A live steam A Class in Gauge 1

KEITH BUCKLITCH describes how he went about it...

Having constructed my fleet of Gauge I L&YR fish vans, I needed something to pull them, and what better than an Aspinall 'A' Class 0-6-0 locomotive? Over 400 were built at Horwich between 1889 and 1918. The original locomotives had round top fireboxes; later examples and many rebuilds were fitted with Belpaire fireboxes. Whilst Aspinall designed an 1800 gallon tender to accompany the engine, many were fitted with Barton Wright tenders. The Aspinall tenders were fitted with water scoops and could carry 3 tons of coal and my model uses this tender. A large number of the class continued into British Railways ownership including No.1300, built in 1896, and now in preservation.

The model had to be live steam, of course, and I had pondered for some time over the need for a form of twin inside cylinder engine and had drawn up a couple of designs, when Dick Moger announced the development of the ARMIG locomotive. Here was a complete power train system designed for twin inside cylinder locomotives. The initial ARMIG itself is a Wainwright, SECR 0-4-4 loco with an especially compact cylinder block allowing it to fit beneath the smokebox of a small tank engine. The basic premise of the ARMIG design was that a number of Gauge I suppliers would produce parts for the complete locomotive, including frames, wheels, superstructure, crank axles, connecting rods and especially the cylinder block, enabling prospective builders to make what they were capable of producing and purchasing other components.

Design

A couple of hours with TurboCAD produced a general arrangement drawing which showed that I could fit the ARMIG power unit in the outline of the A Class frames and smokebox. With only some minor adjustment to the lengths, the complete power train of rods and crank axle could be utilised, meaning that if I made a total 'b***s up' of them, I could at least purchase the components ready made. In the event, I compromised to save some time, in that I purchased a crank axle, but made my cylinder block and drive components. The ARMIG system uses square ended axles with suitable square broached holes in the wheels. These are available from Slaters, who supply plastic wheels with brass hubs and steel tyres, or from Walsall Model Industries, who will turn and broach cast-iron wheels from their range of castings. For the 'A' Class, I chose the G1903, 15 spoke, 48mm diameter with an 8mm crankpin throw from WMI. For the tender I used G1826 wheels.

Sometimes, when designing a locomotive model, one has to consider whether to compromise in order to make use of readily available material. The boiler is a case in point. Copper tube is available in a limited range of 'preferred' sizes nowadays. One can obtain special sizes at enormous cost, but when possible I make use of standard sizes. In this case 42mm outside diameter 20swg copper tube is almost exactly the correct diameter (beneath the cladding) for the boiler for a $^{1}/_{32}$nd scale Aspinall 'A' Class locomotive. (The alternative would have been to either cut a strip out of a larger diameter tube and butt joint it after squeezing to a smaller size or rolling the boiler from flat copper sheet.) *See Fig 1*

For the boiler design, I had to decide initially between gas firing (as per the ARMIG design) or spirit (meths) firing. Personally, I am a fan of meths firing, although in many ways a gas fired loco is easier to build and design (no worrying about blast pipe height and diameter, blower pipe, water and fuel plumbing etc), just fill the boiler, light the gas and away you go. Against that you may still have to provide a water feed system, even if it takes the form of a hand pump, but to my ears, the worst thing is that often one can not hear the locomotive working over the noise of the gas burner. With a spirit-fired boiler the balance of air/fire and steam has to be correct, but when set up properly the beat of the engine can be heard, and the harder the loco has to work, the louder the exhaust sound.

So, I chose to use spirit firing. Now, how to convert the heat of the fire to steam? I do not intend to go into detail of the boiler I used, but basically there are three designs of spirit-fired boilers today. One is the simple 'pot boiler' such as the 'Mamod' type we are all familiar with. These do not respond to increased work load requirements and are only suitable for pottering around. Modern locomotives use internal firing systems, and the choice comes down to whether one builds an internal firebox or an external firebox. Examples of boilers with internal fireboxes are the Gauge I 'Project' design, or the 'multi-tube' boilers built by Paul Forsyth. Option three is to use an external firebox, but combined with a tubed system. These were designed by John Van Riemsdijk and are commonly known as the 'C-type' boiler, and that is what I chose for the 'A' Class. *See Fig 2*

By using five, $^{5}/_{16}$ inch diameter fire tubes and a small grate area, I was able to design (with help from Barry Applegate) a boiler with a heating area of over 20 sq.in.

So, the basic outline of the model was decided, now for construction. For many of my locomotives, I like to publish the drawings for other builders to follow and have produced several laser cut parts for chassis components over the years. Often though, I have machined the 'prototype' model by hand (or CNC), resolving errors and difficulties before producing the final laser cut parts. This time, I thought I would make use of laser cutting from the start, hopefully identifying any errors and resolving any potential problems at the design stage. We shall see how efficient I was at avoiding problems as we go along. Suffice it to say that by using 3D CAD, I was able to avoid some potential pitfalls early in the process. For example, I had wanted to fit sprung axle boxes to the loco. When I assembled the 3D crank axle into the 3D chassis assembly, it became obvious that the cranks fouled the axle boxes. The only way to have obtained sufficient space would have been to thin-down the cranks, but as the intention was that potential builders could make use of the ARMIG components, it was felt this was undesirable, hence the decision was made to run with an unsprung chassis. As I still wanted to be able to drop the

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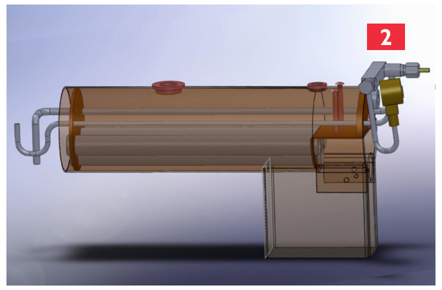

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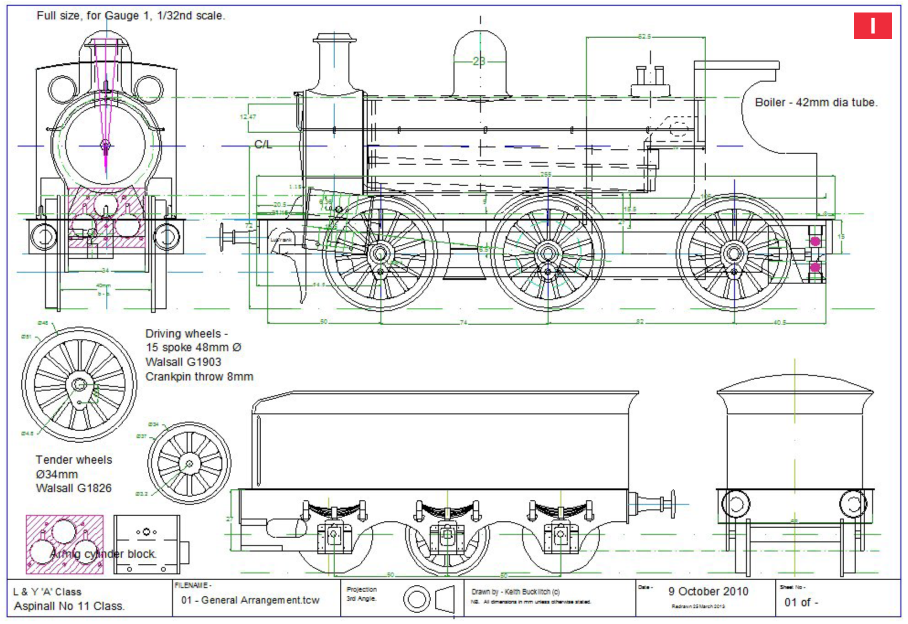

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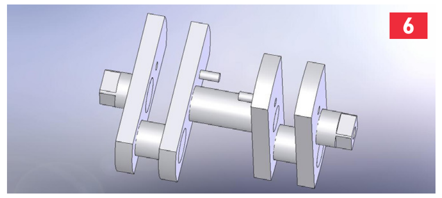

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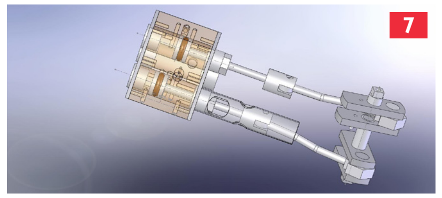

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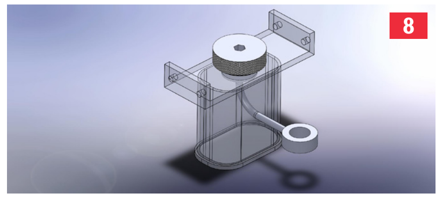

wheelsets out of the chassis, I decided to use small keeper plates to secure the axle bushes in place in the frames, which could be removed if required by loosening the retaining screws.

Once I had created the general arrangement drawing, using the layers facility of the CAD software, it was a fairly simple matter to extract the layer containing the frame components and copy and paste them to a new dedicated drawing. The 2-dimensional frame components were extruded to the 3D shape, together with the buffer and drag beams and the saddle stretcher plate. These were then joined together in 3D to create the basic chassis assembly. *See Fig 3*

Initially, I had thought that the components would be bolted or riveted together using angle brackets at the corner joints. However, a chat with Malcolm High of Model Engineers Laser indicated an alternative method of assembly using mortise and tenon joints. The frames were thus modified so they interlock together. *See Fig 4*

Once satisfied that everything was square, the joints were soldered with 'tinman's' solder. I used this in preference to silver-solder so that in the event of a major problem, the joints could be un-soldered relatively easily. I was pleasantly surprised how fast the chassis could be assembled by this method. The previously made cylinder block was pushed in place and lined up exactly with the prepared holes in the frames. The system was almost self-aligning and was found to be perfectly square by default once the block was screwed in position.

The cylinder block is machined according to the dimensions and instructions in the ARMIG book so I do not intend to repeat them here. Ideally one should use bronze or gunmetal for the cylinder block, but brass is more easily obtainable and will see out my lifetime. Machine the block to the outside dimensions then mark out carefully for all the holes that have to be drilled or machined. For machining the cylinder bores and steam chest, I prefer to use the milling machine with suitable cutters. It is much easier to obtain accurate placements of the bores by using the milling table controls, and if you have access to CNC, then the whole job can be done automatically. However, if machining a stand-alone cylinder block, then I most commonly mount it in a four-jaw chuck on the lathe, but for the ARMIG block, where there are three bores required the milling machine enables accuracy much more easily. *See Fig 5*

If using bronze for the cylinders, then brass is suitable for the pistons and slide valves, but if using brass, then substitute bronze for pistons etc. The aim is to have dissimilar metals for the sliding faces when possible.

Partly to save time and effort, I purchased a crank axle from 'Just the Ticket' *(See Fig 6)*, a set of ready turned driving wheels broached for square ended axles from Walsall Model Industries (WMI) and the castings for the tender wheels also from WMI. These latter I turned up myself on the lathe. I always find Walsall wheels beautiful to turn, with the iron coming off in a fine powder. When turning wheels, I start by gripping them in the 3-jaw chuck with the back facing the tailstock. Face off the back, centre drill and drill a $^{3}/_{16}$ inch diameter hole completely through the casting. Repeat with all the wheels. The wheels are then mounted on a mandrel so they can be removed easily and all the stages of turning are repeated on each wheel in turn ensuring that all dimensions are equal as appropriate. Using a mandrel also overcomes any errors of concentricity in the lathe chuck.

Assembly proceeded with making the piston and valve connecting rods and assembling the power train with the crank axle in position in the chassis. *See Fig 7*

Lubrication

Steam locomotives require a small, but constant supply of steam oil to the cylinders if they are going to run smoothly and for long periods with minimum wear. In the larger scales – 3½ inch, 5 inch gauge etc, the oil is usually pumped into the cylinders mechanically. Small scale locomotives mostly rely on the oil being picked up by a flow of steam as the loco is running using the condensation principle whereby steam condenses in the oil tank and displaces oil into the steam flow. Commonly, this happens where the steam pipe passes through the oil tank and a very small hole communicates with the inside of the oil reservoir. Some models feed steam under pressure to the tank to initially boost the oil supply. An alternative system, (which I often use) is known as a 'dead-leg lubricator'. Here, the oil tank is connected to the cylinders via a narrow pipe (as small as $^{1}/_{16}$ inch O.D.). Steam flows into the tank, condenses and oil is displaced back along the pipe to the cylinders. Don't ask me how steam can flow in one direction and oil in the other along the same pipe, but I can assure you the system works.

The lubricator tank was mounted between the frames, below the front

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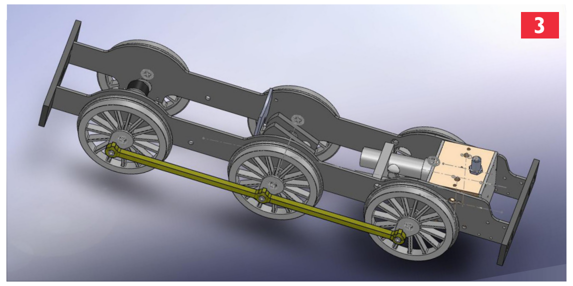

Examples of Keith's CAD drawings for the A Class locomotive

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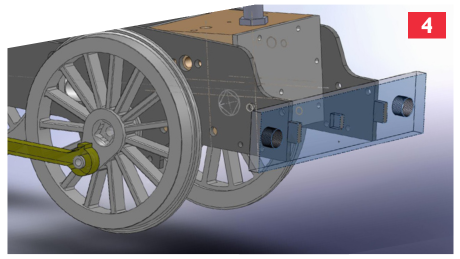

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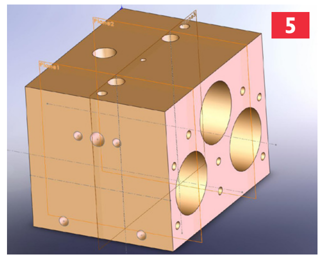

footplate and behind the buffer beam. With the air flow round it when running, hopefully this is the coolest position to enhance condensation of the steam. ***See Fig 8 (previous page)***

Once everything was connected up, the valve timing was set, a generous coating of oil was applied on all moving surfaces, and a compressed air supply fed to the cylinders. Opening the valves produced rotation of the crank axle, indicating that things were working as required. The other axles were positioned, the wheels affixed and the coupling rods fitted in place. One advantage of laser cutting is that items made to the same dimensions should fit together exactly, and it was found that all the axles rotated with no indication of binding anywhere once the rods were in place. Again the compressed air supply was turned on and the chassis left to run for a couple of hours, to allow it to 'run-in'.

Boiler fittings

These are few in number – consisting of the steam manifold, two steam valves for regulator and blower, a 'clack' valve, and a safety valve. The steam pipes pass through the boiler from backhead to smokebox acting as hollow stays. A bush on the backhead supplies the steam manifold into which the steam valves are inserted. ***See Fig 9*** The steam valves I use are scaled down versions of the 'captive spindle' type of valve used in my 5 inch gauge locomotives. It is impossible to unscrew the valve completely thereby preventing scalding steam being released into the cab of the locomotive. ***See Figs 10 & 11***

Axle pump

With such a small volume boiler, a constant feed of water is necessary. I looked at a number of designs, eventually settling on the pump used in the GIMRA 'DEE' design. Drawing this in CAD and fitting it on the General Arrangement drawing showed it would fit the available space. The pump sits beneath the cab floor, attached to the rear drag beam and one side. The pump is driven by an eccentric on the rear axle and a 'Scotch Crank'. The axle pump incorporates a 'by-pass' valve, which, when open allows excess water to return to the tender. The handle for the valve extends through the cab floor and is easily flicked open or closed as the loco passes by.

To be concluded in Magazine 261

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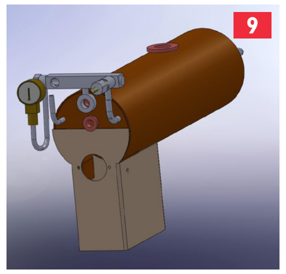

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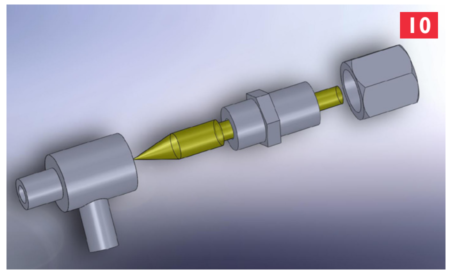

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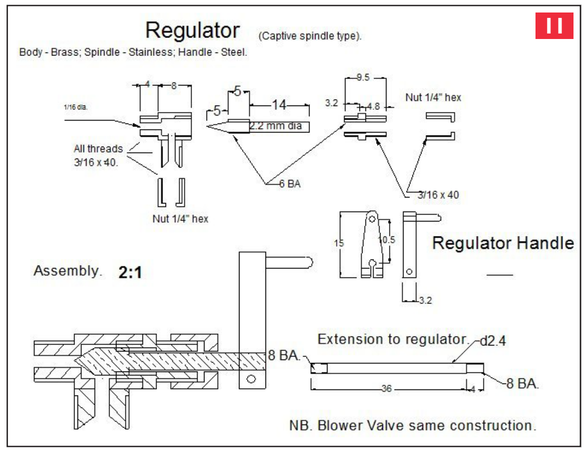
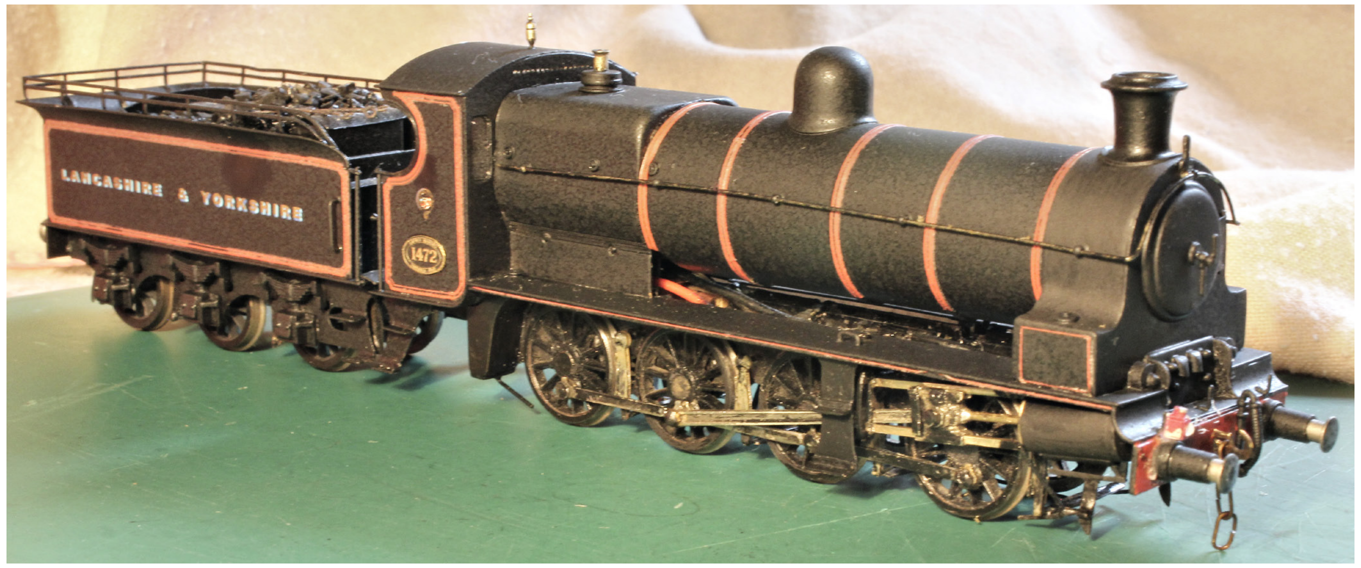


Hughes Compound 0-8-0

DAVE KIRBY describes how he built this 4mm scale, 00 gauge model of an unusual prototype...



At a Society meeting at Barry Lane's house many years ago I acquired an incomplete test etch for an 0-8-0. There was no chassis, just some superstructure parts; whoever brought it put it up for auction and I tendered the winning bid of £10. For many years it gathered dust on a shelf in my work room until I decided to do something with it in the mid-1990s and, after much thought, I opted to try and scratch build an L&YR compound.

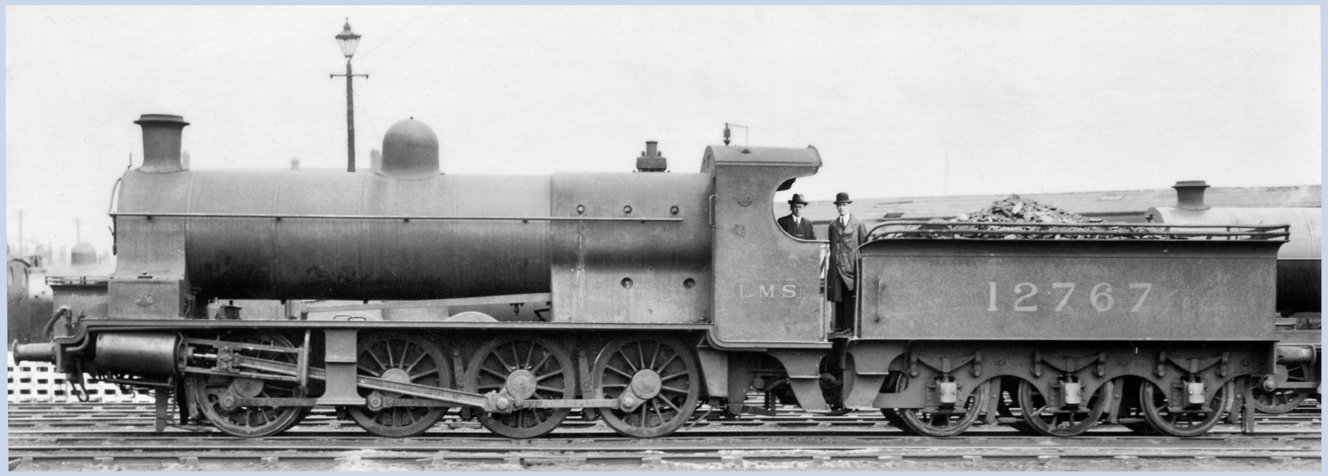
From an old drawing I marked out the basic shape and depth of the chassis together with the holes for the brake gear and the axles. The boiler is brass tube of the relevant size and the smokebox and sand boxes are formed from one piece of 0.005 brass sheet. For some reason work on the loco stopped at this stage and I turned my attention to the tender which I completed. Then work stopped altogether.

Construction recommenced in late January 2014. I had obtained the number plates for No.1472 from Barry many years before. This was one of the ten new builds of 1907, unlike the original conversions, on which all cylinders drove the second axle, these new engines drove the third axle from the outside high pressure cylinders and the low pressure ones drove the second axle. I referred to Barry's book on L&YR locomotives for various measurements and a picture of 1477 on page 114.

I started work on the outside motion parts but before I had proceeded very far I decided to try and find some more pictures of the class and, as luck would have it, I found a photo in Noel Coates and Martin Waters *L&Y Album* of the exact loco I had number plates for. The cylinders were turned down from brass bar to a diameter of 7mm and a small length of 2mm square brass bar soldered on the back which in turn was fixed to the front of the chassis at the correct angle. Slide bars are brass bar of 1mm square, motion support brackets were made from code 75 rail as were the connecting rods. The chimney, dome and safety valves were obtained from John Redrup of London Road Models, while the wheels are from the Mike Sharman range. The power house is a Mashima 1620 motor driving via a Branchlines Multibox 67:1gearbox.

Although our layout *Calderwood* is built to 00 standards I have spaced the frames to EM dimensions; it sounds an odd coupling but it works very well. Pickups are of the wiper type with some in contact on the top of the tyre and some touching the back. The loco is painted with matt black car spray, lined and matt varnished. The side steps have to be put on after the chassis is in place because the motion bracket will not pass behind them. All in all I think it makes an interesting model of a prototype which I have not seen on the exhibition circuit in 4mm scale up to now.

Above left: **Close up of the rear of the tender showing the water filler, coal rails and works plate.**
Above right: **Close up of the front of the loco showing the ends of the pistons and valves.**
Opposite and below: **Side view of the completed locomotive.**



Hughes 0-8-0 4 cylinder compound LMS No.12767.(L&YR No.1477). LYRS Collection

The first decade of the 20th century saw various attempts to further improve the successful Aspinall 0-8-0s. The introduction of the 8-wheeled tender increased their range between water stops and the aftermath of the Knottingley boiler explosion resulted in the corrugated firebox engines and an increase in firebox water space on new Belpaire fitted boilers. Then in February 1906 No.1452 was rebuilt as a four cylinder compound with all cylinders driving the second axle. This was followed in 1907 by ten newly built engines, Nos.1471-1480, which had a split drive with the outside (high pressure) cylinders driving the third axle. They also differed visually from No.1452 in having raised footplates (to improve access) which swept down under the cab and at the front to buffer beam level. Eric Mason tells us they were successful in service but future batches of 0-8-0s had the larger boiler. An order for 10 large boiler compounds was made but cancelled before work started.