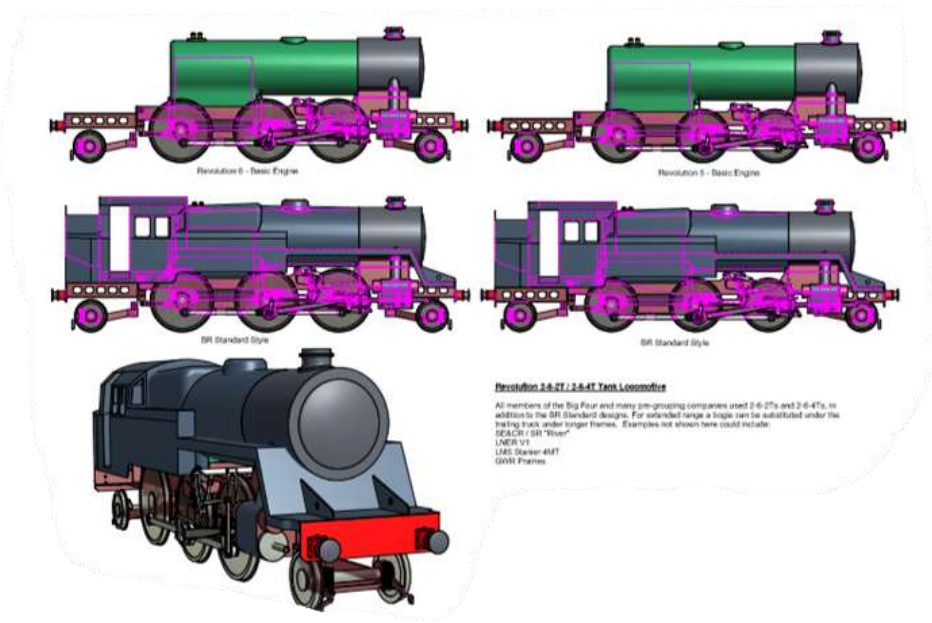
The drawings show the original "Revolution" concept from 2011. Some of the details and ideas have moved on since then so don't take everything as-read! For example, the original design has a grate area of 21.8 sq. ft (similar to the BR4 2-6-0 at 23 sq. ft) and it might be beneficial to increase this slightly. It will be noted that the tractive effort of the largest bore cylinders gives a useful Tractive Effort of 31,568 lbs which will give good acceleration and permit short working cut-offs. As the locomotive is designed for operating speeds between 25mph and 40 mph outright power is not expected to exceed 1200 IHP so a massive grate isn't required.

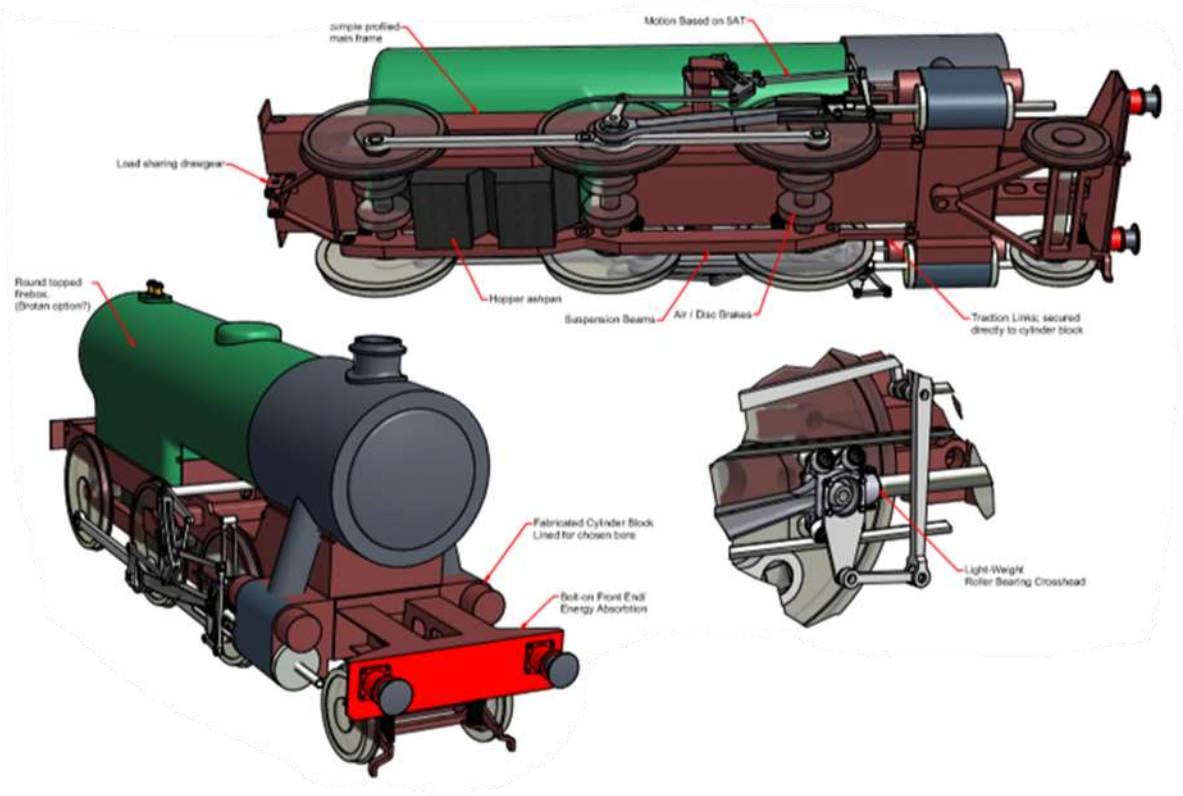
The original concept also included options for 5ft or 6ft diameter driving wheels. For heritage lines it is unlikely that anything other than 5ft would be required.

The images show the ways in which a common “core” locomotive can be finished off to represent a variety of styles.









- Boiler to be of simple parallel construction with a deep, narrow, round topped firebox between the frames. This configuration is relatively cheap to construct and simple to fire.
- Cylinders either fabricated or cast in a Monobloc configuration complete with smokebox saddle. Cylinder bore to be reduced for lower power variants by lining the cylinder bores.
- Frames to be of simple plate construction. Issues with cracking are to be avoided by use of alternative suspension arrangement (see next two items below).
- Axles are to be located using a system of radius arms. The purpose of this is to ensure the principle loads (piston thrusts) are reacted by a direct load path to the cylinder block. This relieves the frames of all but carrying loads.
- Springing will incorporate a degree of compensation to minimise track forces.
- Build accuracy of the complete locomotive is achieved by having a high level of precision embodied at a component / sub-assembly level. Laying out of frames and machining of horn guides will be avoided.
- Extensive use of sealed bearing units will be made on axles and motion. This includes rolling elements in both the slide bars and motion.
- The locomotive will be kept as simple as possible. Whilst improving thermal efficiency is desirable, having a high level of reliability and maintainability is paramount. It is *not* the intention to produce "The Ultimate Steam Locomotive" – that would be too controversial!
- Incorporate best practice where appropriate, including the advances of Porta, Wardale *et al* which have been tried and demonstrated to work effectively. Easy wins

can be made in the areas of insulation, piston and valve ring design, ashpan steam and lubrication.

- Other areas where contemporary technologies could be developed are:
    - Compressed air locomotive brakes using discs/callipers/pads from modern traction.
    - Elastomeric springing.

Costs

The bottom line. All heritage operations are run as businesses and need to turn a profit. Roger Waller, with his new generation of rack locomotives, demonstrated that built-for-purpose steam locomotives can operate at costs comparable to modern traction[2]. Low cost is the underpinning of the "Revolution" concept and it achieves it in the following areas:

1. Design costs. Design costs are unavoidable and must be done on a professional basis in order to achieve realistic timescales. For this reason, "Revolution" – as a full-size locomotive – can only become reality if several locomotives are to be produced and the design costs amortised.
2. Build costs. These are minimised in the following ways:
    a. Building several locomotives permits fixed costs – such as patterns – to be amortised.
    b. Building only the "core" locomotive on a commercial basis and allowing the operator to assemble and finish the locomotive themselves in a style of their choosing. Most preserved railways have some capability to produce fabricated structures relatively cheaply using volunteer labour.
    c. As the core locomotive is built as sub-assemblies there is no requirement for a large factory for final assembly, this being done by the operator.
    d. Off the shelf components can be used wherever suitable. As a new locomotive there is no requirement to slavishly recreate old designs.
    e. Assembly time will be minimised. Whilst it is an over-simplification to state that the loco will be "just bolted together", it would be much simpler than constructing a traditional design.
3. Low running costs. Achieved by:
    a. Maximising thermal efficiency as much as a "simple" design will allow.
    b. Making the locomotive quick and easy to prepare and operate.
    c. Improved reliability, hence improved availability.
    d. Reducing fuel and water bills by making a locomotive big enough to do the job – and no bigger. It's not cost effective to have a Class 8 Pacific on a 4-coach train!
4. Low maintenance and overhaul costs.
    a. Lower consumption of consumables e.g. bearing lubricants.
    b. Elimination of heritage steam bugbears, e.g. spring breakages.

[2] https://www.advanced-steam.org/5at/modern-steam/practitioners-of-modern-steam/roger-waller/

c. Quicker replacement of components/sub-assemblies through improved maintenance access and modular construction.
d. Spares for a fleet of locomotives kept in stock – reduced down time and cost.

The above emphasises that if a small fleet of modern locomotives could be built then the benefits in terms of spares availability and costs become significantly greater than if just a single modern loco is operated.

Alternative Fuels

At the time the "Revolution" concept was first aired there were no particular concerns about the longevity of coal supplies, and since the heritage movement relies principally on coal this was the chosen fuel for the locomotive. Within the last couple of years moves have been made to eliminate coal burning in the UK. The implications to the heritage movement are still not fully understood. With "Revolution" there is an opportunity to develop a locomotive capable of burning bio-fuels or liquid fuels and in doing so provide the heritage sector with a locomotive suitable for future operations.

Taking "Revolution" Forward

Building a full-size steam locomotive, particularly one which is of a new design, would require a great deal of work and finance to bring to fruition, and the project would have a certain amount of risk. Whilst there is technology to help manage and mitigate risk, it will remain in some measure.

Following a presentation to the AST at the 2019 AGM, the AST has commenced a feasibility study looking at designing and building a 10¼" gauge demonstrator of "Revolution". Building in approximately 1/5 scale significantly reduces the costs and risks whist creating a locomotive which demonstrates the principle features of the "Revolution" concept.

Initially the locomotive will be built in its simplest form and this will enable the AST to develop its testing, measuring and logging techniques. The size of the demonstrator means it can be transported easily to lines around the country, but can also be tested statically under controlled conditions. At the present time the AST relies on the cooperation of loco owners for the chance to take measurements.

The modular nature of the design makes it an ideal test bed for new developments (e.g. draughting, boiler design) without incurring huge costs. This will allow the AST to develop and test new steam technologies bringing greater benefits to the wider steam movement.

Revolution - Project Development

John Hind

At this year's AGM we announced our intention to carry out a Feasibility Study into building it and we set up a 'Kick Off' meeting on Saturday the 30th of March at Doncaster. Myself, Chali Chaligah, Joseph Cliffe, Richard Coleby, James Conway, Paul Hibberd, Mike Horne, Iain Jack and Jamie Keyte turned up, for an event not seen in Doncaster since perhaps LNER days.

The day started with Introductions round the table and was followed by a short presentation on what makes a Successful Project, which was followed by a number of Post-It Note Sessions on the themes of to identify Tasks and Issues. For anyone not familiar with Post It Note

Sessions, they are a way of gathering ideas and thoughts and give everyone there a chance to have a say.

Busy Writing Post It Notes

Locomotive Specification Post It Notes

There were 199 in total; split down in the following categories; Locomotive Specification - 89, Design Process - 36, Fund-raising - 33, Manufacture - 11, Costs - 11, Locomotive Testing - 10, Way of Working - 7, Miscellaneous – 2.

From the meeting a number of people took away a number of actions. The principal ones are: -

Locomotive Specification - Richard Coleby and Jamie Keyte took this on board and are preparing a DRAFT for Engineering Meeting that we are holding on Tuesday 4/6/19.

What CAD System to use – Richard Coleby, Jamie Keyte and James Conway have started working on this - the problem is how to find a common CAD system, that all can access, that does not cost a couple of thousand pounds per user.

Fund Raising – Paul Hibberd is looking at the ideas raised at Doncaster. There are lots of ideas and from them we need to develop a fund-raising strategy.

Develop Marketing, Social Media Strategy and use of 'On-Line Giving'– Iain Jack will be developing a strategy for this. Developing a clear story and rationale that can be used to attract funding is vital to success.

Costs – Once the locomotive specification is clearer, I am happy to head this up, but will be looking for help from anyone with experience of building 10¼" gauge engines. Once we have an estimated cost, we will know the magnitude of the Fund-Raising task.

Way of Working and Communication - I have started work on this and already have had help from Jamie Keyte, Jonas Nilender, James Conway and Iain Jack.

Develop strategy for Ownership of the engine that takes advantage of VAT reclamation, gift aid, etc - Paul Hibberd is looking at the options for the most tax and VAT efficient ways of owning the engine.

Next Meeting - is going to be Tuesday 4/6/19 at Stapleford Miniature Railway, which is 10¼" railway near Melton Mowbray. As well as working meeting, there will be chance to look at several 10¼" engines. For anyone coming by public transport, there will be arrangements to pick people up from Melton Mowbray Railway Station.

The meeting is to be about the locomotive and the design process.

The outline agenda covers: -

a) Locomotive Performance
b) An overview of the design process and confirming the basic specification and reference points.
c) Confirming the features to be incorporated on the initial design, and identifying aspects of design for future development*.
d) Discussion about the preferred way of undertaking the CAD work.
e) Online storage (the cloud).
f) Drawing numbering system, document control, file labelling and other electronic "housekeeping" needs to be confirmed, as by then we will be starting to produce some documents.
g) Allocation of someone to oversee the Master Design
h) Splitting the work into discrete blocks and specifying the outputs of each chunk of work – typically enough design work to establish feasibility at this stage**.
i) Allocation of work and sub-system design to individuals or groups.

* If anyone has an idea that they consider worthy of development, but not part of the initial build, then they are free to work up a feasibility study at their leisure for future consideration.

** Basic work packages at this stage to be:

- Cylinder Design
- Axles, suspension and running gear
- Valve gear design
- Main frame
- Boiler
- Smokebox and draughting
- Front end and pony truck
- Back end inc. drawgear, tender / tank
- Brakes (could be part of axles etc)

- Stationary test rig

- Test points and fixtures

- Auxiliary systems (e.g. ashpan steam etc etc).

Nearer the date we will send out the finalised agenda.

Membership Chris Newman

It is pleasing to report that membership numbers have continued to increase and that we now have 68 members. Only four have failed to renew their membership this year, one of whom, Brian Gregson, has been out of contact since April 2018 and who may have passed away. Brian was 87 and in failing health when he last wrote. He had been an apprentice fitter with BR in the late 1940s and had worked at Doncaster Works drawing office and the Rugby Testing Plant before moving to the automotive industry and spending much of his life working in the US and elsewhere overseas. Brian gave encouragement to Jamie to get his Revolution project started to the extent of offering financial support to get it started.

Membership numbers have continued to grow with eight joining since the start of the year bringing total membership to 68. Our new members bring a wealth of knowledge and experience as briefly summarised below:

Daniel Farina from Chamarande in France: a Mechanical engineer with 25 years' experience in the oil and gas industry, lasers, optics, aero engines and special equipment. He is also President of the *Confrérie des Amateurs de Vapeur* (Brotherhood of Live Steam Amateurs) and Chief Editor of the association's quarterly magazine L'Escarbille.

James Bunch from Bedfordshire: Steam loco fitter; loco owner with extensive experience in main line operations.

David Fisher from Cardiff: chartered mechanical engineer who has worked as a designer across many industries, now manager in train heavy maintenance. Owner of two locomotives.

Mike Willcox from Wellington, New Zealand. Mike has had 39 years engineering experience including heavy machining, gear cutting, marine work, stud welding, construction and railway engineering. For the last 20+ years he has worked for Mainline Steam (NZ) and is a member of the Federation of Rail Organizations NZ (FRONZ) heritage technical committee. He is also an independent rail inspector of steam locos and wagons for FRONZ company "Rail".

Sam Peck from Leicestershire: Chartered Mechanical Engineer with over ten years' experience in Powertrain design and development and currently works in the automotive industry, improving the efficiency of petrol engines. He is accustomed to number-crunching and messing around with data, and is accustomed to working on a test bed measuring cylinder pressures etc. and will be more than happy to turn my hand to steam locomotive test data. Sam is interested in assisting Mike Horne with the development of his steam loco electronic performance monitoring equipment.

Eoin Callinan from County Clare, Eire: he has a degree in mechanical engineering and is currently working on thermal modelling of semiconductor responses to test conditions. He volunteers as a fireman for the West Clare Railway, working on their 0-6-2T *Slieve Callan*

which was the subject of his final year university project. Like Sam, Eoin would be interested in assisting Mike Horne with his electronic performance monitoring equipment.

Mike Goodwin from the University of Wales Lampeter: Mike is an electrical/electronics technician who is currently manages media services for the University of Wales. He has been involved in the Gwili Railway in Carmarthen, Wales, where he has been a passed driver since 2000. He was assistant workshop manager for the railway and head of motive power until career commitments forced him to give up the role. He spends a lot of time doing machining and fabrication and has been heavily involved in making parts for the restoration of Taff Vale No 28.

Dr. Andrew Hartland from Hampshire: Andrew is a chartered mechanical engineer who 40 spent years in engineering project management, including 15 years in the aerospace industry where he was involved in the concept design for a fighter aircraft, and 10 years in the oil and gas industry. His MSc thesis was a design for an advanced steam locomotive.

The current membership base is distributed as follows:

Full Members: 13 (as before)	UK: 52 members.
Associate Members: 49	EU: 10 (Spain, France, Germany, and Netherlands).
Student Members: 6	USA: 3 members (as before).
	Australasia: 2 members.
Total Membership: 68	China: 1 student member (as before).

October Conference — Chris Newman/John Hind

Planning is underway for AST's 2019 Conference which will be held at the Crewe Ibis Styles hotel in Crewe over the weekend of October 5th and 6th. We are very grateful to the generosity of members and non-members who have offered to present papers. Without their willingness we could not hold the conference. We are still working on the programme; speakers and topics to date are: -

- Electronic Locomotive Performance Measurements — Mike Horne & John Hind
- Bio-Coal Update — Wolf Fengler
- The History of Locomotive Storage Ltd — Peter Greenwood
- Visit to Locomotive Storage — Peter Greenwood
- Calculation of front ends with multiple orifices — Jos Koopmans
- The New Build Patriot Project — TBC
- A 21st Century Bogie for the King George the Vth Locomotive — Chali Chaligha
- The T1 Project — Wolf Fengler
- The Revolution Locomotive — Jamie Keyte
- Revolution Project Development — John Hind

- Translating Chapelon's *La Locomotive a Vapeur,* first (and only complete) edition (1938) — Hendrik Kapitin

Transport to and from the hotel to Locomotive Storage will be by Vintage Bus.

There will be the ever-popular conference dinner on Saturday evening and the bar will be open into the night.

We are negotiating with the IBIS hotel a package deal that includes the conference fee, accommodation, meals on the day, conference dinner and refreshments. There will also be a day rate for anyone who can only attend for one of the days or who does not want to stay overnight. For anyone travelling from further afield we are also negotiating discounts for extra nights stays.

For anyone who does not want to stay at the Crewe IBIS, we will provide a list of other hotels and B&B's in the area. We are expecting to finalise details during May and will send full details out then.

Book Sales

Chris Newman

Whilst the publication of **Volume 1 of Porta's Papers – Tribology and Lubrication** in December have temporarily served to burnish sales figures in an otherwise disappointing quarter, however sales have dwindled to zero since the end of March. Book sales since December have been as follows:

Volume 1 of Porta's Papers – Tribology and Lubrication (pub. ASTT): 27 sold (total sales 27 excluding 2 copies held in stock);

Steam Locomotive Design Specifications and Calculations for New Build Baldwyn 2-4-2T 'Lyn'
(pub. ASTT): 2 sold (total sales 25);

Here be Dragons by Phil Girdlestone (pub. Camden): 3 sale (total sales 26);

The Red Devil and Other Tales from the Age of Steam by Dave Wardale (pub. Camden): 3 sales (total sales 21 + 233 sold previously by 5AT Group);

The Fire burns much better … by J.J. Koopmans (pub. Camden): 1 sales (total sales 3);

An Introduction to Large-Lap Valves by Adrian Tester (pub. Crimson Lake): 1 sale (total sales 7);

A Defence of the MR/LMS Class 4 0-6-0 by Adrian Tester (pub. Crimson Lake): 1 sold (total sales 14);

Total sales for the quarter: 38 books (zero in April)

New Titles: Chris Newman is currently working on Porta Papers Vol 2 covering Compounding, the Tornado proposal and Water Treatment. Preparatory work has been suspended while he waits for feedback from Shaun McMahon regarding the chemical name for the antifoam Porta recommended, and a contribution from Martyn Bane who has kindly offered to write some notes about his experiences applying the treatment in the UK.

Website updates Chris Newman

Once again not a lot of work has been done on the website. Only six new pages have been created:

- A members' payment pages for Porta Papers Vol 1 and Ian Gaylor's Lyn Design Specification and Design Calculations, offering a 20% reduction on the normal price of these ASTT publications.
- A page reporting on ASTT's 2019 AGM.
- A page providing links to the AGM presentations.
- A page providing a link to ASTT's Articles of Association.
- A page giving advanced notice of ASTT's October conference (soon to be updated).

Steam Railway - Bio-Coal

John Hind

I had been following the Steam Railway articles about the 'coal crisis' and earlier in the year contacted them to tell them about or trials burning bio-fuels back in 2012. They asked that I write some notes for them. Here are the notes that I wrote with the help of Richard Coleby and Iain Jack. Parts of it were used in the April edition of Steam Railway. Here is the full text: -

'In the spring and summer, of 2012 the Advanced Steam Traction Trust carried out a number of trials of carbon neutral fuels, as an alternative to the traditional fuel of coal.

Two trials were carried out at the Stapleford Miniature Railway to understand what was possible with the alternative fuels and then one trial was carried out on the Wells & Walsingham Railway.

The plan was start to start the trials on larges miniature locomotives and then provided trials were successful, scale up to narrow gauge, then standard gauge. This strategy also meant that for the early trials we did not need large quantities of the bio-fuels, which in 2012 were in short supply.

Trials were started in April 2012 on the Stapleford Miniature Railway, which is a 10¼" gauge with a 2-mile track.

At Stapleford we had sole use of the railway, so we could run as required, without effecting service trains.

The April Stapleford trials, tried compressed wood chips and torrified wood. Bio-coal was first tried June. Wood chips and torrified wood were soon discounted because of smoke, spark throwing and inability to maintain steam. Bio-coal showed the most promise, though the product available in 2012, while it came close to the energy content of coal, was less dense, dusty and could break up on handling.

In July 2012 the trials moved to Wells and Walsingham Railway, which is a narrow-gauge railway of 10¼" gauge with substantially larger engines than the Stapleford engine and an eight-mile round trip on a line with heavy gradients.

The bio-coal used for this trial was an improved version of the previous grade with less dust and fines.

Three runs on service trains were carried out. The trial provided useful information about the product, some confirmed earlier findings and some were new.

The earlier trials of bio-coal at Stapleford gave concerns about fast burning and spark and smoke emissions, but hinted that heat output might be satisfactory. The trial with a larger engine and firebox and a far more rigorous duty cycle confirmed that the heat output was satisfactory.

The major concern was the excessively fast burn rate under high draught conditions, which combined with the lower bulk density of the product made it virtually impossible to build a

workable firebed, without constant firing. As a rough estimate the consumption of bio-coal was around 4 to 5 times the volume of Welsh Steam coal normally used on this engine.

A steam locomotive can work very effectively with a thin fire provided the fuel is sufficiently dense so that it is not sucked off the firebars. Under light draught bio-coal was observed to perform quite well and it could be intermittently fired and maintain steam pressure but immediately a higher draught was required holes appeared immediately in the firebed. Trying the alternative thick bed required constant firing and even then, the bottom of the fire was burning away so quickly that it was not possible to build to a suitable depth.

The view at the time was that if the bio-coal could be produced during manufacture with greater compression and hence with greater density and in larger sizes, it would decrease the burn rate and reduce smoke and spark emissions.

Our trials came to end in 2012, as we could not get supplies of an improved product.

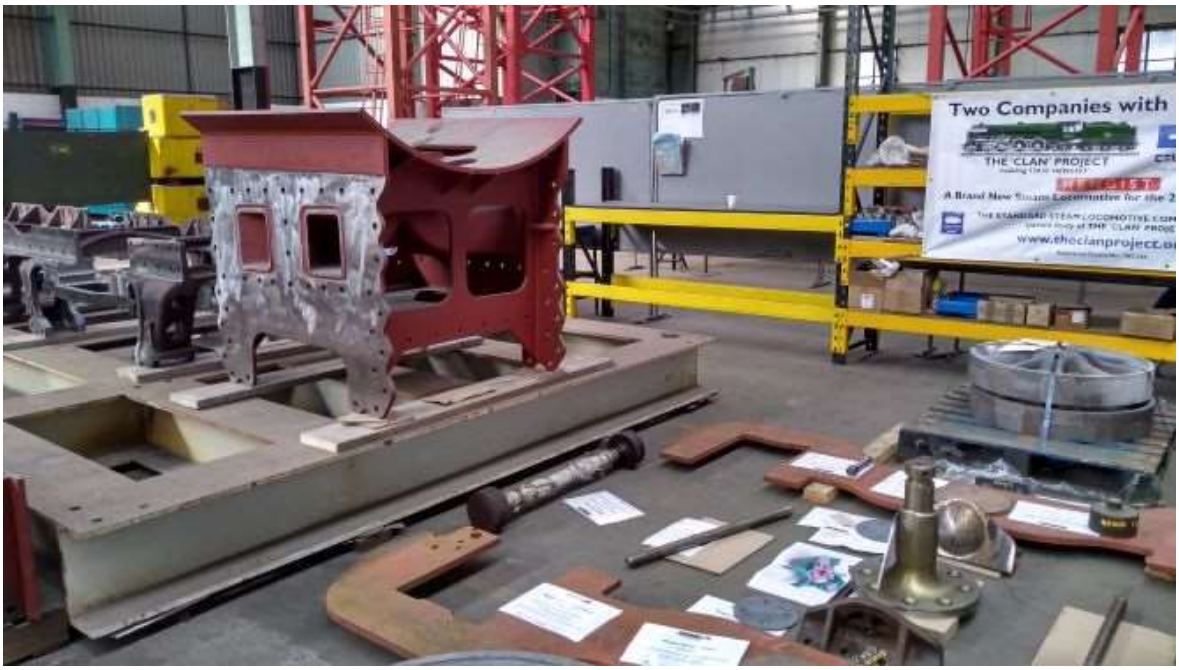
Since our trials, the Coalition for Sustainable Rail (CSR) in the USA have carried out trials in 2016 and 2017 with bio-coal in a similar way to ourselves starting out on a narrow-gauge railway. Wolf Fengler of the CSR came over to the UK in October 2017 and gave a presentation on the results at the 2017 ASTT Conference. Wolf is coming to our October 2019 Conference to give a further update.

The rate of progress has been governed by the availability of bio-coal and CSR are planning to trial a denser product, closer to the characteristics of coal on a standard gauge locomotive, in the Spring of 2019. The product looks to have characteristics much closer to coal than the product we trialled.

Bio-coal and its use in locomotives is still in the development phase. It may be a viable successor to coal, provided it can come close to the characteristics of coal and can be produced in bulk, to make it a commercially available product, at an economic price.’

New Build Clan Project Open Day – 27/4/19 John Hind

On Saturday 27/4/19, Iain Jack, James Conway and John Hind went to an Open Day organised by the Clan Project to show the frame components before the frame is assembled. The frames are being assembled at CTL Seal in Sheffield, who are a general engineering company, whose main business is making and assembling machines for the wind energy, nuclear and offshore industries. It might seem a strange place to assemble a locomotive, but their workshops are an example to the Heritage Steam movement in terms of facilities, cleanliness and processes. It is the environment that 21st Century steam should be assembled in.



Some 60 people attended and since they have had the frames ready to assemble, there has been more interest in the project, though, they are still short of funds.

Conversion of the BR drawings to 3D CAD continues and the cylinder patterns are being made (free of charge by a volunteer). The cylinders are due to be cast in 2020. They intent to implement the recommendations we made in our report of 2015, though, they have asked for more background on our recommendation to adopt direct rather than atomised lubrication and we will have to make a presentation to them in the Autumn.

The Clan Project had contacted E S Cox's family and his daughter, grandson and great granddaughters were there. I had a chance to talk with his daughter and found out, amongst other things, that she typed all her father's books on a typewriter, he bought for his daughter – his great granddaughters use it to this day. After retirement, he continued to receive letters from enthusiasts, which his wife called 'his fan mail'.

Series on Mechanical Lubrication - Part II

John Duncan

L.M.S.R. Cylinder & Valve Mechanical Lubrication

In 1952 the Engineering Apprenticeship ended in the Works and transferred to Gorton MPD for Mechanical and footplate training under Mr C. Oakely. Then later transferred to Chester MPD (6A) under Mr Rhyll the DMPS. During that time due to a shortage of Fitters, I was made up to a Fitter on mileage exams and found a very different cylinder and valve lubrication system on all LMS locomotives.

The LMS under Fowler, Stanier, Fairburn and Ivatt system of lubrication was the “Silvertown” mechanical lubricator invented & developed by the Midland Railway. A set mechanical double acting pumps to each side of the lubricator.

Atomisers where the pressurised oil from the pump is mixed with saturated steam via a cylinder cock control valve open when the cylinder cocks are closed. Then the atomised oil is connected direct to each piston valve liner. The remaining feeds all direct via back pressure valves: two to each cylinder and one to the piston rod gland and one to the valve rod gland. NOT atomised.

See Sectional Schematic Drawing No.DD2793 (Fig 1 below)**: -**

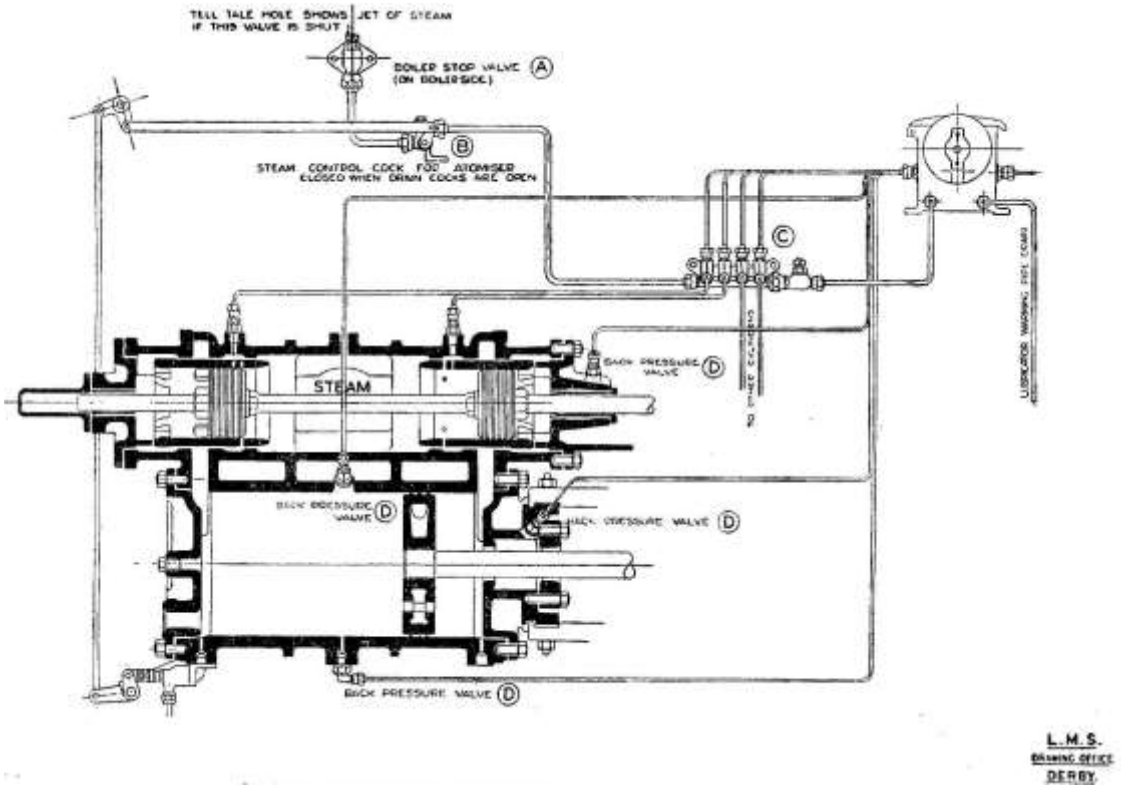


Fig 1 – Cylinder Lubrication Diagram – LMS, Derby, DD 2793

The number of atomisers is based on the number of piston valve heads.

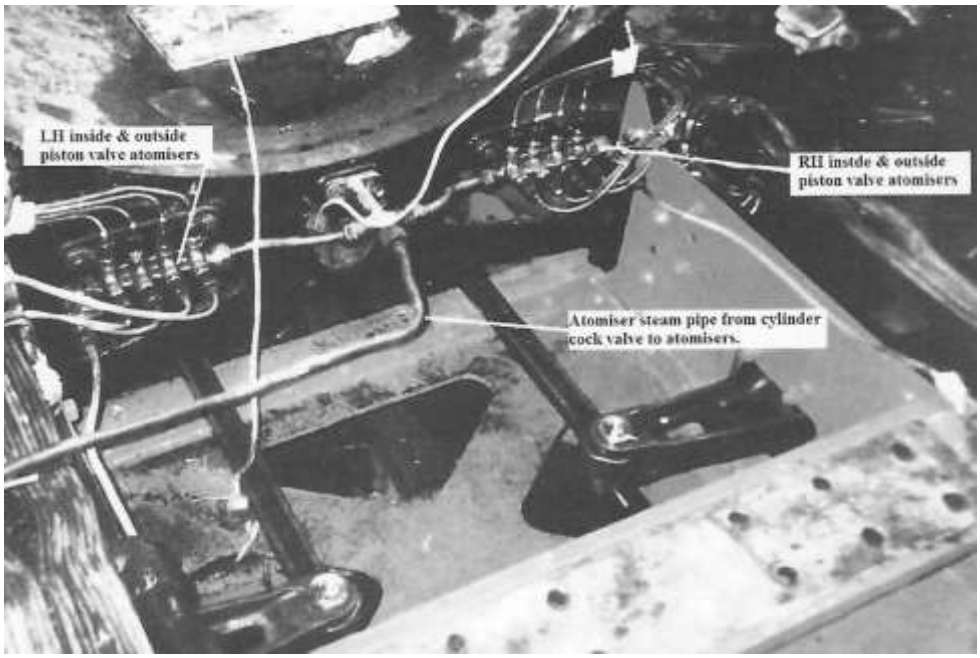


Fig 2 – 6233 at Butterley showing the atomisers mounted on the back of the smoke box saddle (fitted before the boiler was fitted)

The LMS four-cylinder locomotives required two “Silvertown” 12 feed lubricators, one each side of the locomotive. The three-cylinder locomotives had a 12-feed lubricator on the driver’s side of the locomotive containing superheater oil. Feeds to 6 atomisers then on direct to front and back piston valve on each cylinder. Feeds via spring loaded check valves, NOT Atomised to each cylinder at the top and to each piston rod gland. The valve spindles were lubricated via spring loaded check valves from the axle box lubricator on the right-hand side of the locomotive with axle oil from the front of the lubricator feeds Nos 7, 8 and 10.

The 3 cylinder and valve lubrication were developed from the privately built ‘Royal Scot’ class. The one described is from Dwg. D32-12202 which refers to locomotives 5500 to 5551 – see Figs 7 & 8.

The 22 Caprotti poppet valve gear class ‘5’ locomotives had an 8-feed mechanical lubricator with two blanked off, just 3 feeds via check valves, two to each cylinder and one to each piston rod gland.

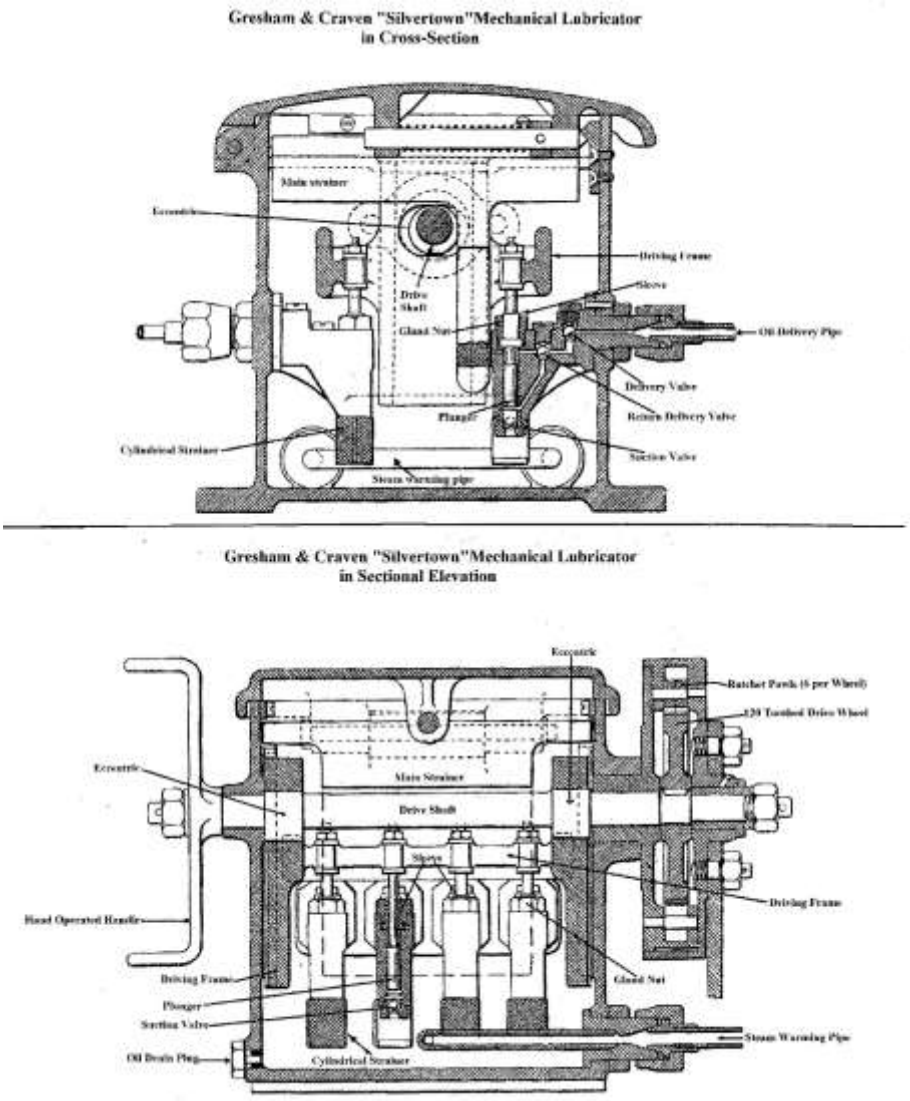


Fig 3 - An 8 feed ‘Sivertown’ lubricator in section.

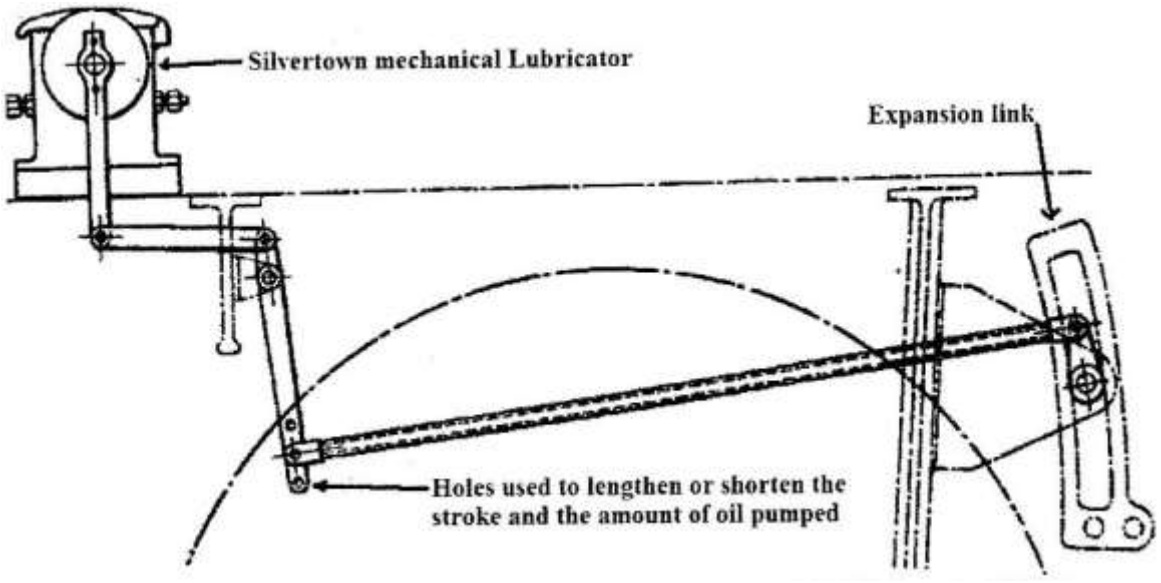


Fig 4 – Method of Operating a Mechanical Lubricator from the pivot of the expansion link from Walschaerts valve gear.

This method was used on most locomotives with Walschaerts valve gear, where it was not affected by shortening and lengthening of the cut-off.

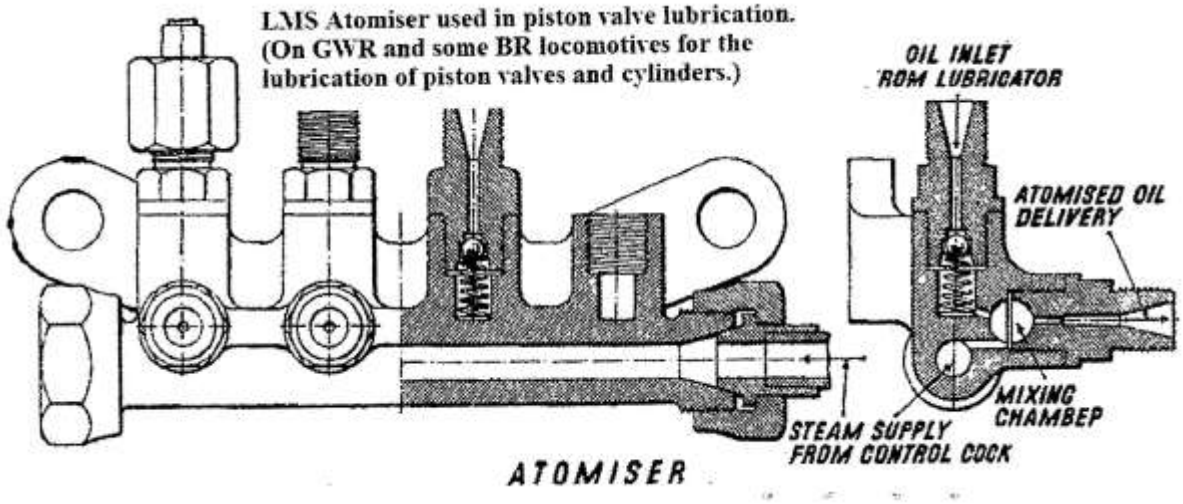


Fig 5 – LMS Atomiser used in Piston Valve Lubrication.

The problem with this atomiser there is no check valve between the steam supply from the boiler and oil from the lubricator traversing in the wrong direction. There is no baffle to mix the oil and steam thoroughly as in the mixing chamber shown. A simple atomiser.

The sectional drawings below (Figure 6) shows the methods used to control the atomiser steam supply and the back-pressure valves to control the pressurised oil from the lubricator direct to the cylinders, piston rod and valve spindle glands, in one direction.

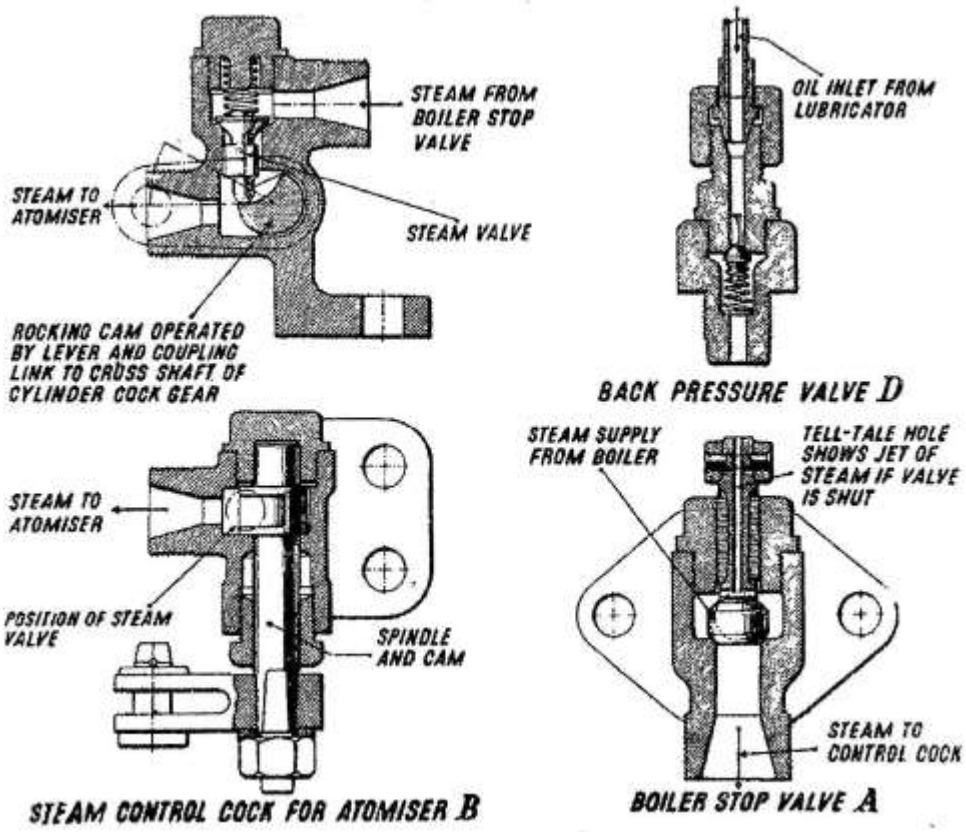


Fig 6 – LMS Atomiser Steam Control Cock, Boiler Stop Valve and Back-Pressure Valve.

Do we need atomisers at all? The LMS Class '5' Caprotti's ran till the end of steam on B.R. without atomisers. Have a look what has developed from the 1960's to today in cylinder & piston valve lubrication. From the Porta papers to Wardale's SAR class 26.

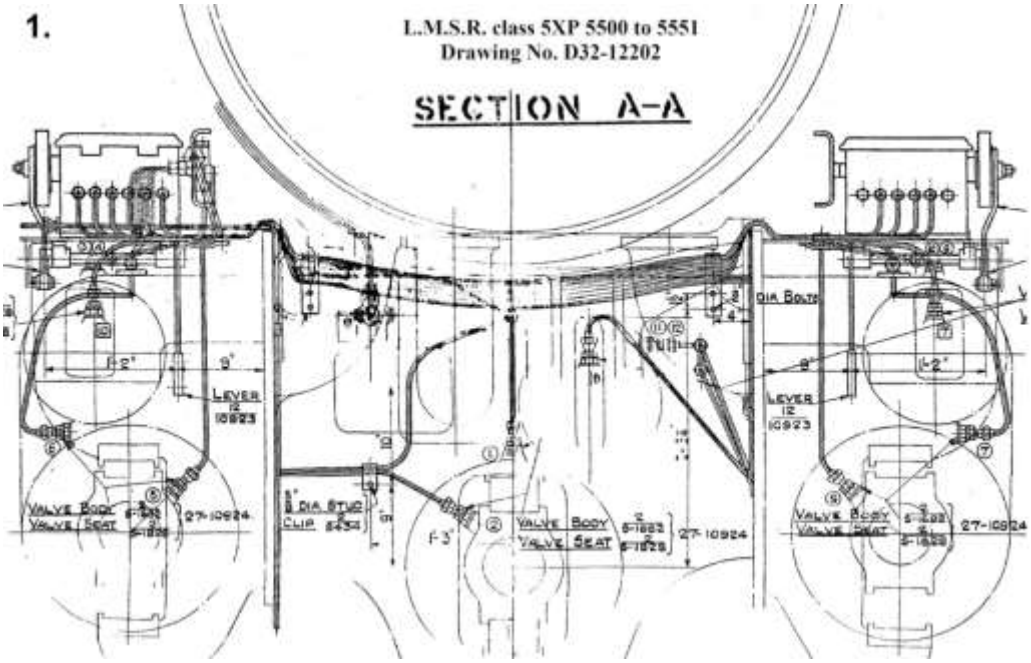


Figure 7: Section through the frames showing the cylinder oil mechanical lubricator on the left and the axle box mechanical lubricator on the right - looking forwards to the back of the cylinders. (From LMS Drawing D32-12202 - locomotives 5500 to 5551.)

Fig 8 below shows the left-hand side view of the cylinder mechanical lubricator on the far right and the row of six atomisers right of middle of drawing, below is the left-hand cylinder. Above on the left is a table “Cylinder Lubricator”; “Points to be Lubricated” and “Pump Number”. The numbers on the drawing with circles around them represent the pump numbers delivering to those points. Numbers with squares around them are from the axlebox lubricator on the RH side of the locomotive.

The Lubricator steam warming cock and pipe to the left of the atomisers on the LH steam pipe anti-vacuum valve. The atomising steam cock is on steam pipe to the Vacuum Brake Ejector steam cock. The pipe then goes down off the side of the boiler to the atomiser steam control valve, operated by the cylinder cock rods. The valve is ‘open’ when the cylinder cocks are ‘closed’. The steam goes on to the Atomisers.

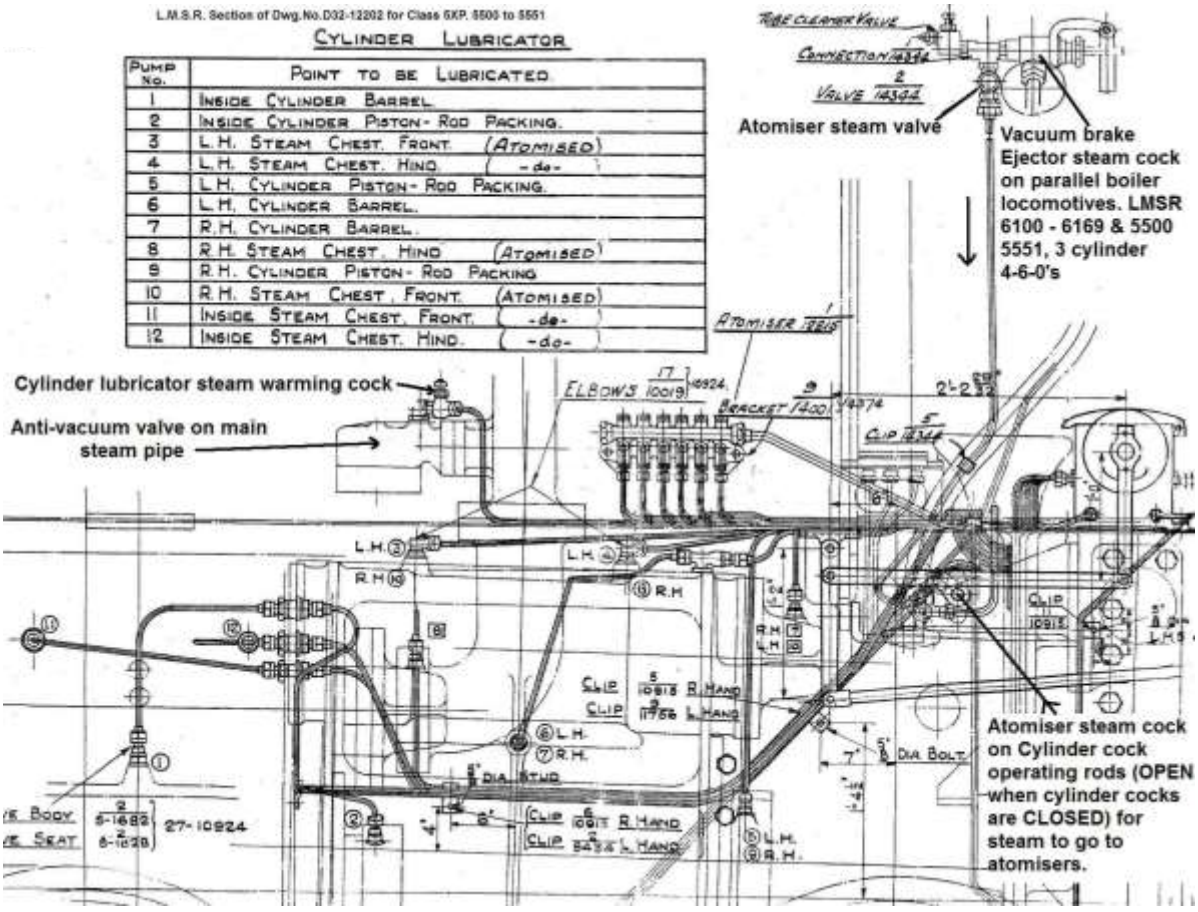


Fig 8 – left-hand side view of the cylinder mechanical lubricator and atomisers from LMS Drawing D32-12202 (locomotives 5500 to 5551).

The later Stanier 4-6-0’s - 5552 - 5742 and the rebuilds - 6100-6170 and the 18 rebuilds from 5500 to 5551 had the cock for the atomiser steam on the left hand side of the smoke box on the saturated side of the superheater header with its tell-tale hole that let off a small jet of steam when ‘CLOSED’ (see boiler stop valve ‘A’ on Figure 6).

The LMS cylinder mechanical lubrication worked well and the piston valve and piston rings changed at 30,000 to 35,000 miles lasted that period till BR came along with new ‘Ideas’!

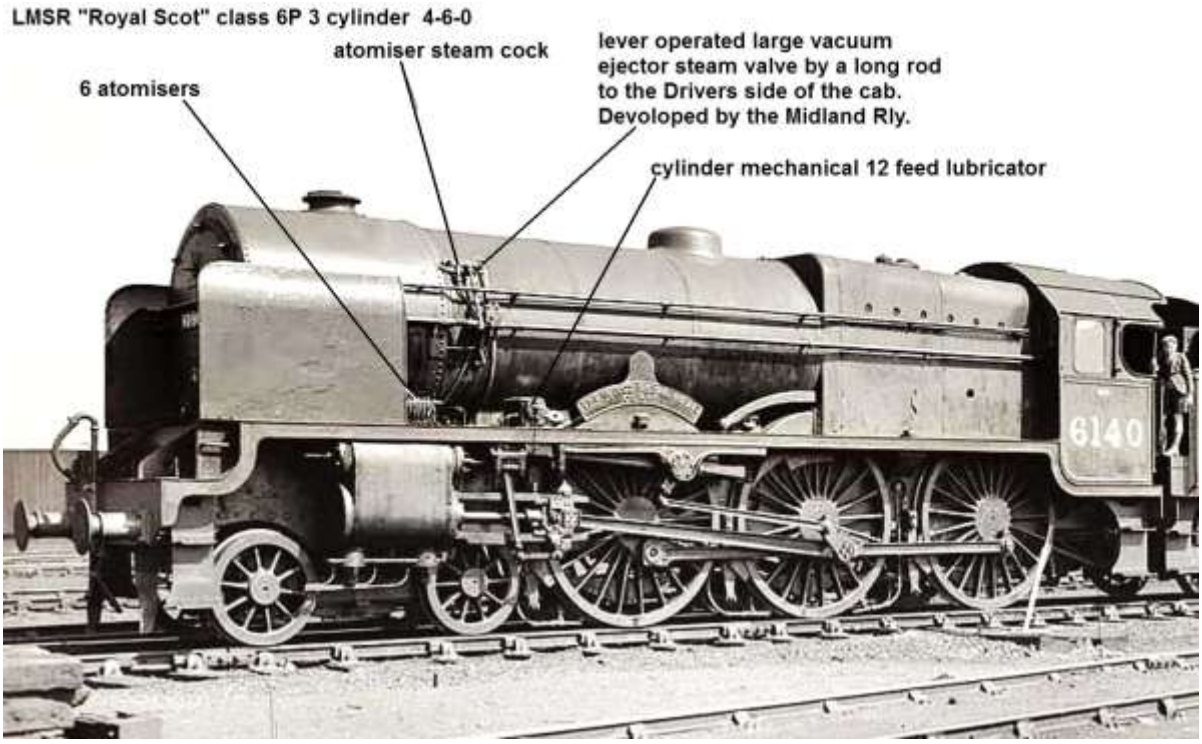


Fig 9 - 6140 showing where the atomiser steam comes from.

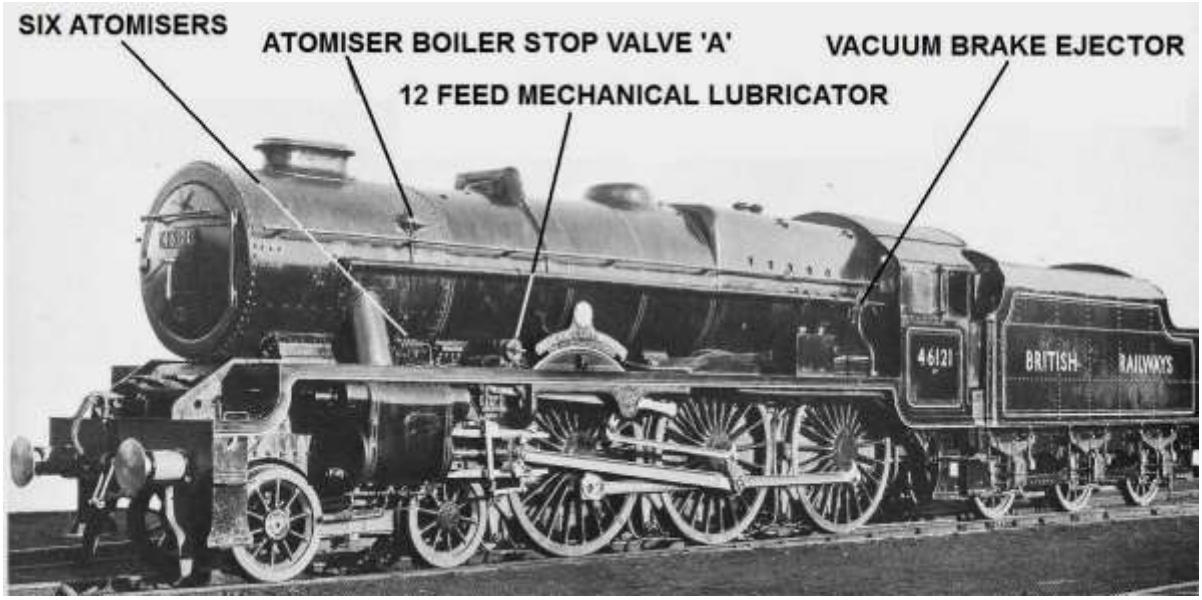


Fig 10 - 6121 showing the atomiser steam from boiler stop valve 'A'

4079 Pendennis Castle in Australia

Alan Barnes

The last newsletter which mentioned that new member James Conway involvement in designing the air brake system for GWR Castle No4079, prompted Alan Barnes to write of his involvement with 4079, while it was in Australia: -

'Your suggestion that I write something, plus new member James Conway and his project to fit 4079 Pendennis Castle with air brakes, made me think back to 4079s time in Western Australia 1978-2000 and it's use on air braked trains on the Hamersley Iron (now Rio Tinto) iron ore carrying heavy haul railway. Between 1976 and 1996 I was employed by Hamersley

at their Tom Price mine site as a truck driver/machinery operator. Whenever 4079 came up the line I usually helped in servicing the loco so I got to know some of the operating crew and how the loco worked with air braked coaches, ex New South Wales Rly. The air for the brakes was supplied by a diesel driven compressor mounted on top of the auxiliary water tanker towed behind the loco, it seemed it a bit crude but it appeared to work.

4079 at a servicing stop at Tom Price circa late 1980s. The diesel driven air compressor can just be seen sitting on top of the water tanker behind 4079s tender. It was connected to a

proportioning valve under the tank.

4079 at Tom Price in June 1994. After some hard steaming the smokebox was a bit over half full.

Steam Locomotive Improvements in the Railway Heritage Industry

Hugh Odom, PE

Today, nearly 60 years after steam's demise as the chief form of motive power on the world's railways, technological improvements to steam locomotives continue. This article provides an overview of the steam locomotives used in the heritage rail industry which have been upgraded to improve their performance, improve reliability, reduce maintenance requirements, or other- wise make them less expensive to operate. The focus of this article is on improvements developed largely since the demise of mainline steam railway power. Improvements have included thermodynamic modifications, installation of upgraded components, the use of improved materials, improved fabrication and repair processes, and alternative fuels.

To give an idea of recent steam improvements, over the past 20 years around 60 operating steam locomotives have been upgraded with substantial improvements. Several new locomotives were built with improvements incorporated. Approximately 60 improved steam locomotives are currently in operation around the world in heritage railway service. The table following this article provides a list of locomotives incorporating thermodynamic improvements added since January 2008.

Improvements to steam locomotives in the heritage railway industry are restricted by limited re- sources (time, money, personnel, and facilities), the desire to maintain locomotives in as close to their original condition as practicable, and skepticism about the value of improvements. Be- cause of this, there is little incentive for experimentation, and the improvements which are ap- plied must be previously proven in service.

While the improvements applied to the listed locomotives are diverse, virtually every locomotive in the table at the end of this article includes an improved exhaust system. The majority of these are Lempor Ejectors, while a few were exhausts designed by Dr. Jos Koopmans of the Nether- lands. Upgrading the exhaust system is one of the most effective ways of improving a steam locomotive. An improved exhaust system can improve steaming, reduce fuel consumption, and increase power. These benefits can lead to reduced maintenance requirements as the locomotive may be operated under less stress. An improved exhaust can be added for a reasonable cost and without irreversibly modifying the locomotive. Many improved exhausts have been in- stalled with no change to the external appearance of the locomotive.

While some improvements such as roller bearings, mechanical lubricators, and feedwater heaters were developed well before the end of mainline steam, these components are often retrofit to existing locomotives not originally equipped with them. A relatively recent innovation, the use of self-lubricating materials such as Vesconite can eliminate the need for periodic lubrication of some components. Self-lubricating materials have been used for bushings, washers, and similar components, and may be used for other items such as crosshead shoes in the future. Other improved materials have been used in locomotive repairs. The Strasburg Railway in Strasburg, Pennsylvania, USA, a tourist railway and contract repair shop, built a 304 stainless steel tender tank for one of their locomotives in 2006. Strasburg determined that the reduced corrosion in both the water and coal spaces and the corresponding reduction in maintenance would more than offset the increased cost of the material over time.

An increasing area of change and innovation with heritage railway steam is the use of alternative fuels. While virtually every imaginable fuel has been burned in steam locomotives in the past, current issues have resulted in the fuel in many locomotives being changed, and may result in new fuels being used in the future.

Oil has been used as a fuel for steam locomotives since around 1900. Difficulty in obtaining suitable coal, concerns regarding exhaust emissions, or seasonal lineside fire risk have led some operators to convert from coal to oil. Oil fuel has the advantages of easier handling, no dust, no ash, reduced smoke, and reduced lineside fire risk. Traditional oil fuels such as Bunker- C (heavy fuel oil) have largely been replaced with diesel or heating oil which is easier to handle, burns cleaner, and is more readily available. Modified or new burner systems have been developed to more efficiently burn these less viscous oils. Waste motor oil and waste vegetable oil are also being used in some locomotives.

Where solid fuels are retained, the use of Porta's Gas Producer Combustion System (GPCS) can provide improved efficiency with reduced smoke emissions. At least one newly constructed locomotive, No. 762 "Lynn", is equipped with a GPCS firebox.

Another replacement for traditional coal is "bio-coal", technically designated torrefied biomass. Several organizations around the world are working to develop products made from wood and plant refuse which can be directly substituted for coal. This fuel has the environmental advantage that it is considered "carbon neutral" as it does not contribute additional carbon dioxide to the atmosphere over that which the wood or plant material would contribute if allowed to decay naturally. In the US, the Coalition for Sustainable Rail (CSR) has successfully demonstrated the use of bio-coal in 15 inch gauge steam locomotives at the Milwaukee County Zoo in Milwaukee, Wisconsin, USA. Testing on a standard gauge locomotive on the Everett Railroad in Pennsylvania is planned in the future.

Other areas of improvement include new construction and repair techniques. While welding was in widespread use well before the end of mainline steam, its application to steam repairs and fabrication has greatly increased in recent years. All-welded boilers provide significant advantages over their riveted counterparts, including reduced weight and reduced corrosion. Welded cylinder assemblies have been used on some newly constructed locomotives. More recently developed processes, such as laser, plasma and waterjet cutting, 3-D printing, and Computer Numerical Control (CNC) machining operations allow reduced time and costs for repairs and fabrication. New ways of using these processes continue to be developed. For instance, while it is not currently possible to 3-D print a large, metal component such as a steam locomotive cylinder, 3-D printing has been used to produce a pattern used to cast a new cylinder. This has the significant advantage of allowing easy replication of this pattern in the future. No doubt similar innovations will be applied to future steam work.

Long after its demise on the mainline railways of the world, steam motive power continues to be improved. Improvements have included better exhaust systems, improved materials, alternative fuels, and improved repair and manufacturing techniques. These improvements provide improved performance and reduced operating costs, helping ensure the continued use of steam in the heritage railway industry.

Table of Steam Locomotives Improved Since 2008

Year	Railway	Locomotive	Modifications Performed by	Modifications
2008	Welshpool & Llanfair Light Railway, Powys, Wales	0-6-2 Joan	Nigel Day	Lempor Exhaust.
2008	Welshpool & Llanfair Light Railway, Powys, Wales	0-8-0 Resita	Nigel Day	Lempor Exhaust.
2008	Monticello Railway Museum Monticello, IL, USA	2-8-0 No. 401	Dr. Jos Koopmans (design of exhaust system)	Sweney/Armstrong Exhaust Nozzle with Lempor type tapered stack liner and mixing chamber, all-welded boiler, welded tender, oil firing.
2008	Perrygrove Railway, Coleford, Gloucestershire, UK	2-6-2T Lydia	Steam Loco Design	New 15" gauge 2-6-2T for tourist railway. Designed by Steam Loco Design and fabricated by Alan Keef. Features Lempor exhaust and roller bearings.
2009	Welsh Highland Railway, Wales	2-6-2+2-6-2 No. 87	Phil Girdlestone, Steve McCallum, and Shaun McMahon	Lempor Exhaust.
2011	West Coast Wilderness Railway, Australia	0-4-2RT no.s 3 and 5	Nigel Day	Lempor exhaust.

2011	Scottish Railway Preservation Society Steam Group	J94 "Austerity" 0-6-0T No. 7	unknown	Lempor exhaust- curiously, a photograph shows this appears to be sort of a cross between a Kylpor and a Lempor featuring a Lempor 4-nozzle arrangement, but with a separate, very tall intermediate petticoat pipe.
2012	West Coast Wilderness Railway, Australia	0-4-2RT No. 1	Nigel Day	Lempor exhaust.
2012	Embsay & Bolton Abbey Steam Railway	0-6-0T Beatrice	Unknown	Rocking grate, hopper ashpan, Lempor exhaust. This locomotive previously worked for the National Coal Board and was one of those modified with GPCS, under-fire stoker, and Kylpor exhaust in 1964 by L. D. Porta.
2013	Keighley & Worth Valley Railway	2-8-0 No. 5820 "Big Jim"	5AT Group / Advanced Steam Traction Trust	USATC S160 WWII design locomotive. Lempor exhaust added.
2014	Rhaetian Railway	G 3/4 No. 11 2-6-0T "Heidi"	DLM	1902 SLM steam locomotive modernized by DLM, included new boiler with superheater, new pistons and piston rods, new valves and valve rods, modern light oil firing system, and electric preheating system.

2016	Great Western Society	King Edward II 4-6-0 No. 6023	Dr. Jos Koopmans	Due to reduced height loading gauge, a new, shorter stack had to be installed which adversely affected the drafting. To restore good drafting, a new 4-nozzle exhaust and extended stand was fitted, designed by Dr. Jos Koopmans. The locomotive has hauled up to 420 tons with the new exhaust system.
2017	Lynton & Barnstaple Railway	2-6-2T No. 762 "Lyn"	Ian Gaylor	New narrow gauge (2 foot gauge) steam locomotive based on a 1898 Baldwin design. Completely designed using computer aided design (CAD), incorporates the following modern features: superheater, piston valves (cylinders disguised to look like the slide valve cylinders of the original), GPCS firebox, Lempor exhaust, roller bearings on all axles, welded boiler, Porta wheel profile.
2018	Waterloo Central Railway, Ontario, Canada	Essex Terminal 0-6-0 No. 9	Dr. Jos Koopmans, Michael Guy	New 4-nozzle exhaust and extended stand fitted below existing stack. Design by Dr. Jos Koopmans and fabrication by Michael Guy. (Photos courtesy of Michael Guy.)

2018	Puffing Billy Railway, Australia	2-6-2NA 14A	DLM	Conversion to oil firing. New 5 burner system fitted (one pilot burner and 4 main burners), similar to the new construction 0-4-2RT rack locomotives built by DLM predecessor SLM in the 1990's. Lempor exhaust previously designed and fitted to 6A by Nigel Day was transferred to this locomotive at the same time.
2018 (?)	Scottish Railway Preservation Society Steam Group	J94 "Austerity" 0-6-0T No. 19	unknown	Lempor exhaust
2018	Ravenglass and Eskdale Steam Railway	River Esk 2-8-2 (photo by Nigel Day)	Nigel Day	New main steam pipe, exhaust system, Kordina and Lempor. New valves, piston rings and cylinder liners done to Porta type standard with modifications by Nigel. Full air brakes, two whistles and a full set of new boiler fittings. Steam sanders and improved lubrication.
2018	Doe River Gorge, Tennessee, USA (operates on a portion of the former Eastern Tennessee & Western North Carolina Railway, AKA the “Tweetsie”)	Crown Metal Works 4-4-0 (3 foot gauge) No. 3	unknown	New inner exhaust chimney and "Porta-style" exhaust nozzles.

Note- Identification of upgrades to operating locomotives is a bit like detective work.

Updates and additions to this list are always appreciated; please e-mail me at

whodom2001@yahoo.com

DHR B Class replica

Cedric Lodge

Since my last report, I have received copies of the drawings on DVD. For the benefit of new Members, I will recap before proceeding: About two years ago, David Mead of the Darjeeling Himalayan Railway Society was working at the DHR works at Tindharia. Whilst there, he uncovered a cache of drawings of the B Class locos. (It must have been akin to discovering the tomb of Tutenkamoun). He attempted to get the drawing scanned, but Indian Railways preferred to send them to Gwahati where they were copied. He came away with the drawings on two DVDs; in due course, I received a set.

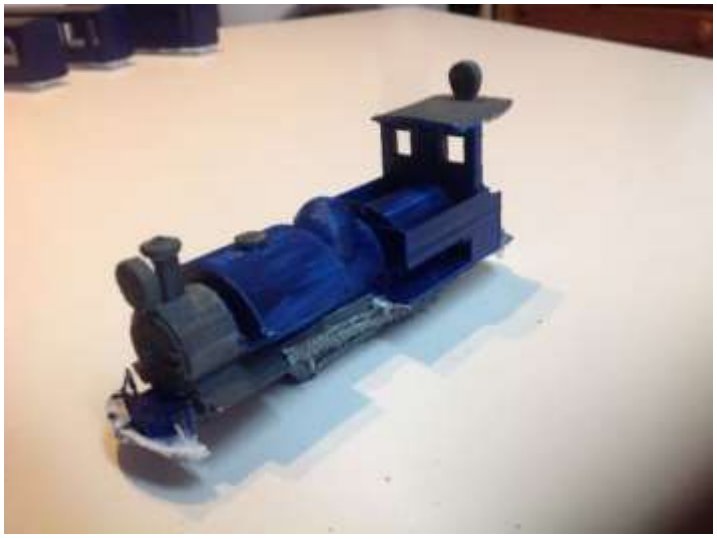
I must confess to a feeling of excitement as I opened the first DVD, and saw for myself drawings which I believed did not exist.

But all is not quite what, in my euphoria, I expected. The ultimate would have been a complete set, covering the whole loco. of one of the versions built by Sharpe Stewart, and bearing their name in the bottom RH corner. But what we have is a mixed bag: blue prints bearing the name Baldwin Locomotive Company, black-on-white copies of drawings made by IR, and copies of drawings of carriages.

On a PC, the blue prints are not easy to follow, and further work is required to reproduce them in larger and hopefully more easily readable format. But we have them, and they open the way to the creation of a replica loco.

The B & W copies are much easier to follow, and complement the blue prints. But they are copies made by IR staff, and thereby hangs another tale. When I was in India some years ago, I obtained an injector with a view to making replacement cones, which could be supplied to the DHR. To help me, IR supplied me with a drawing of the cones. Whilst making a list of the drawings and reproducing them at A4, I came across this drawing. One of the cones is shown with a parallel bore. I later had the opportunity of measuring the cones from one of the injectors on 19B-the only B Class loco. to escape India, whilst it was visiting the Welsh Highland Railway. The respective cone from 19B had a tapered bore. So, what of the IR drawing? There was obviously an error. And if there was an error on the injector cone, what of the other drawings made by IR. Although they must all be treated with circumspection, it is still better to have them than not.

Last year I met up with a graduate engineer on the Festiniog Railway-Caleb Lovegrove, and we got chatting about my dream of building a replica B Class loco. He volunteered to transfer the drawings to CAD, from which a CAD version of drawings could be produced. I must admit to being a bit sceptical, but supplied him with copies of the DVDs. Earlier this year, he produced a set of copies in A3, and a few weeks ago and much to my astonishment and delight, produced 3D printed models of a B Class loco., two carriages and a brake van. A little crude at this stage, but nevertheless, very encouraging. I am confident therefore that the drawings can be used to produce CAD drawings, which will in due course be crucial in the creation of a replica B Class loco.



George the Vth Project – Casting the Dome Paul Hibberd

Paul Hibberd has sent this sequence of pictures which show the steps in casting the dome for the new build George the Vth Prince George.

They start showing a male and female mould, show the casting process and finally the cast dome.

2-6-2T Lydia a brief history

Ian Gaylor

I enjoyed reading Jamie Keyte's excellent article on rubber springing and axle location in the last newsletter and this prompted me to write the notes below on the design of 'Lydia' for the 15" gauge Perrygrove Railway as the design includes the use of elastomeric suspension. The line is ¾ mile long is steeply graded with two sections of 1 in 30 and a minimum radius of curvature of 44ft and is situated in Coleford in Gloucestershire.

In 2006 I was requested by locomotive builders Alan Keef Ltd to prepare a specification and concept design for a new locomotive for the railway to enable them to increase their

maximum train length from 3 to 4 carriages while also facilitating ease of operation and maintenance.

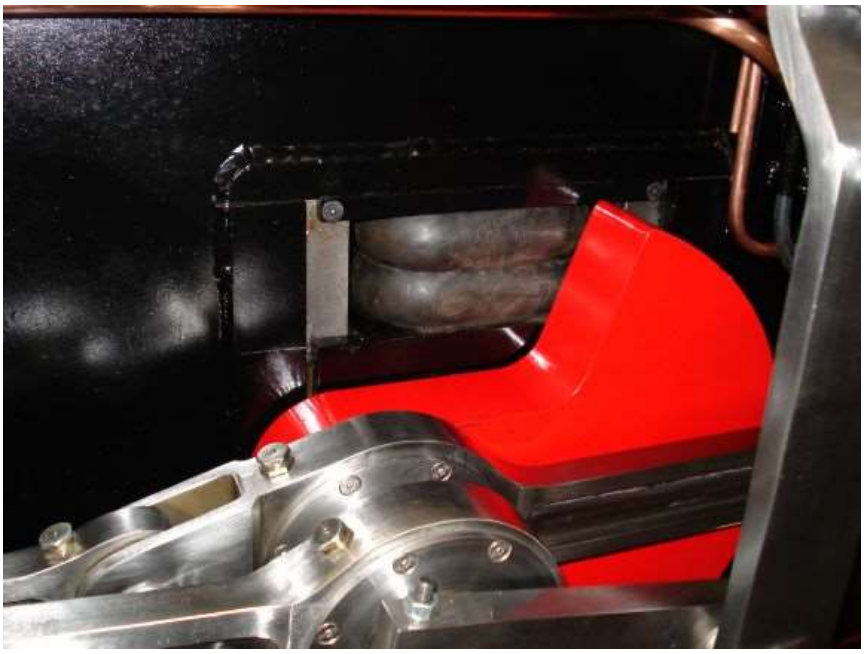
After visiting Perrygrove and discussing their requirement in detail, I prepared a specification and undertook the fundamental design calculations and computer modelling of the proposed core locomotive to achieve the required performance. This culminated in the preparation of an outline design drawing for the complete locomotive leaving details of the cosmetic items including tanks, cab and bunker to be completed by Keef's design team who also undertook all the detail manufacturing drawings apart from the boiler which was undertaken by Graham Morris Engineering.

There was considerable debate at the time during the design process about the size of the fire tubes to be fitted to the boiler as analysis showed that there was a very significant thermal efficiency benefit to using tubes of a much smaller size than those fitted to the Railway's other locomotive. The Railway was concerned that small tubes could become blocked and that they would need to stock another size of tube brush. However, I am pleased to say that the science prevailed and the actual boiler with small tubes steams very freely, does not require tube brushing other than at washouts and consumes much less coal than the Railway was used to!

A 2-6-2 wheel arrangement was selected with the leading and trailing pony trucks providing good guidance for the locomotive when entering a bend running either forwards or backwards. The centre coupled axle has flangeless wheels to facilitate negotiating the tight bends without excessive flange friction.

In addition, the tight radius curves dictated that minimising the overall length of the locomotive and overhung weight at the extreme ends was desirable to reduce the tendency to yaw laterally on entering or leaving the line's tight curves. This has influenced the boiler design which incorporates a narrow firebox with a sloping grate over the rear driving wheels thus ensuring that the large diameter, short barrel boiler is well supported and the overhang at the rear of the engine is minimised giving good weight distribution.

Timbren self-damping elastomeric springs are utilised throughout as shown in the photograph.



When the Inspector from HMRI rode on the locomotive as part of the type approval process he commented very positively on the ride quality. In addition to excellent ride characteristics elastomeric springs avoid the possibility of fatigue failures associated with the use of leaf springs. Timbren springs are used for a variety of commercial applications https://timbren.com/aeon-springs/ including road trailers but it is worth measuring an actual spring when specifying them in a design as the product does not always exactly match the manufacturer's drawings.

For ease of manufacture and maintenance, slide valves have been selected in preference to piston valves as for this low speed hill climbing application the performance of the locomotive will not be compromised. The use of balanced valves reduces frictional losses and wear on the valve gear. The valve gear is Hackworth with a curved die block slide to improve valve gear geometry and valve events which geometrically makes it Marshall gear! Rollers are used instead of a sliding die block which was inspired by the Twining valve gear fitted to Wroxham Broad at the Bure Valley Railway which works very well and I note that this is to be used on the proposed Revolution 10 Project. The valve gear design was optimised for 30% cut-off in forward gear with a full gear cut-off of approx 70% for easy starting whilst providing long travel motion for the valves to ensure good steam flow at short cut-offs.

All the motion and axlebox bearings are rolling element grease lubricated units for low friction and ease of maintenance.

The locomotive is provided with a four nozzle Lempor exhaust system to keep exhaust back pressure to a minimum and a four-jet blower is incorporated into the blast nozzle assembly.

Mechanically operated sanding gear is fitted with sand being stored in a boiler mounted sandbox for warmth to keep it dry. The sand is applied between the first and second driving axle to facilitate both forward and backward operation with only one set of sanding gear.

The locomotive was delivered to Perrygrove in October 2008. It has since undergone commissioning trials and entered service after receiving type approval from HMRI.

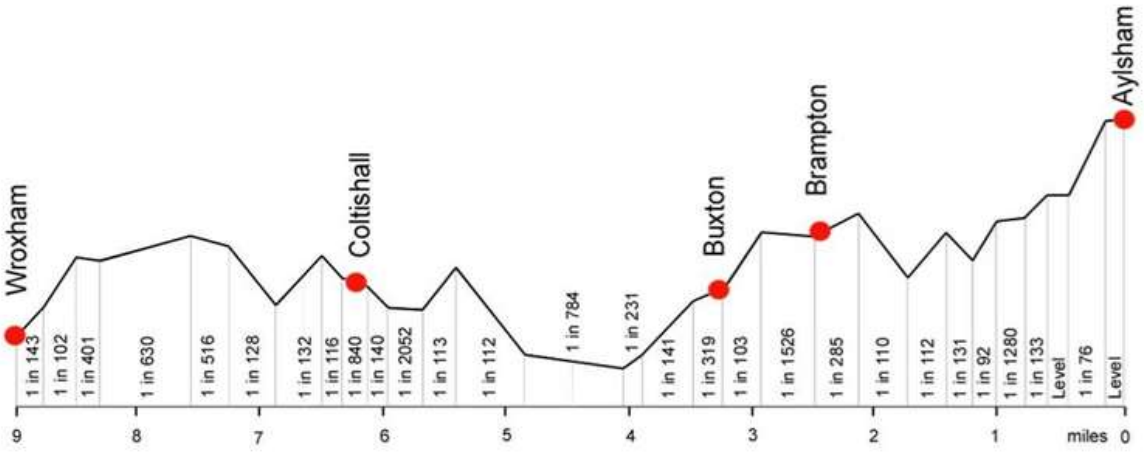
The completed locomotive has proved popular with locomotive crews and the Railway's owners alike and has been the motive power of choice since delivery.

Lydia's regular Driver, Jez Kirkwood, commented that after the Railway's second busiest day ever, that he could not believe quite how efficient the locomotive was as steam raising and 11 return trips were achieved with the consumption of only four and a half buckets of coal. In addition, he reports that she has proved a pleasure to drive, easy steaming and comfortable and that even after a busy day standing on the footplate, he goes home feeling comfortable and relaxed. These sentiments are echoed by the then Railway's owner, Michael Crofts, who estimated that the improved fuel efficiency saved him around £800 p.a.

Lydia at Perrygrove

The locomotive attended the Bure Valley Railway Gala on the 10-11th October 2009 and I was fortunate to act as Pilotman and Fireman on this occasion. This was an exciting opportunity to put Lydia through her paces in a different environment with a 9-mile line, switch back gradients, bigger trains and a higher line speed.

An 8 coach set was hauled for the event and the locomotive handled this with ease achieving a calculated 50 drawbar horse power accelerating up the 1:103 Buxton Bank from 5 mph at the foot of the bank to 18mph. Whilst the locomotive steamed freely throughout the run boiler efficiency dropped from around 70+% when operating at Perrygrove to around 48% based on water evaporated and coal consumed giving an average combustion rate of 53.6lbs of coal/sqft of grate/hr.



As the termini, Aylsham and Wroxham, are only 26m difference in height the switchback nature of the line means that locos are either pulling hard or coasting and so it seems likely that peak combustion rates exceeded 100lbs of coal/sqft of grate/hr. As the measured efficiency was around 14% lower than the anticipated calculated efficiency it is thought that this difference was probably due to unburnt fuel losses arising from the high combustion rate. During the gala the only problem encountered was that the higher line speed caused the oil in the crosshead lubrication pots to be flung out and frequent topping up was required!

Lydia at the Bure Valley with Ian Gaylor Driving

Lydia has also visited the Ravenglass and Eskdale Railway where she performed well and Peter Van Zeller observed to me that had they realised how well a loco with a small grate could perform on their line they might not have previously sold Bonnie Dundee.

Cab Layout

Lempor Exhaust

Leading dimensions and specification

Boiler Type	Saturated
Grate area	0.18 m²
Grate length	450 mm
Grate width	400 mm
Firebox heating surface	1.19 m²
Tube heating surface	6.9 m²
Boiler tube bundle mean gas free area	0.0204 m²
Working pressure	1379.3 KPa (200 psi)
Cylinders	
Number and valve type	2 x Balanced slide valve
Bore	140 mm
Stroke	203 mm
Running Gear	
Wheel arrangement	2-6-2T
Driving wheel diameter	406 mm
Pony truck wheel diameter	305 mm
Springing	Uncompensated elastomeric
Projected Performance	

Theoretical max. tractive effort on starting	9.7 KN (2187 lbs)
Service speed max.	32.2 Km/hr (20 mph)
Max. drawbar power on level track at 16.1 Km/hr (10 mph)	37.3 KW (50 hp)
Weights and Dimensions	
Estimated adhesive weight	5.5 Tonnes
Estimated total weight including fuel and water	7.3 Tonnes
Length over buffer beams	3961 mm