

West Wiltshire Society of Model Engineers Newsletter

Issue No. 8

August/September 2019

Calendar

August

3rd - Saturday Steam Up. 10am-4pm

4th - Open Day at WWSME club. 1pm-4pm

4th - Portable 5" Track at Wessex Country Fair.
11am-4pm

10th - Portable 5" Track at Seend Fete. 11am-
4pm

17th - Saturday Steam Up. 10am-4pm

24th - Portable 5" Track at White Horse Music
Festival. 11am-4pm

26th - Portable 5" Track at Corsley Show.
11am-4pm

September

7th - Saturday Steam Up. 10am-4pm

14th - Wiltshire Model Steam Gala. 10am-
4:30pm

21st - Saturday Steam Up. 10am-4pm

October

5th - Saturday Steam Up. 10am-4pm

19th - Saturday Steam Up. 10am-4pm



News

Des Clarke

On 24th of July we said goodbye to our chairman and friend Des Clarke. A member of the WWSME since 1967 Des has given so much over so many years to make our club what it is today. Pictured is the Simplex locomotive which Des built when the design was first published in the Model Engineer and was the first 5" locomotive at the club along with the clockwork Hornby gauge O engine given to Des when he was eight by his father who swapped it for vegetables grown at the station allotment.



Open Day, Fetes and Events

Through August we have a busy calendar of an open day at the club plus events and Fetes being visited by the 5" portable track.

If you are able to volunteer for any of these events please add your name to the lists in the clubhouse.

September Show

The Wiltshire Model Steam Gala is fast approaching on 14th September. Please can volunteers for stewards add their names to the list in the clubhouse and if you are able to donate cakes and loan garden chairs for the day please contact Michelle Richardson.



Roller Rebuild (Part 5)

By Dan Jones

'Rebuilding an Aveling and Porter Steam Roller No. 11296 of 1925'

As I finished cleaning the internal plate work with the needle gun, I could see the throatplate had been welded up on each side over the tight radius that makes up the flange between the boiler barrel and the throatplate (**fig 1.**).



Figure 1 - View showing one of the welds on the throatplate radius shortly after removing the firebox

The reason for this welding is because the radius of the flange, which you can see goes in several directions, has fatigued over time and cracked. Bear in mind that ultimately this flange supports the entire front end of the engine. It's very common for Avelings with the belpaire boiler (flat-topped crown sheets) to crack along these corners. It all comes down to the manufacturing process- these plates would have been pressed over a former from flat sheet steel in one go, but as the red hot metal cools down and contracts, a lot of the stresses get caught in these corners which are being stretched in every direction, hence why they fatigue and crack. I could see when I stripped the engine down that there were some patches of weld on the outside of the throatplate, but I was working on the inside and could see weld- how did that get in there? If you look back to the article where I removed the firebox, I noted that the tube nest had been cut out

at some point and welded back in- well the reason for that was so the repairer could get access to the cracks and weld them up. It was far cheaper for the owner/contractor to do this and keep the engine working than it was to scrap it and buy a new roller to work the job.

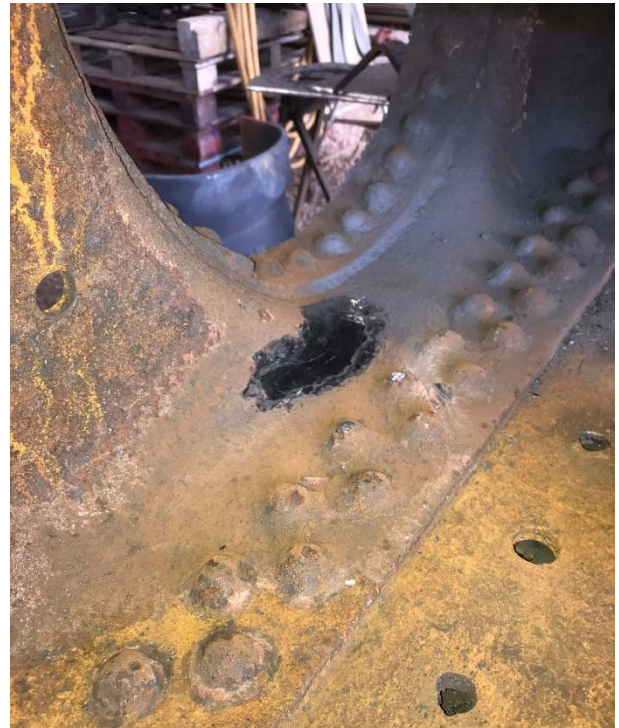


Figure 2 - Grinding away the weld and grooving out/chasing the cracks

These working-day repairs aren't suitable by modern standards and certainly wouldn't pass a boiler inspection, so I had to remove the weld internally and externally then groove out and chase the crack until it stopped and met fresh metal again (**fig 2.**). I ended up almost grinding through the thickness of the plate to remove all of the crack, then filled the groove with a good weld (**fig 3. and 4.**).



Figure 3 - Welding up the crack internally

The work of course had to be checked by the boiler inspector who carried out an NDT (Non-Destructive Test). Basically he sprayed a penetrant dye over the welds and checked there was no evidence of the cracks showing.



Figure 4 - Welding up the crack externally

Now that the throatplate had been repaired, I could carry on with drilling out the welded stay holes and grinding the welds flat again. Just as I had finished the firebox stay holes, I was told that the inspector had a quick look at the cross stays and decided that they should also be replaced. Because the Aveling has a belpaire style boiler it has a series of cross stays which travel above the top of the firebox and screw into each hornplate to hold the sides together. I didn't really want to replace the cross stays because I would need to make a 2ft long tap to cut the new threads in the plate and would have to screw cut the new stays on the lathe which is a very long and tedious job, but that's what I'd been told to do by the inspector so I didn't have much of a say on the matter.



Figure 5 - Cutting out the cross stays with the cutting torch

There's no point in avoiding it, so I set about cutting out the old stays with the cutting torch from inside the boiler (**fig 5.**). There are 2 rows of 5 stays, the bottom row having had the same treatment as the firebox stays where they had been removed, had 1" bar pushed through and then seal-welded. The top row of cross stays were original screwed-type stays with a 1" BSW thread.



Figure 6 - Crown stays removed

Once I had cut out the cross stays I could also cut out the crown stays (**fig 6.**). In a way it's good that I had to remove the cross stays because with the cross stays still in place I couldn't drill out the crown stays from the inside but would have to drill them from the outside. Much the same as the firebox stays, the crown stays had been welded and left no evidence as to where the centre point of the stay would be. I had initially measured the centres of the crown stays from the inside and translated it on the outside and centre punched the centres. It's a good job I never drilled to those marks because I found they were a long way out once I had pilot drilled from the inside (**fig 7.**).



Figure 7 - External view of the crown sheet showing the measured stay centre and the piloted centre

Before I could actually start drilling the crown stays on the inside, I had to remove the two longitudinal stays. This meant unscrewing the two lock nuts on the backhead, heating the protruding stud until red, then leaving to cool before leaning on the other end with a big set of stilsons. When I say a big set of stilsons, I mean they were about 5ft long. And when I say I had to lean on them to get the stay to unscrew, I mean I had to bounce my entire body weight for them to even think about shifting! After about an hour I managed to get them out- I saved the two lock nuts and restored the threads in the backhead by running a tap through (about 1" BSP I think) but the two stays were destined for the scrap bin.



Figure 8 - Crown stays centre punched from inside the boiler

With the longitudinal stays removed, I could then grind down the stubs of the crown stays flush to the plate then centre punch and pilot drill with the mag drill. This sounds like a 5 minute job but it wasn't quite as simple as that. The boiler was resting on its side so I could climb in through the hole left by the firebox and lie on the inside of the hornplate. While lying down I had to accurately swing the hammer and centre punch the stays (**fig 8.**). Then the fun bit, holding the mag drill up against the plate in the right place while trying to activate the electromagnetic base, and of course actually drilling the hole. At least I only had to do the pilot drilling from the inside as I could put the tapping drill through from the outside with the boiler stood upright (much less heavy lifting in a confined space!) (**fig 9.**).



Figure 9 - Crown stays all pilot drilled from inside the boiler

Since virtually all of the stay holes in the outer wrapper had been restored and the cracks in the throatplate had been repaired, I moved on to restoring the foundation ring. For those unfamiliar with loco-type boiler construction, the foundation ring is a big forged ring which sits around the bottom of the firebox and fits in between the firebox and the outer wrapper. It acts as a sort of spacing ring to keep an even water jacket around the firebox but most importantly it keeps the water inside the boiler!



Figure 10 - Drilling out the old rivets from the foundation ring

While the foundation ring had suffered some pitting during its lifetime, it was still in good enough condition to be reused. The first job was to drill out the old rivets and remove the bits of old firebox that were still attached. Thankfully there's a big radial drill at the yard, so I set up a mounting block on the bed of the drill and strapped the foundation ring to the side of it. There's not many occasions in heavy engineering where a pilot drill is used and this was certainly no

excuse- straight through with the clearing drill and plenty of oil then opened up into fresh metal with a reamer (**fig 10.**).



Figure 11 - 3-piece firebox assembly, drilling the rivet holes using the radial drill

The next key stage of the rebuild- the firebox. The firebox in this engine is made up of 3 pieces: two flanged end plates (the rear plate with the fire hole and the front plate with the tube nest) and a one piece crown sheet and walls. When the kit of parts arrived back from the pressing company, I got on and loosely assembled the firebox in the foundation ring- this sets the distance between the two end plates and between the firebox walls. Once assembled, I could copy the rivet spacing from the old firebox and translate it directly onto the new plates using some careful measuring. I marked the hole centres and gave each one a deep centre punch. With all the holes marked out, I could start drilling the rivet holes (**fig 11.**). I drilled then bolted every other hole to make sure the plates didn't move as I worked along the seam. You will notice that the rivet holes on the top of the firebox crown are countersunk (**fig 12.**).



Figure 12 - The drilled and bolted firebox assembly, note the countersunk holes on the crown sheet

These rivets will be made with flat heads rather than the typical domed head as there is a lot of water turbulence across the top of the firebox when hot, which causes increased levels of corrosion around the stays and the rivet heads. So if I put flat heads in, there is less visible material which would otherwise be susceptible to corrosion but still retains the same level of strength.

Once all the holes had been drilled and bolted, I had to ream the holes out to the clearance size for the rivets then deburr all of the holes with a countersink tool in a handheld air drill (industrial size of course!). Now that all the rivet prep had been done, including trimming all the rivets to length, I could start to think about firing them in.

The sequence for hot riveting starts with heating the rivets until they are a bright orange, almost on the verge of burning away. A good tell to know when the rivets are hot enough is when you can see the rivet starting to sparkle. When the rivet is hot enough, they are carried using a pair of tongs by the head and run over to the workpiece and inserted into the hole from the inside (manufactured head on the inside with the shank pointing outwards). We use a piece of equipment called a jam-back to hold the rivet securely in the hole; the jam-back is basically a pneumatic ram which pushes between the rivet and the opposing plate work, keeping the rivet tightly in the hole. Once the call has been given to say that the jam-back has been fitted, a pneumatic rivet gun is used to form the head on the outside. It's key to use all of your weight to really force the gun onto the rivet and stop the gun from bouncing off. It's also important to keep the gun in line with the shank of the rivet in order to form perfect domed heads. In either case, if you don't keep the pressure on the gun or keep the gun straight, you end up splatting the shank of the rivet out the side of the snap and forming a bit of a tumour on the side of the rivet head. Another important note when hot riveting is to minimise the time between removing the rivet from the heat and forming head by as much as possible to prevent the rivet from cooling down too much. If the rivet cools down too much before forming the head, it'll be physically more difficult to form the head which in turn can

damage the snaps (fatigue) and there won't be the same amount of contraction in the rivet as it cools to pull the plates together.



Figure 13 - The riveted firebox assembly

In total the firebox is held together with 60 rivets, all of which took only an hour to have riveted together (**fig 13.**). It takes about 10 to 15 seconds to take the rivet from the heat and have the head formed. I do have a short clip showing the set-up which can be viewed on request to anybody interested.



Figure 14 - The caulked joint, achieved with a chisel and a small pneumatic gun

The final stage but possibly the most important stage of the firebox build was to caulk the seams to make them water/steam tight. Caulking in the steam world is using a chisel to force metal into the gap between two plates. The chisels fit into a small pneumatic hammer/gun (basically a small rivet gun) and you simply run the chisel up and down the seam continuously until you get no more gaps in the seam (**fig 14.**). By spending plenty of time and taking plenty of care with the job at this

stage, you help yourself in the long run by making sure the boiler doesn't leak once assembled and hot.

...making stays, stay taps and firebox fitting to come in **Part 6!**

