

# WDLR Baldwin 4-6-0T Locomotives in the UK - Part 1

## Personal Modelling Notes by Robin Edwards



My relatively extensive, but by no means exhaustive, research into the Baldwin 4-6-0T locomotives used in Britain was prompted by the return of one of these locomotives from India to the Amberly Chalk Pits Museum in the 1980's. This loco called 'Lion' was subsequently restored by the Greensand Railway Museum Trust and is based at Leighton Buzzard. A second Baldwin was initially displayed at Duxford and is now undergoing restoration on the Welsh Highland Heritage Railway initially at their Gelert's Farm workshop, then Alan Keef and now the Vale of Rheidol Railway workshops.

This is a set of personal modeler notes and by no means intended to be a definitive work on WDLR 4-6-0T Baldwins in the UK but hopefully will provoke further information or views from other modellers.

I have pulled together information from a variety of published sources to get it into all one place as I am unlikely to remember where it all came from! Little of the information is new, but I have studied as many photographs as I can to try to understand the details and to get them as correct for each loco as I can.

It has been assembled over quite a lengthy period of time, mainly in the 1980's and largely before the publication of Robert Gratton's excellent book on the Ashover Light Railway. His book contains an extensive and detailed description on the Baldwin locomotives and additional information from this source has been 'patched-in' where relevant, as has information subsequently published in the Narrow Gauge & Industrial Modelling Review. This may have resulted in garbled or incoherent text in places, for which I apologise in advance. I have not tried to include information from either Roy Link's superb WDLR Album or Andy Cuckson's Snailbeach District Railways book. This is not because they are not relevant but because I don't have the time at the moment. Roy's drawing for the Ashover's Peggy appeared in Robert Gratton's book and a revised, more generic version incorporating a small modification to the cylinder inclination appeared in Review issue 46 along with a copy of a Baldwin Works drawing. This drawing was also included Review issue 78 and I think it is this drawing that is included in his WDLR Album. Roy also produced specific Snailbeach drawings for an article by Andy Cuckson in Review issue 56. Roy's generic drawing in his WDLR Album, along with David H Smith's drawing in Andy Cuckson's SDR book and John Milner's drawing in his Rails to Glyn Ceiriog (part 2) book are what I consider to be the best drawings of these fascinating locos.

The first part of these notes is centered on the blue-print, dated August 1916, published in Review issue 46. It appears to be an early Baldwin proposal for War Department consideration.

## General Details

A total of 495 4-6-0T Baldwin locomotives were built between 1916 and 1917. An initial order from the War Office for 45 locomotives was quickly followed by further orders for a total of 450 locomotives. The makers numbering system suggests that Baldwins were by no means restricting their manufacturing capacity to WDLR 4-6-0T locomotives. The 4-6-0T production batches can be grouped in to thirteen (Table on page 193 of Robert Gratton's Ashover book), indicating that some 600 other products were out-shopped during the same period.

The first order for 45 locomotives carried LROD numbers 501 to 545 and was completed by December 1916. Two later orders, eventually for a total of 450 locomotives, carried LROD numbers 701 to 1150 and were completed by April 1917. The gap 546 to 700 in the LROD numbering system was later filled by renumbering locomotives 1000 to 1150.

A number of modifications were specified during these later orders, presumably realised from operational experience (gained not only from the early Baldwins but also possibly from the other 4-6-0 locomotives in use). These are specified in Appendix IV (page 249) of Robert Gratton's Ashover book. The only modification not specifically covered in the list is the fitting of water lifters which also coincided with the inclusion of a mud pocket at the base of the boiler.

The provision of water on the light railways of World War One must have been a considerable problem and from experience gained early on in the war, water lifters were specified for later Baldwin locomotives. Water lifters used a form of injector designed to suck water in from an external source below tank level, a water filled shell hole for example, and blow the water/steam mixture into the left-hand tank via an 'S' shaped pipe. The injector was mounted below the cab floor on the left-hand side with the inlet nozzle sited in the middle of the rear buffer beam. A steel rest for carrying a length of flexible hose was fitted to the back of the bunker. The steam was supplied from a valve on the left-hand side of the steam dome. Narrow Gauge at War by K Taylorson suggests that these were fitted from WDLR 855 onwards (i.e. BLW 44760).

Strangely, the early drawing from Baldwins includes water-lifting equipment, although the original batch of locomotives were not fitted with these. The Baldwin design is supposed to be based on one which had recently been supplied to the French and their locomotives may have been fitted with water-lifters. Perhaps the War Department in Britain, ignorant of potential water supply difficulties, decided to save costs by not adopting the water-lifter option. Whatever the reasons, water supply did prove to be a problem and later locomotives were supplied with water-lifters. The water-lifter pipework on the blueprint doesn't look like that eventually fitted as the water pipe between the tank and the injector under the cab has a 'S' shaped curve in it looking from the end elevation. I haven't found any details of the water lifter injector but it looks like the water feed came from the rear of the cab along the left hand side under the cab before turning inwards, presumably to the injector; the outlet pointing forwards towards the tank, turning upwards in an elegant 'S' shape towards the top of the left hand tank.

Early locomotives, without window shields, had their cab front sheets constructed from three sections, whereas later versions were constructed from two sections.

An interesting fact from Appendix IV (page 249) of Robert Gratton's Ashover book is the explanation for the hole in the back of the bunker. A cleaning plug was fitted in the firebox backhead, above the firebox door, and 4 inches to the right of the boiler centre line. The hole in the bunker was actually a tube that enabled the use of a long washout nozzle for boiler cleaning.

It appears that many modifications were made in service, depending upon the operational conditions (and the enemy!) and the picture is further confused by the changes made to extant locomotives whilst in India.

Twenty-one Baldwin 4-6-0T locomotives were shipped back for major repairs in the latter stages of the war to relieve the overworked front line workshops. They were sent to W G Bagnall Ltd at Stafford (see pages 251 to 253 in Allan C Baker's and T D Allen Civil's Bagnalls of Stafford book). Some of these later saw service in the UK.

At the end of the war most WDLR locomotives were disposed of direct from site in France or the other fronts, although some equipment was transferred back to England and combined with stocks of equipment recently manufactured or returned to England for repair and stored at Purfleet in Essex pending sale.

By August 1919, 15 Baldwin 4-6-0T locomotives were advertised for sale at Purfleet. Some of these were Bagnall re-builds; some had been shipped back from France. More could have followed but prospective buyers may well have anticipated difficulty in obtaining spares from America since, although offered for sale at attractive prices, only eleven of this Baldwin type subsequently worked in Britain (excluding the two imports from India in the 1980's). Some 50 were sent to India and it is fortunate that at least two of these survived to be re-patriated to the UK.

The Baldwin returned to Amberly and subsequently restored by the Greensand Railway Museum Trust at Leighton Buzzard is of the later design although it has subsequently received flanged centre driving wheels and had lost its water lifter and hose carrying bracket through tank and bunker replacement.

The 4-6-0T Baldwin locomotive has been described many times, so only a brief summary of construction details are given here for my benefit. Following typical American practice, the 4-6-0T Baldwins had cast bar frames and two domes. The front dome held sand for the front wheels, whilst the steam dome was fitted with two pop safety valves and a whistle. The regulator was of the pull-out type and operated down a tube mounted above the boiler, between the steam dome and cab front. Initially I was really confused by the term 'pull-out' regulator, but this is typical of US practice and the 'pull' rod was controlled by an almost horizontal ratchet lever on top of the firebox. Two small sand boxes mounted under the cab floor provided sand for the rear wheels. Coal was carried in a bunker at the rear of the cab which was open at the back. Walshaerts valve gear operated square-cased slide valves mounted over two outside cylinders. Strangely enough, considering their intended short lives, the War Office specification asked for copper fire boxes and brass boiler tubes, although when the Glyn Valley Tramway Baldwin was subsequently re-tubed it was found to have steel boiler tubes with brass ferrules! Both steam and hand brakes were fitted, the hand brake handle was mounted horizontally on the left hand side of the firebox and operated a link behind the left-hand tank. The chimney was fitted with a damper to aid lighting-up.

### LROD Modifications

A number of modifications were carried out by the LROD, either in France or back in Britain. Only those applicable to the British Baldwins are considered here. The British modifications were carried out by W G Bagnall Ltd at Stafford during extensive overhaul and included extending the cab roof, additional tank fixings and possibly modifying the re-railing beams, although re-railing beam modifications were also carried out in France.

I think that the best Baldwin drawings available are by Roy Link in his WDLR Album, David H Smith in Andy Cuckson's SDR book and John Milner in his Rails to Glyn Ceiriog (Part2) book. My research was based on Douglas Clayton's drawing which was the best available when I started and has appeared in a variety of publications (see references 1, 2, 3 and 4) and also in the Wrightlines instructions for their 7mm scale Baldwin kit.

Douglas Clayton's drawing represents the basic 'standard' with/without water-lifter types, typified by the two examples used on the Snailbeach District Railway. Roy Link's drawing in Bob Gratton's book is specifically of 'PEGGY' from the Ashover Light Railway.

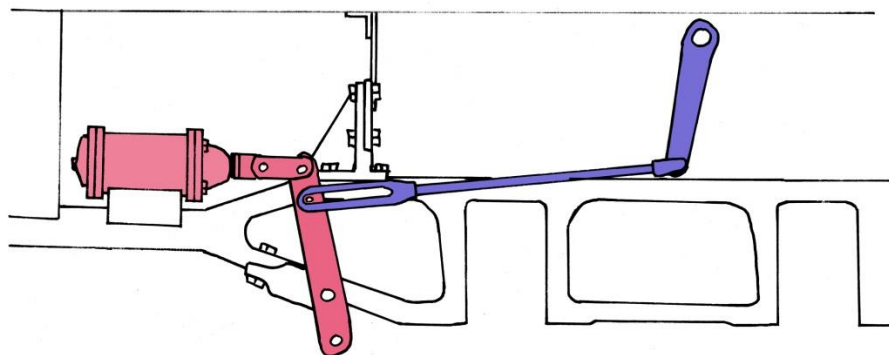
With each drawing, however, a number of details have been omitted for clarity or are not immediately obvious to me. These include:

- i) brake rigging
- ii) steam brake cylinder
- iii) smokebox 'blower' steam supply
- iv) hand brake linkage
- v) boiler drain plug
- vi) cylinder drain cock linkage
- vii) valve and cylinder lubrication pipes
- viii) rear sand box operating linkage and pipes
- ix) injector discharge clack valve
- x) injector feed isolating valve
- xi) reversing lever
- xii) bunker detail
- xiii) cylinder and slide valve detail
- xiv) tank equalisation or balance pipe
- xv) external steam supply valve on steam dome
- xvi) injector drain pipes

The position and operation of these should hopefully be fairly clear from the accompanying figures and photos. I have redrawn some of my early sketches, scanned them and tried where possible to use colour to help understanding. This has not been that easy as when I started out I mostly worked in black ink!

#### Brake Rigging, Hand Brake & Steam Brake Cylinder:

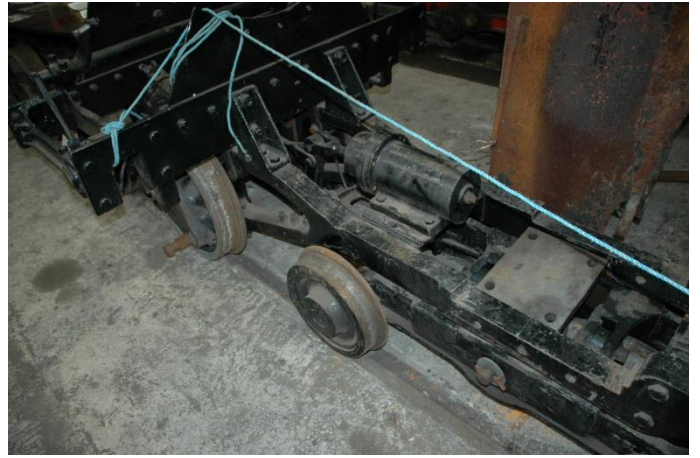
Brake blocks were fitted to each driving wheel and were operated through a pivoting link near the front motion bracket. The steam brake cylinder was mounted horizontally just behind the smokebox saddle and acted on the pivoting link. Its steam supply from a valve inside the cab appears to have been routed down the right hand side of the boiler. The hand brake was mounted on the left hand side of the firebox and acted horizontally through a link mounted behind the left-hand tank onto a cross-rod and lever combination down the centre line to the brake rigging pivoting link. I thought I had no details of how the hand brake lost motion but then I realised the Dr Cristian Cenac's book had some excellent sectional views which showed the following to accommodate the steam brake action without bending the hand brake linkage.



The steam brake cylinder and brake block operating arm are shown in red while the hand brake link and central pivot arm are shown in blue.

Then I realized I had some photos taken at the Welsh Highland of the steam brake cylinder and the hand brake link which showed the lost motion section the other way around! It just goes to show that you should look at all your available information as I had forgotten all about those photos, despite putting them on the NGRM Forum.

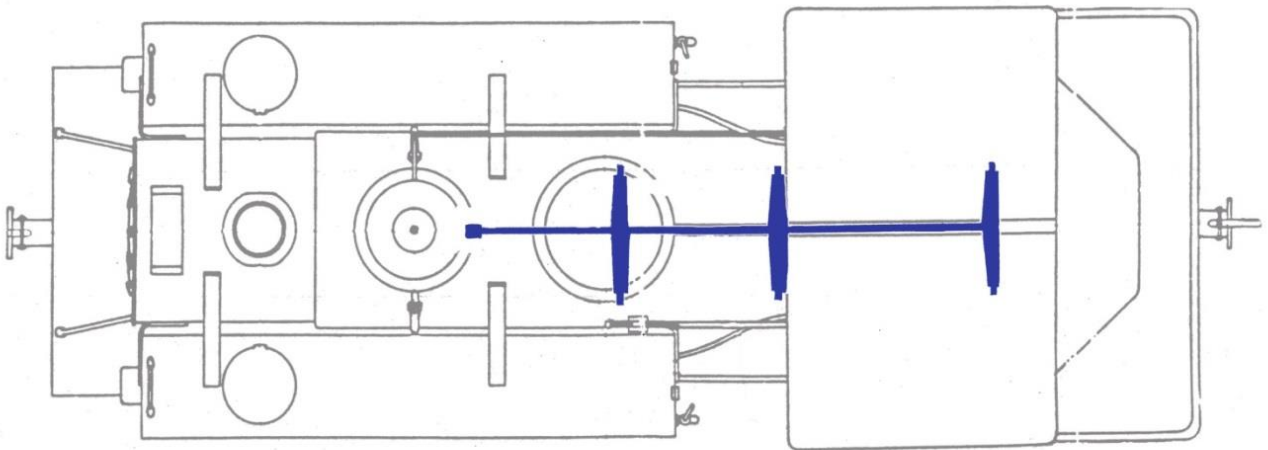


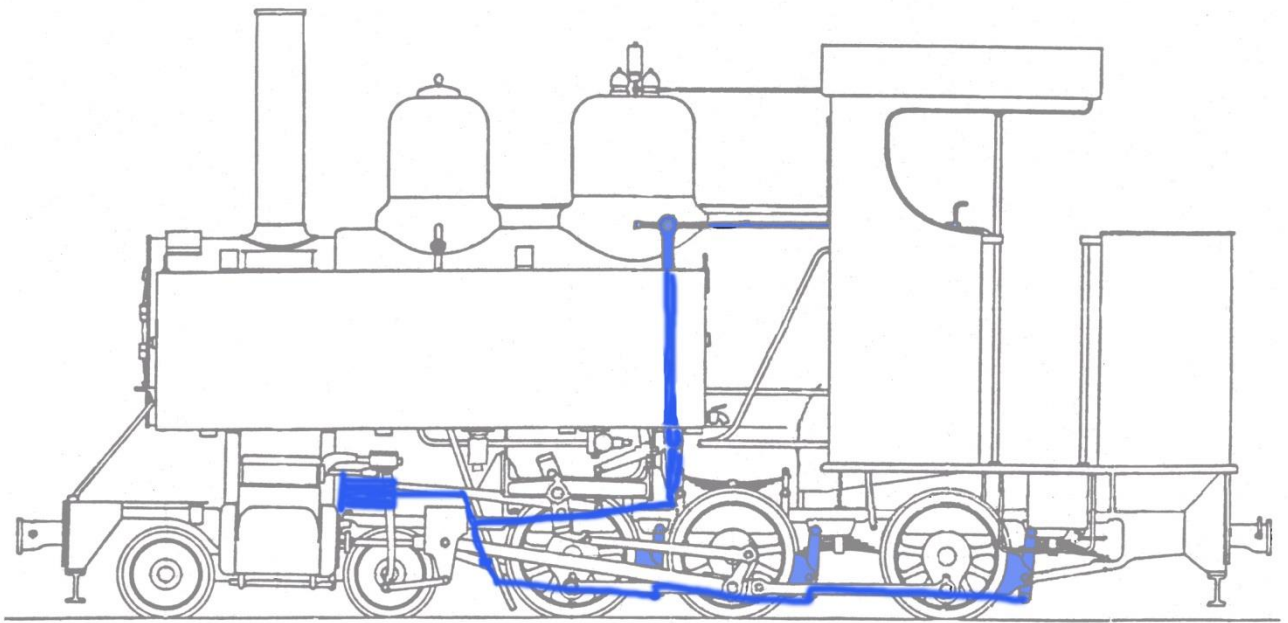


Handbrake  
lost motion

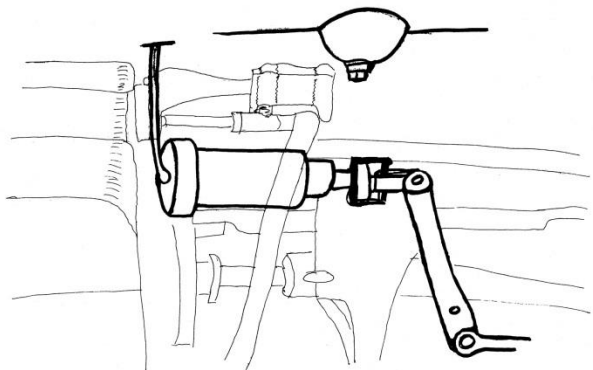
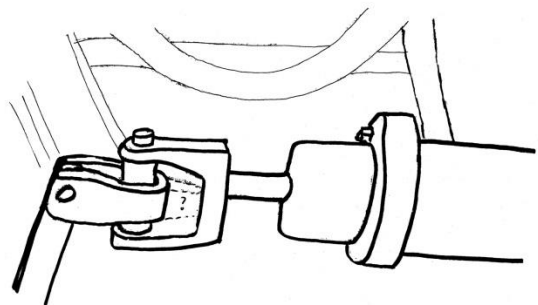
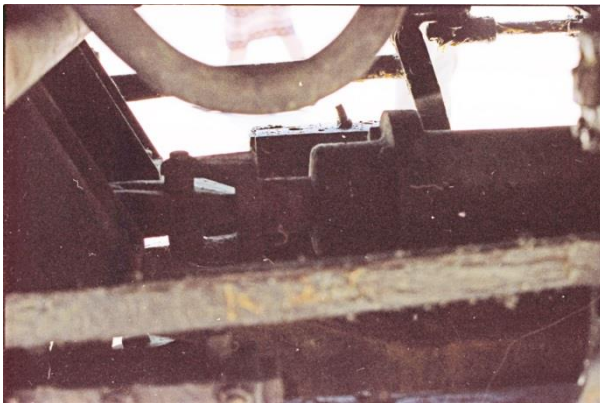
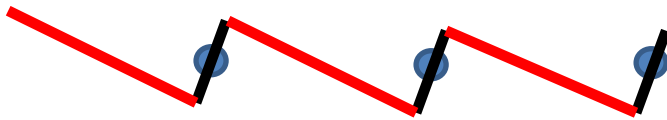
Steam brake  
link

The steam brake cylinder and hand brake linkage are shown in Roy Link's drawing. The brake block linkages are shown below in both plan and side view.



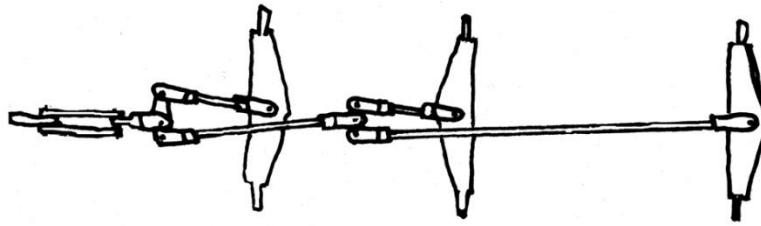


Each pair of brake blocks was joined together at the bottom by a cross-rod (the blue dot in the diagram below). According to my sketched notes from the brief inspection that I got of Lion, the centres of each cross rod were joined to each other (the red lines) with off-set links (the black lines) a bit like this:

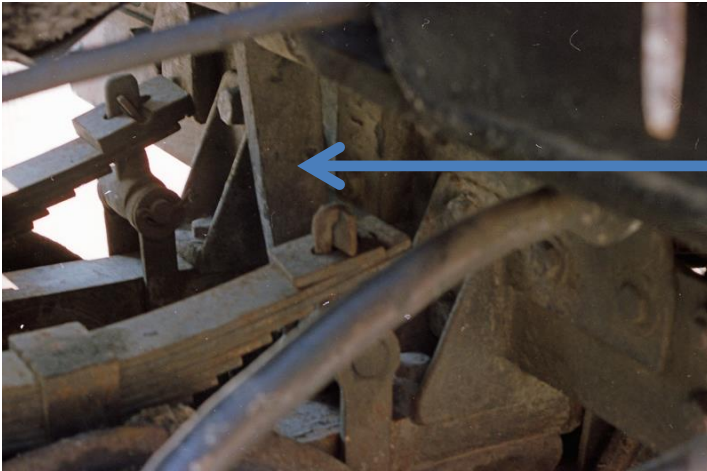




However, there is a drawing in Dr Cristian Cenac's book of the brake gear linkage which quite different to this arrangement and it may be that my sketch totally wrong or is of a later modification carried out in India.



Perhaps it doesn't matter as I am unlikely to fit it to my models!

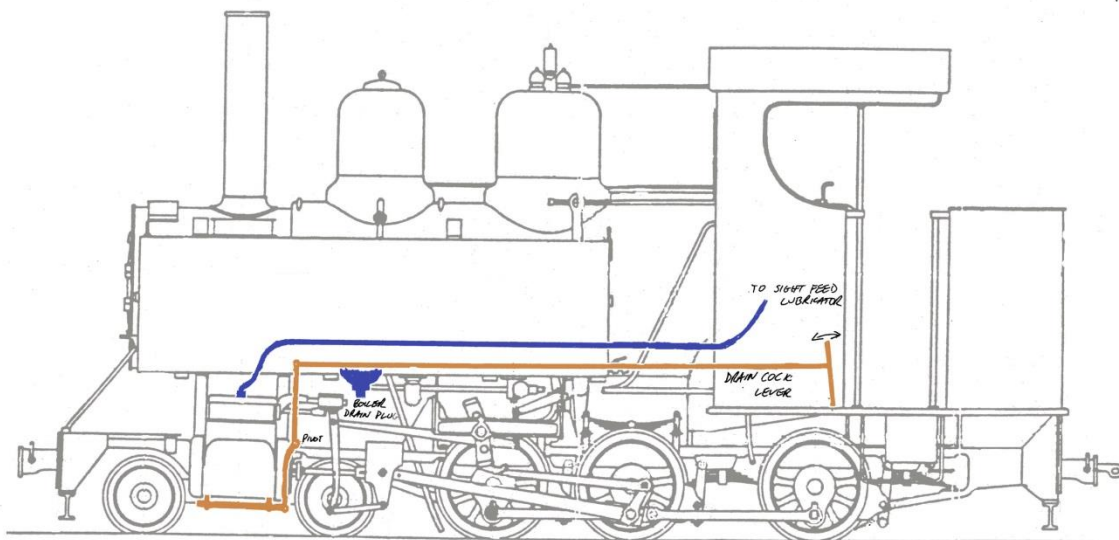


Lower part of handbrake lever under the boiler on the loco centre line

#### Boiler Drain Plug, Cylinder Drain Cock & Lubrication Pipes:

My guess for the boiler drain plug (or mud pocket) which was fitted to later locos (along with the water lifting gear), cylinder drain cock linkage and valve lubrication pipes are shown below. The boiler drain plug was located on the underside of the boiler just behind the smokebox saddle. The cylinder drain cock linkage ran down the right-hand side of the frames from a small operating lever in the cab near the reversing lever, to a short link acting onto the cylinder drain cocks. The valve lubrication pipes ran from the sight-feed lubricator, mounted on the top of the firebox, through two small copper pipes, one each side of the boiler, behind the tanks and fed into the top of the valve chests. These appear to have been routed outside the boiler cladding (high performance, high temperature oils are unlikely to have been used).

There is a good picture in John Milner's *Rails to Glyn Ceiriog* (part 2) book on page 177 showing a steaming trial of the rebuilt 778 at Alan Keef's workshop that shows the cylinder drain cock lever and linkage.



DRAIN COCK LEVER & LINKAGE ON DRIVERS SIDE  
(I.E. RHS OF LOCO WHEN LOOKING FORWARD FROM CAB)  
LEVER PIVOTED NEAR TOP OF CYLINDER WITH  
CROSS ROD TO LHS AT BOTTOM.

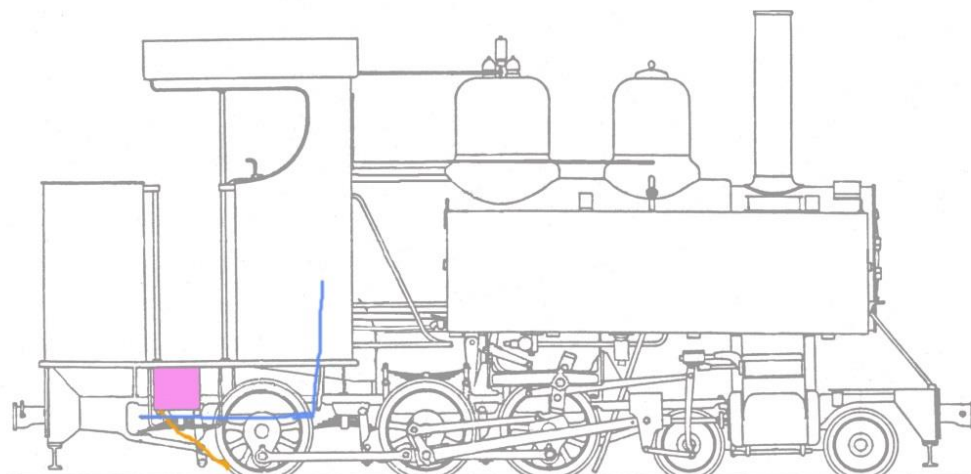
LUB OIL PIPES BOTH SIDES  
DRIVERS DRAIN COCK LEVER  
POSITION APPROXIMATE (HAS TO FIT IN WITH REVERSING LEVER &  
REAR SAND BOX OPERATING LEVER).

The position for the cylinder drain cock operating lever is wrong as it should be between the reversing lever and cab front. Its position is given in a view in Dr Christian Cenac's book and I will clarify it when I work up the firebox/cab details.

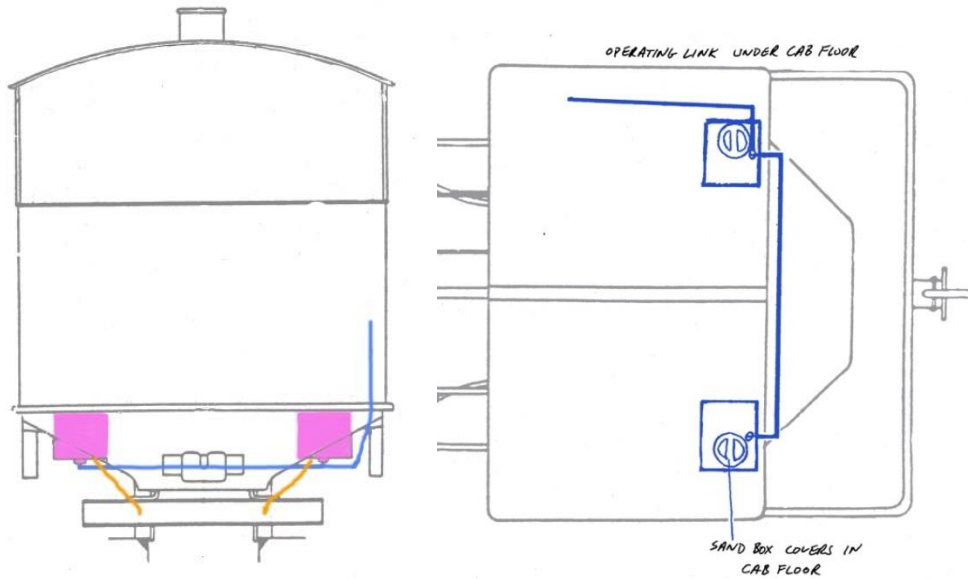
As far as I can tell, a smokebox 'blower' steam supply pipe (or the vent from the steam brake?) was routed down the left hand side of the boiler, inside the cladding and is just visible in some of the photographs between the smokebox and side tank.

### Rear Sand Boxes:

Inspection of photographs shows that the rear sand boxes were square and operated by a lever and rod arrangement from the cab. Details of the cross-rod and sand pipes are probably best shown in David H Smith's drawing. The operating level was on the right hand side of the cab near the side-sheet. Circular covers in the cab floor gave access (these can be seen in some photos) and by all accounts let in water so that the sanding arrangement didn't work. I haven't found any detail on how the sand was actually delivered from the box to the pipe but the linkage arrangement would suggest some sort of simple rotating flap valve arrangement.

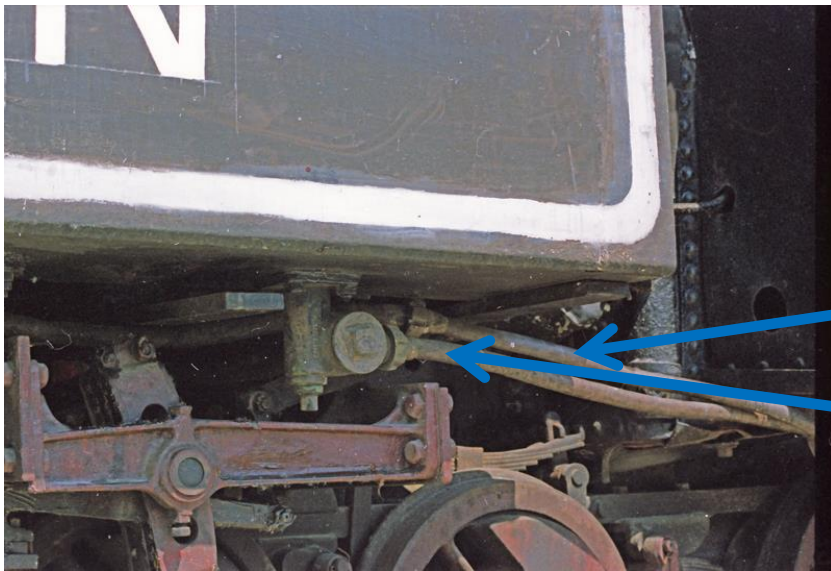






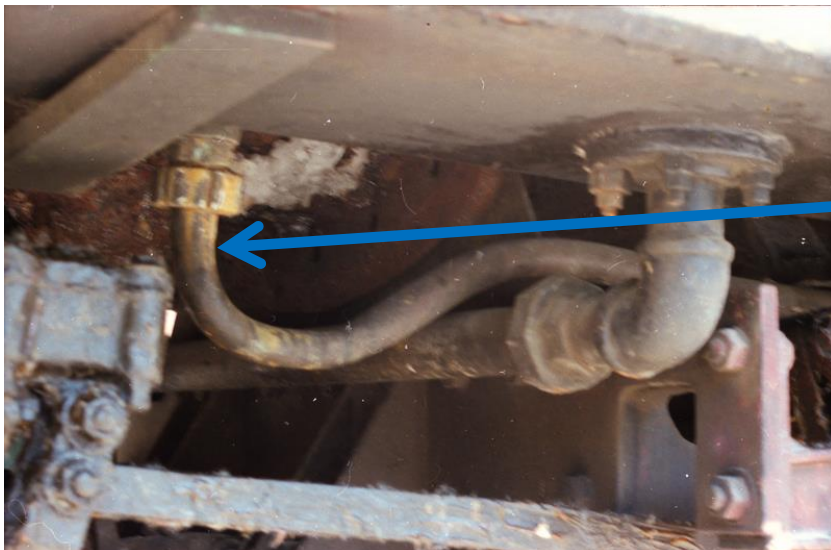
Injector Water Feed and Boiler Feed:

The injector water feed and discharge valves are shown in the photos below. Note injectors have been replaced so the cab pipework does not represent that of the original.



Boiler feed from injector

Injector water feed from side tank

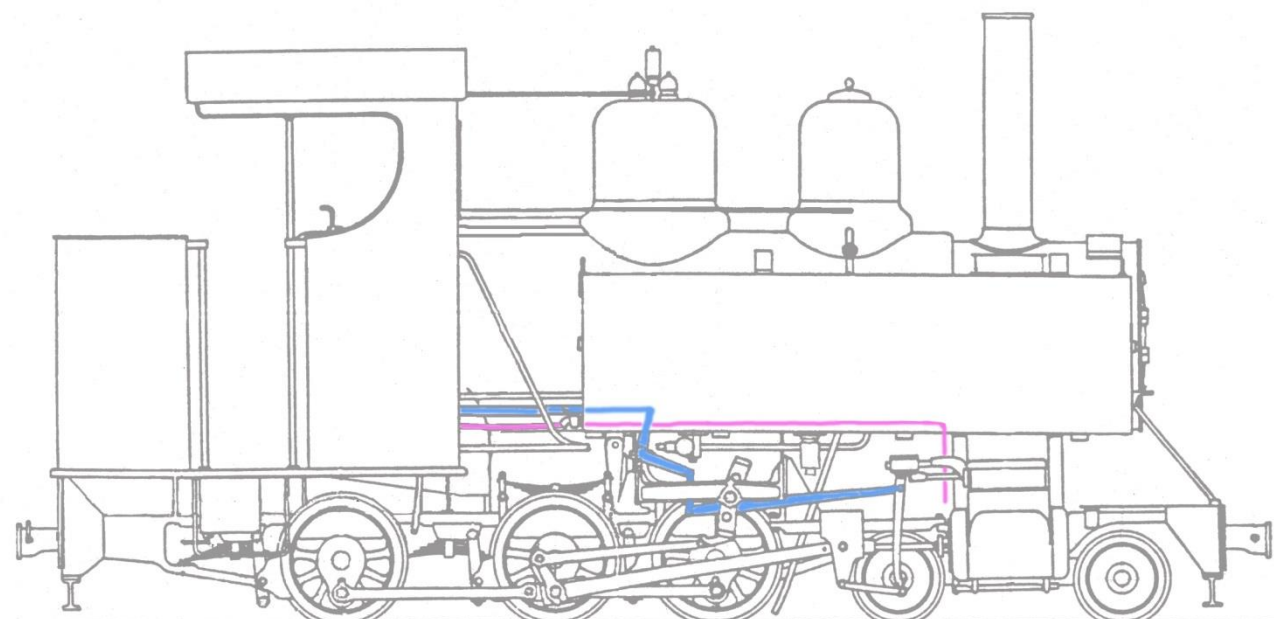
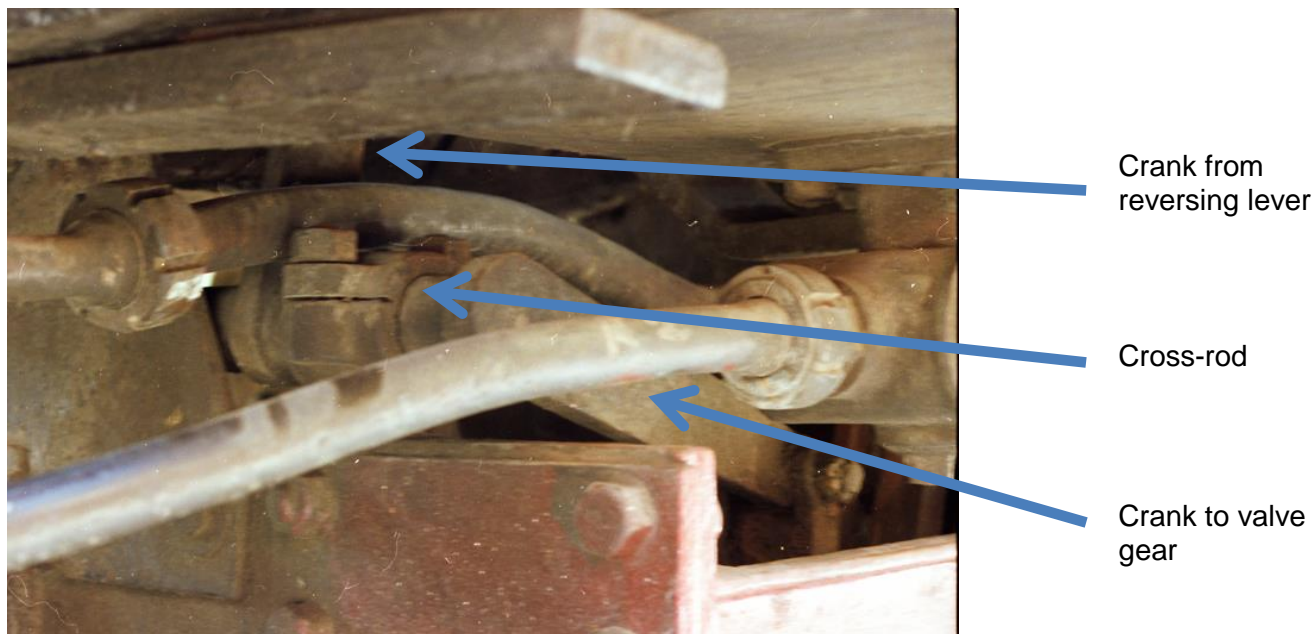


Boiler feed from injector

The discharge clack valve was fitted inside the boiler about half way along. It looks like the feed from the tank incorporated an isolation valve presumably to enable injector maintenance without having to empty the tanks.

### Reversing Lever:

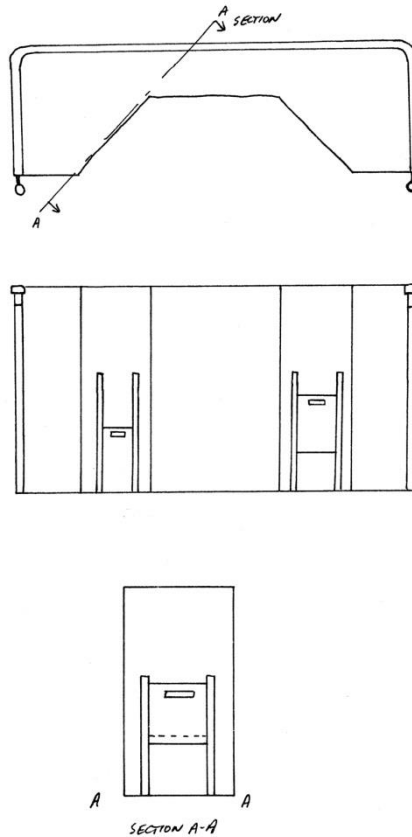
The reversing lever was on the right hand side of the firebox and operated on a ratchet. It looks like the far end of the ratchet bracket was bolted to the side of the firebox and the end nearest the driver was unsupported. The lever operated a link down the right hand side of the loco between the boiler and side tank to an angle crank which operated a cross-rod connecting to each side of the valve gear. Note that in the sketch below the position of the reversing lever in the cab is approximate. A more accurate position will be included in the cab details.



Reversing gear shown in blue, my guess at the steam brake supply shown in pink.

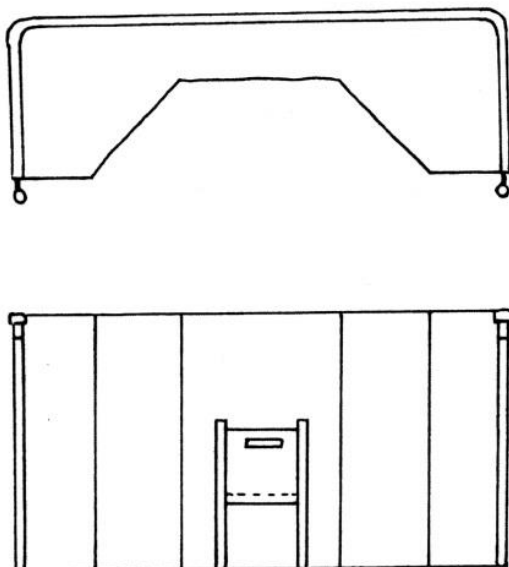
## Coal Bunker:

The general bunker detail is shown in the sketch below which I believe to be the most likely arrangement. I think this is what has been adopted for the Lion re-build (see photo from Tracks to the Trenches, September 2014 below).



This is also based on a photo of the GVT Baldwin on page 182 of John Milner's Rails to Glyn Ceiriog (part 2) book where the angle of the photo suggests a frame for the coal door on the angled side of the bunker.

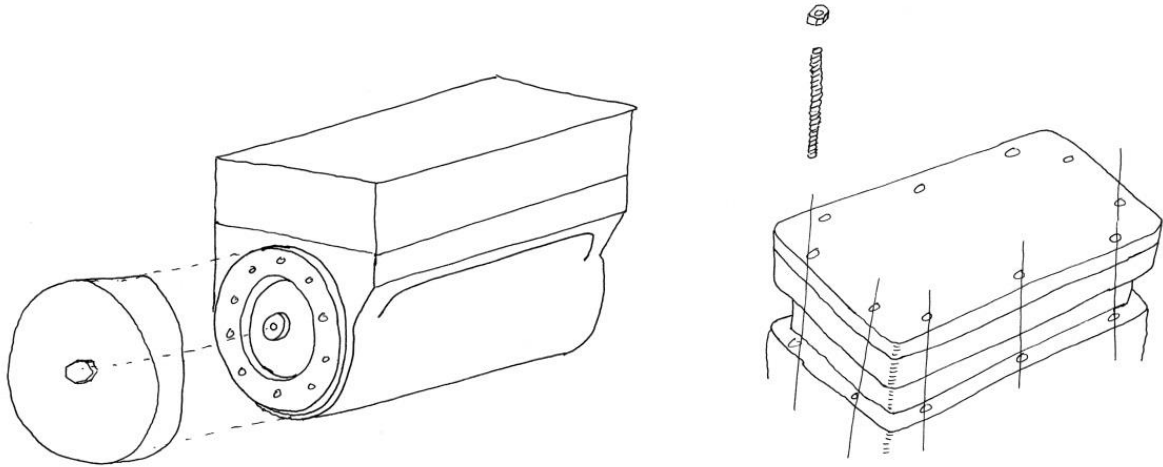
An alternative and much simpler arrangement is shown below. Both arrangements would have required the fireman to push coal around from the top of the bunker, but the double door arrangement shown above would have given the fireman more space to shovel!





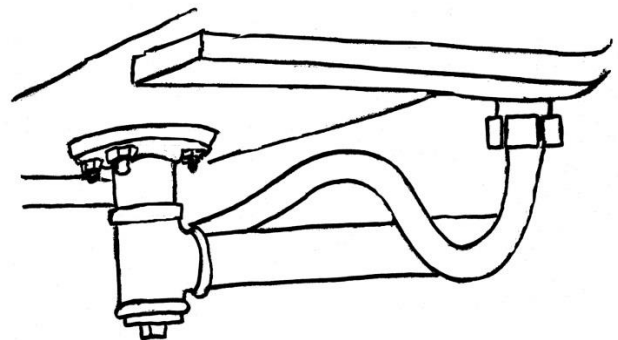
### Cylinder Bolts:

The Clayton drawing details the cylinders and slide valves in their 'neat' covered condition. Some of the British Baldwins ran at one time or another with the sheet steel covers to the cylinders or slide valves removed. Photographs have provided the relevant information which is detailed in the crude sketches below. Both the Roy Link and David Smith drawings include these details.



### Tank Equalisation:

The tank equalisation or balance pipe was mounted half-way along the tanks and consisted of a plain 90 degree bend from the right-hand tank and a 'T' piece fitting with a drain plug from the left-hand tank. This detail is shown below (taken from Lion which had been changed to have the drain on the right hand tank).



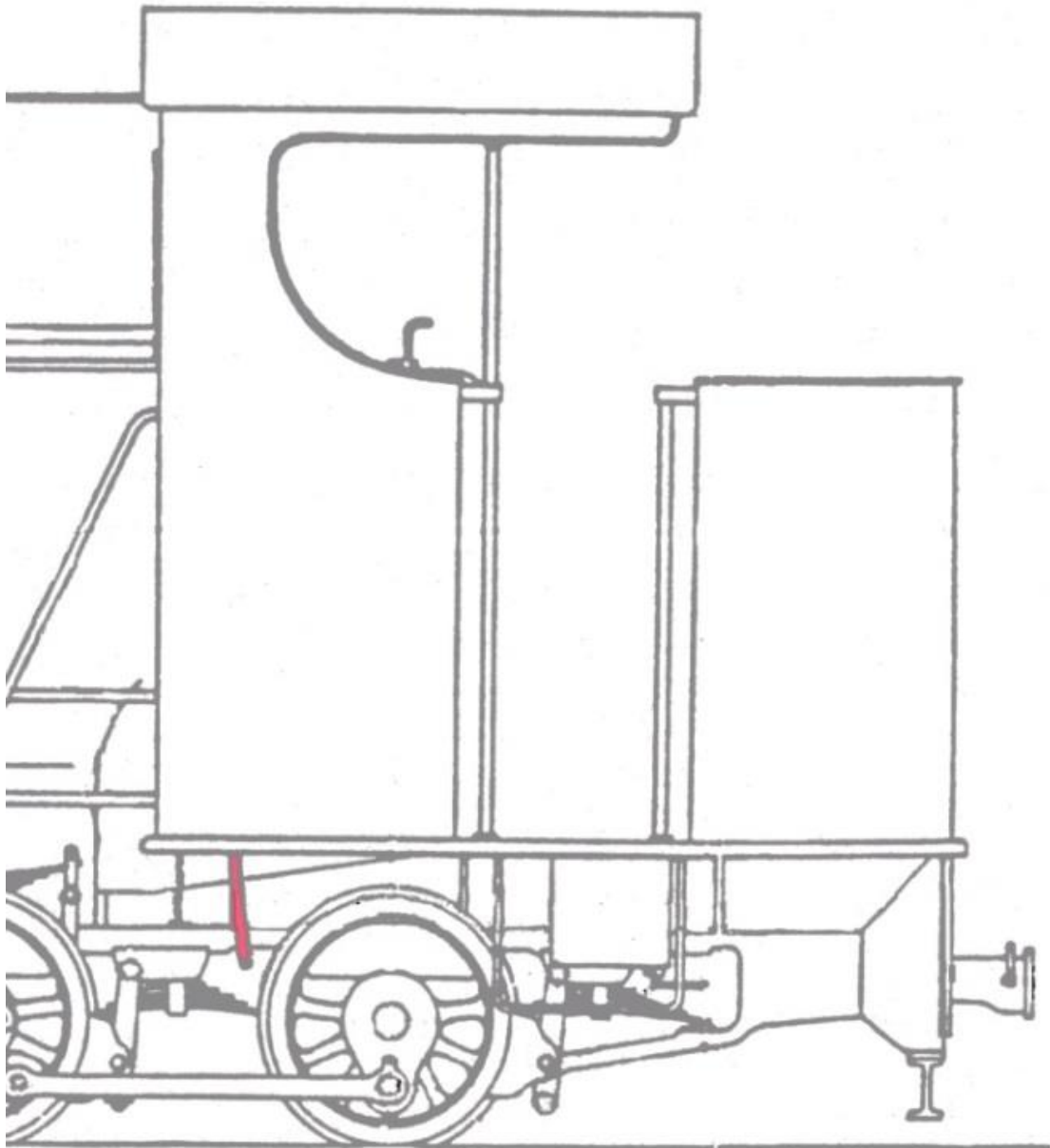
### Steam Supply Valves:

Both with and without water-lifter types had provision for supplying steam externally via a valve mounted on the steam dome. The position of this valve is specified to have been either front or back of the dome. Although for some of the early without water-lifter locomotives, photographs indicate that this valve was situated on the left-hand side of the steam dome.



### Injector Drain Pipes:

The injector drain pipes discharged under the cab floor and were situated towards the cab front. They are shown in the general locomotive diagrams of both Clayton and Link (shown in pink below). There appears to have been wide variation in their shape and length.



## References

1. The Ashover Light Railway Baldwins by D Clayton  
An Article in The Narrow Gauge No 80 (Summer 1978)  
Published by The Narrow Gauge Railway Society
2. Model Railway Constructor - February 1983  
Published by Ian Allan
3. The Snailbeach District Railways by E S Tonks  
Published by the Industrial Railway Society (1974)
4. Narrow Lines Extra No 5  
Drawings of the NWNGR and WHR  
Published by The 7mm NGA/WHR

## Other Primary Sources of Information (not in any particular order)

1. The Glyn Valley Tramway by W J Milner  
Published by OPC (1984)
2. The Ashover Light Railway by K P Plant (Locomotion Paper No 30)  
Published by Oakwood Press (1987)
3. Narrow Gauge Railways in South Caernarvonshire by J I C Boyd  
Volume 2: The Welsh Highland Railway  
Published by Oakwood Press (1989)
4. Narrow Gauge Railways - Wales & the Western Front by H Household  
Published by Alan Sutton (1988)
5. Narrow Gauge Railways in Mid-Wales by J I C Boyd  
Published by Oakwood Press (1970)
6. Narrow Gauge & Industrial Railway Modelling Review Issue Numbers 46, 56 & 76
7. The Ashover Light Railway by Robert Gratton & Stuart R Band  
Published by Wild Swan Publications(1989)
8. Bagnalls of Stafford by Allan C Baker & T D Allen Civil  
Published by The Phyllis Rampton Narrow Gauge Trust (2008)
9. Rails to Glyn Ceiriog (Part 2) by John Milner & Beryl Williams  
Published by Ceiriog Press (2013)
10. WDLR Album compiled by Roy C Link  
Published by RCL Publications (2014)
11. The Snailbeach District Railways by Andy Cuckson  
Published by Twelveheads Press (2017)
12. The 60cm Military Railways of the WW1 in France by Dr Christian Cénac  
Published by Dr Christian Cénac (2003)