

Building a 5" Gauge Anne of Holland Steam Locomotive - Started November 2022

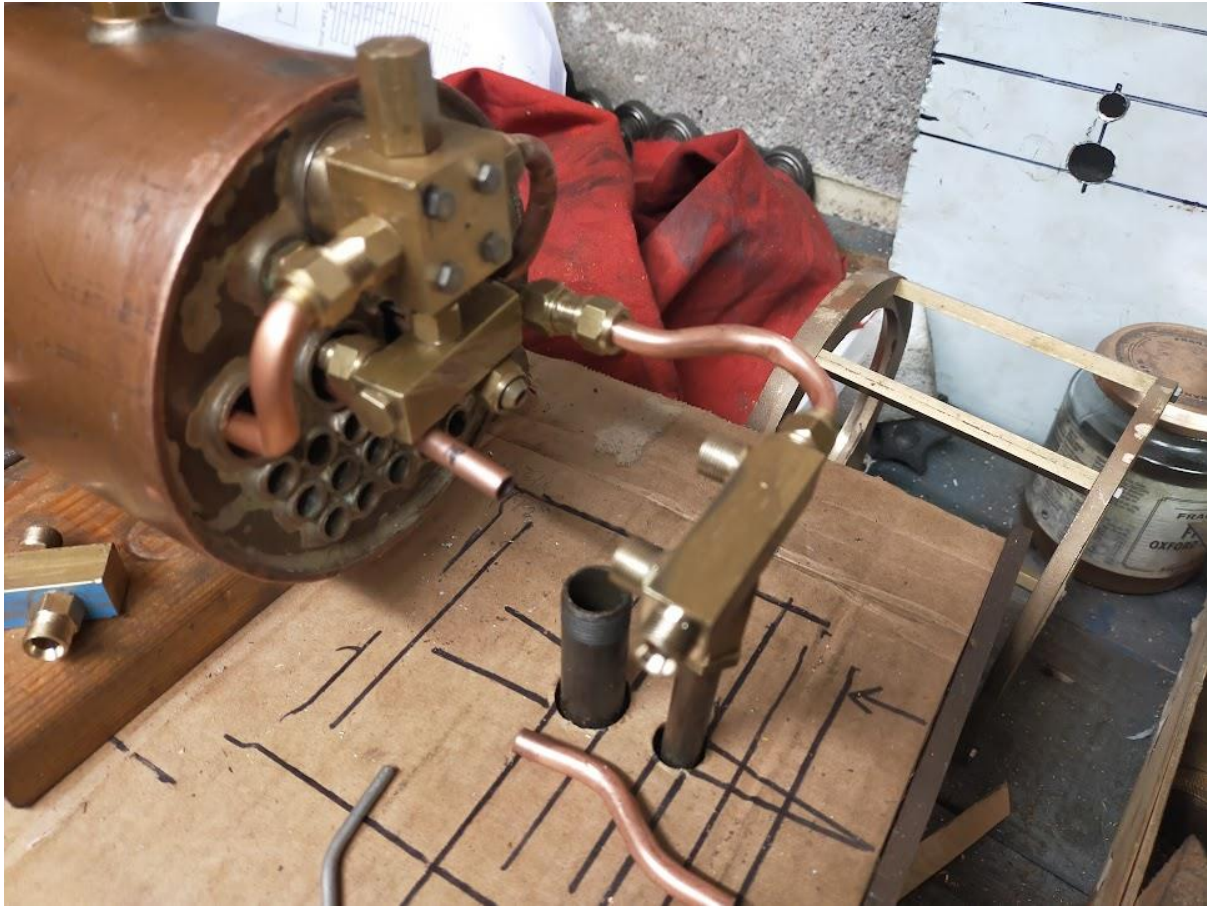
Monday 30th January 2023

I have made good progress on securing the fire box end of the boiler. Steel plates have been fabricated and bolted into position to provide a sliding support base. The foundation ring of the boiler has been drilled and tapped to take 4BA studs. These seem a bit flimsy but they are what is specified in the Butch drawings and in truth the weight of the boiler, especially when full of water and a fire, will do most of the work. The nuts are only loosely clamped as the boiler has to slide to allow for expansion. I was very cautious about drilling the holes as I do not know how thick the foundation ring is, possibly too cautious so I am thinking of soldering the studs in place. Need to check whether it can be silver solder or ordinary lead solder; I don't want to risk damaging the boiler. I used my mill for the first time in anger to cut the slots in the mounting plates – all went well. Yet to figure out how to make and fit the grate and ash pan.



Saturday 28th January 2023

There is some glimmer of light at the end of the tunnel. I have remade the connection on the top of the steam input pipe as can be seen in the picture and succeeded in bending the first of the superheater outlet pipes. Connecting the second is proving more challenging as there is still not really enough room. The last two should be easier because I do not yet have nipples soldered on and will have an opportunity to connect these a different way avoiding the union nut joints.



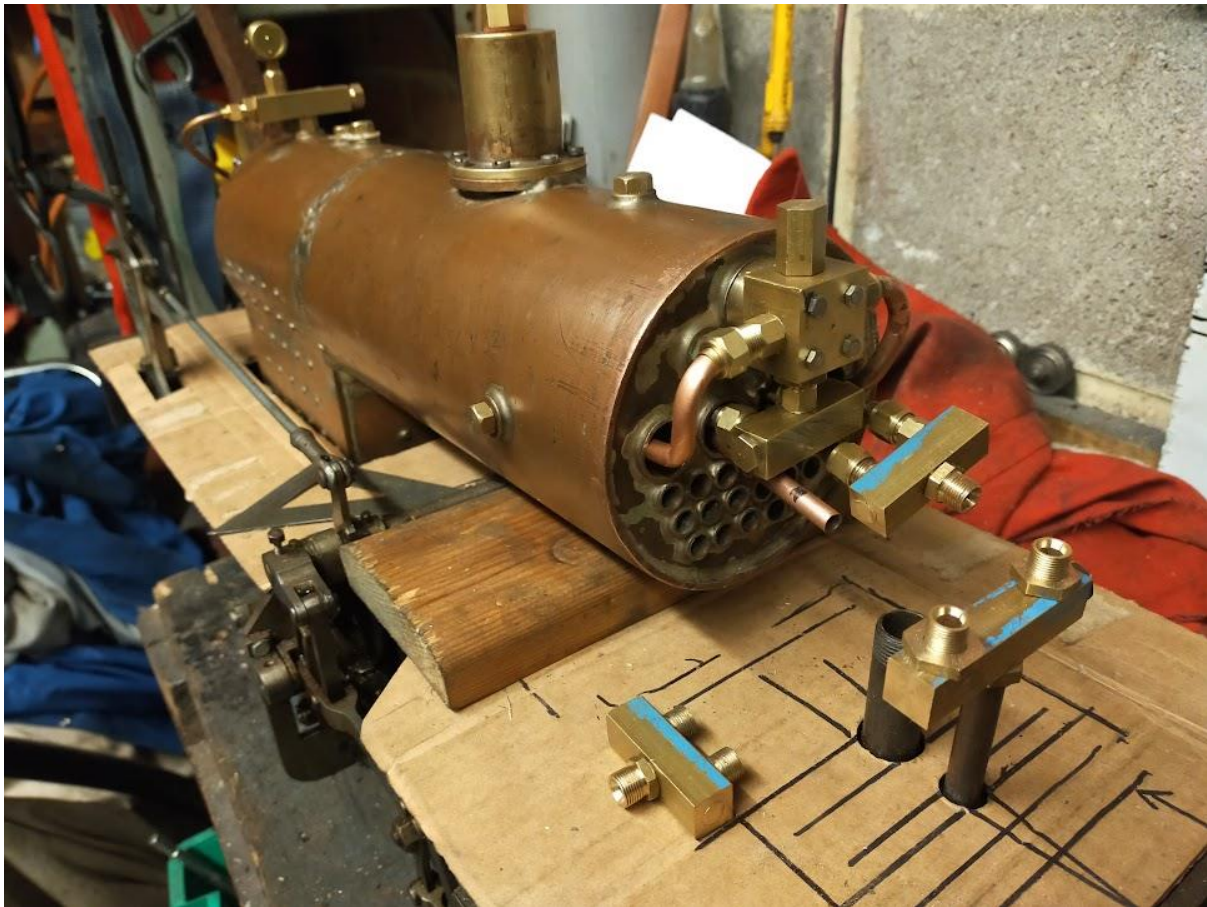
Before making any more of the connections I need to change tack slightly and fix the firebox end of the boiler in position on the frames so that is the next task. Otherwise things will not line up. I am also close to a solution on the smoke box as well.

Friday 27th January 2023

A somewhat disappointing week. The good news is that most of the bits I ordered from Blackgates arrived on Tuesday and this enable me to remake the pipe from the regulator to the wet header in 3/8" copper pipe. While I was at it I cut the square on the firebox end of the regulator shaft and made a new arm. The whole regulator assembly is now fully installed and working. I will need to dismantle it at some point to fit gaskets and seals but at least I know it all fits works.

Things started to go downhill when I moved to the smokebox end and started work on the superheater pipework. The thing I had been dreading was silver soldering the 1/4" tubing into the spears but that actually went surprising well and three of them are now made up. I ran out of 1/4" pipe before I could finish the fourth but that may went be a good thing. The picture shows how far I got with a trial assembly before I realised I had a two problems. First issue is that Siamesing the superheater output pipes is not going to work as I do not have the skill to make the complex pipe bends needed for the final connections. Worse still I realised that my design had a major flaw regarding fitting the smokebox . I now realise I cannot slide this into place after the steam connections to the cylinder input pipe are made . This means the final connections have to be made though the smoke box door aperture which would be virtually impossible with my original design. I

decided the best thing was to put the AOH Project aside for a few days and work on something else until a solution emerges.



Well playing around with various ideas this afternoon I think I can see a way to address the complex pipe bending issue. Tomorrow I will try out my idea as it might also make it feasible to do the final connections through smoke box door. Fingers crossed!

Saturday 21st January 2023

Not sure if I am any further forward but I have been quite busy today and I think there is some light at the end of the tunnel. The picture probably summarises most of what I have been doing.



You can see that I have built a framework for the smokebox and I have a drawing of the wrapper that will be needed. This will fit over the top of the pipework and then slide into position on the boiler. You can also see that I have cut a 3/8" 32tps thread on the top of the inlet pipe ready to mount the connector from the superheater pipes. Also shown are the footboards (or whatever the technical term is). These are made in cardboard for now to get the dimension and layout sorted. I now have drawings for these (it has to be in two parts) from which I hope to get the plates cut in 2mm steel plate. What you might also note is that I have cut the superheater collector manifold in half. It will be much easier to fabricate and connect the pipework as two pairs than one four-way – I think. What I am not sure about is whether I need a separate floor to the smokebox or if I can fix it direct to the footboard plate. Right now Until that is sorted I cannot finalise the fixings or how to seal the smokebox.

I also believe I have identified a way to mount the boiler at the rear. More about this later.

Friday 20th January 2023

Not a lot of physical progress over the last three days as I am still waiting for the bits from Blackgates, particularly the 1/4" copper pipe and the silver solder flux. I have drilled out the two spears but that is about it. However, it gave me time to study the plans for both AoH and Butch and in the area of the smoke box. Mainly because I realised that I had no idea how to design and make it in such a way that I could fit and more importantly remove it with all the pipework in place. Trying to assemble all the pipework through the smoke box door was something John Hill warned to be

careful about. I also realised that I had given no thought to connecting the superheater outlet manifold to the inlet pipework.

That led onto how to fix the boiler into the frames, something the plans do not mention. Talking to people at WWSME it became apparent that this was a tricky area. The boiler gets hot particularly at the firebox end and is made of copper, the frames are steel. Not only do they not get anything like as hot as the boiler but being made of steel they expand less anyway. The bottom line is the boiler has to be retained in a way to allow for this expansion. At the front it will be fixed by the smoke box (though I don't know for sure how to do that yet) so it's the firebox end which will have to expand. Then I hit another obstacle, how to fit brackets to the boiler. Drilling and tapping is for me a no-no as it would go through the water jacket, though I am told it is commonly done that way. Soft solder or some sort of epoxy adhesive have both been suggested. Still thinking about this however, as I have yet to finalise exactly where the boiler will sit in the frames it can wait.

I have come up with a provisional design for the smokebox which I plan to make in the rough with scrap material initially to see if it is viable. All being well I should have a full day in the workshop tomorrow and maybe will have some progress to report. I also had some further thoughts on the superheater pipework which I want to experiment with.

Tuesday 17th January 2023

Two small jobs and one (for me anyway) big job I have been putting off. First small job was to make a connector for the turret to connect the pressure gauge, Second was similar but the connector for the blower plus bending up the connecting pipe. It still needs soldering but looks ok as you can see in the picture.



The big job also appears in the picture, it is the smoke box end piece that fits over the boiler. The flange as delivered was 4.25" whereas the boiler od is 4.5". I used my face plate for the first time to do the job which as far as machining was concerned was quite quick and easy. What took the time was finding the right clamps and getting the piece centralised on the plate. In the end I did this in two stages. I first set it up as close as I could get on the bench and marked out a circle on the plate corresponding to the centre hole of the work piece. I then fitted the plate to the lathe and scribed several concentric rings around the roughly marked circle. Then back on the bench and refitted the work piece but now with some centring guidelines. Then back to the lathe and used the cutter to confirm it was indeed centred. It was a few thou out but not enough to cause concern as it was just a case of cutting and measuring; fits perfectly.

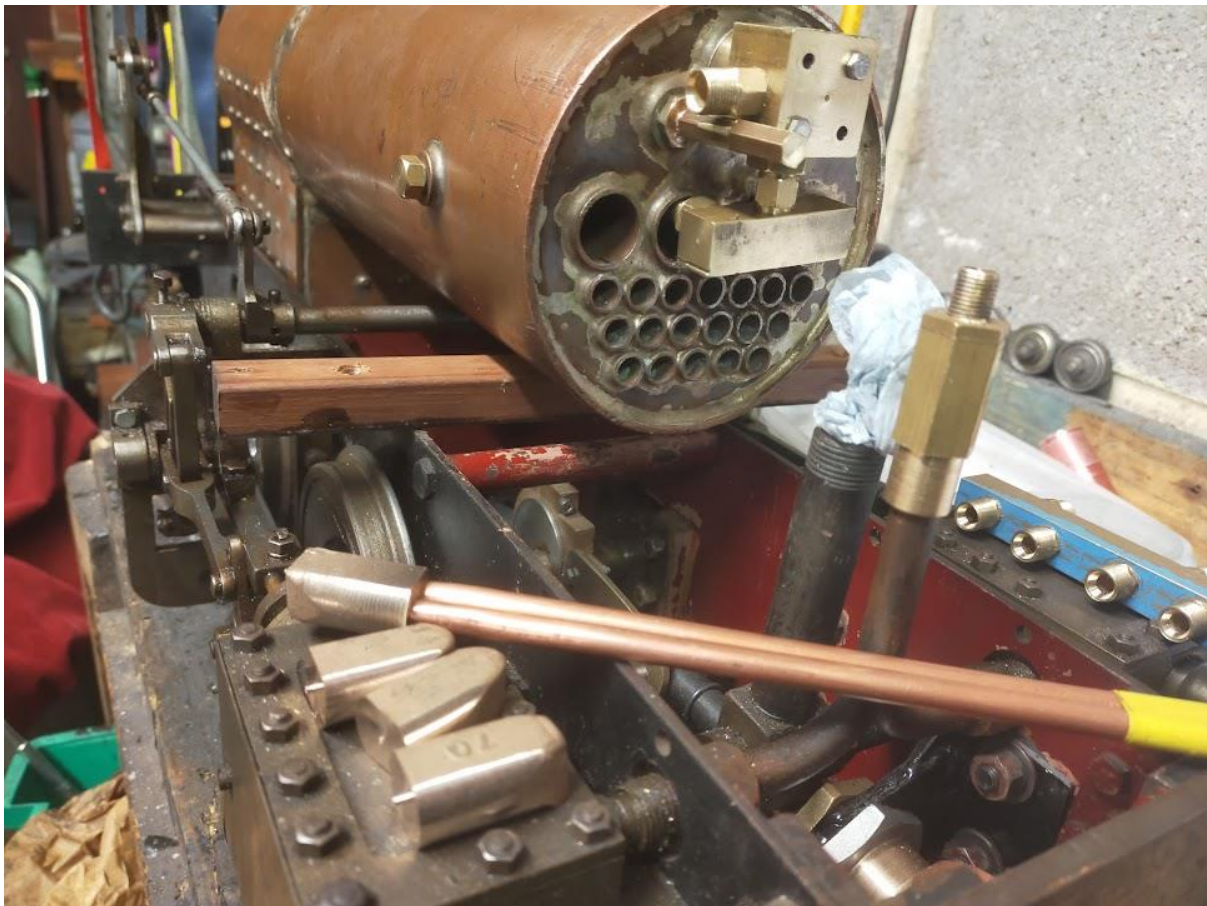
Of course as with all projects its two paces forward, one backward. Today's glitch is the LH superheater tube in the boiler. It seems to be partly blocked and the spear will not go in beyond a couple of inches. Something to look at tomorrow.

Monday 16th January 2023

More slow progress. I have turned my attention to the superheater pipework that fits inside the boiler tubes – there are 4 of them. The ends of the pipes nearest the firebox have to be joined to create the loop - not an easy job and every chance the solder will block the pipe. A while back I bought some phosphor bronze castings known as spears which seem to offer a better chance of success though as it turns out they also offer a challenge. First one was the fact that despite being advertised for the Butch boiler, they were too large to fit in the tubes. Fortunately I now have the 4-

jaw chuck so I was able to set them up and machine them to fit. They came as a single casting so I parted them off into 4 separate items at the same time. Quite pleased with myself and many thanks to Terry at the WWSME who showed me how to set up things in the 4-jaw adjustable chuck as part of the model engineering course they are running.

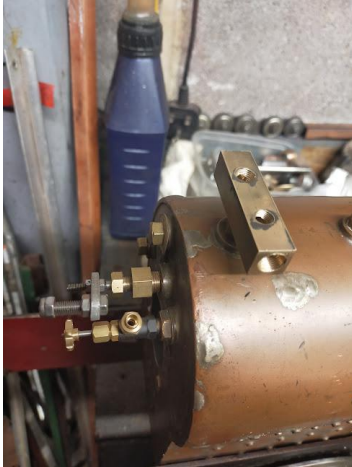
Second challenge is to drill holes into the spears so that there is effectively a chamber at the end to allow the steam to pass from one pipe to the other. Very fiddly compounded by the fact that the spear is only 5/8" wide not giving much clearance for two 1/4" holes; plenty of scope for it to go wrong. I have done two spears reasonably successfully so far but it is nerve racking so I will leave the others for another day. I only have enough 1/4" pipe to complete one anyway until my Blackgates order arrives and I now realise I probably did not order enough for the job anyway – doh! Not a real problem as the priority is to complete the two outer pipes so that the joining manifold can be lined up. The two inner ones are virtually straight and in theory should be easier. The picture shows the progress so far but it still needs silver soldering. This will wait until the second is completed before doing this and some other soldering jobs. Not much to see for a weekend work.



I forgot to mention that I never did find out the thread size on the blower outlet so I carefully re-cut it to OBA and you can see in the picture the connector fitted. Its' very snug and this connector is overly long for now. I will finish it to size later when once the position of the boiler is finalised.

Friday 13th January 2023

Slow but steady progress today. I have made the turret housing body and this is shown fitted to the top of the boiler. Most of the connectors will have to wait until I have either made or bought the items they will connect to. As you can see, I do have the blower valve so I can make that up. A whistle valve is on order. The other two connections are for the injector (if I fit one) and the pressure gauge.



I have also made the manifold that combines the 4 superheated steam pipes and combines them into two outlets for the inlet side of the cylinders. It will still be a tricky business bending the pipes to connect it all up but the alternative of fabricating it as a fully soldered

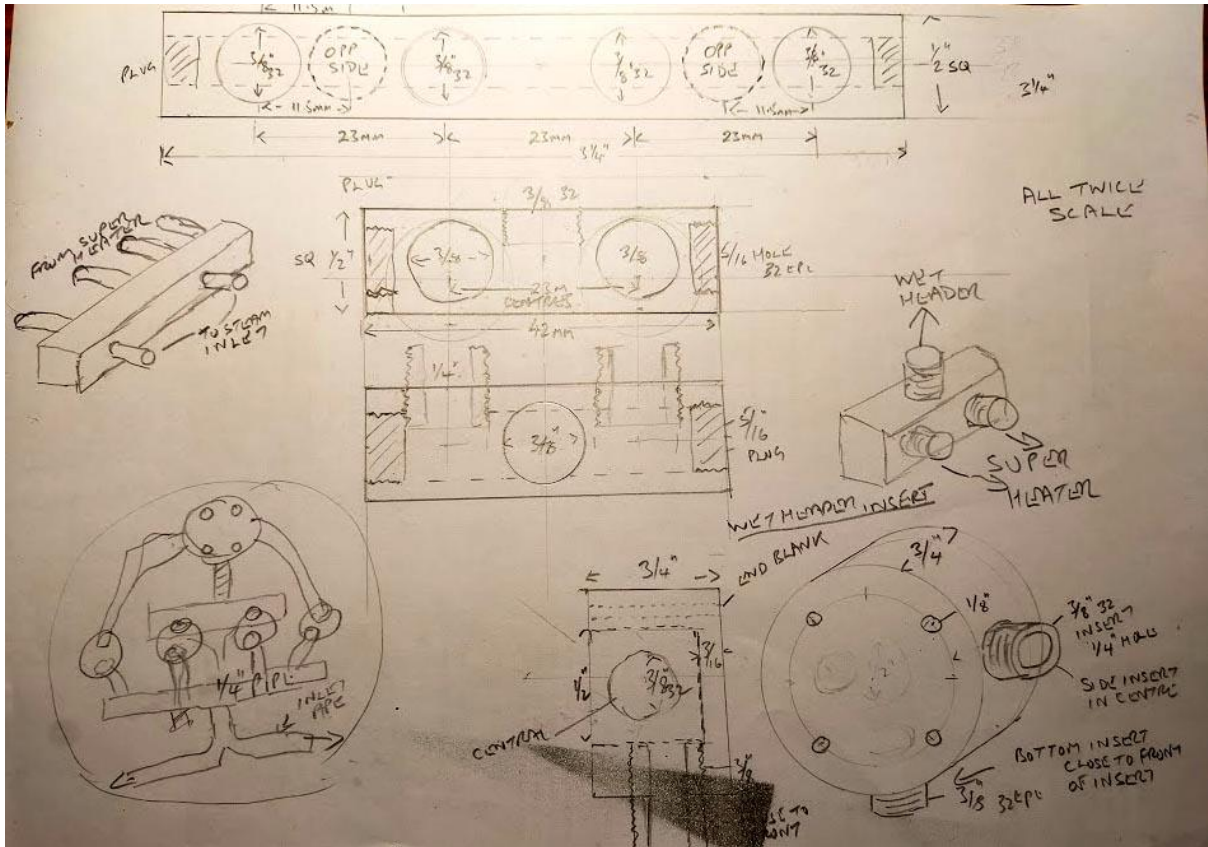
assembly as shown in the Butch boiler drawings is even more complicated especially as the whole thing is being fitted to the AoH chassis. My next step is to install the wet header assembly to figure out the alignment and bends of the input pipes to the superheater. I have hit one potential snag today. The blower outlet tube is very close to the wet header so I will need to make up a quite a slim connector. However, I am puzzled by the thread on the outlet pipe. It appears to be $\frac{1}{4}$ " with a relatively coarse thread but so far I have not been able to establish what. I have tried cycle (26tpi) BSF (24tpi) and OBA which was the closest but none seem correct. It is certainly not an ME thread as these are much finer.



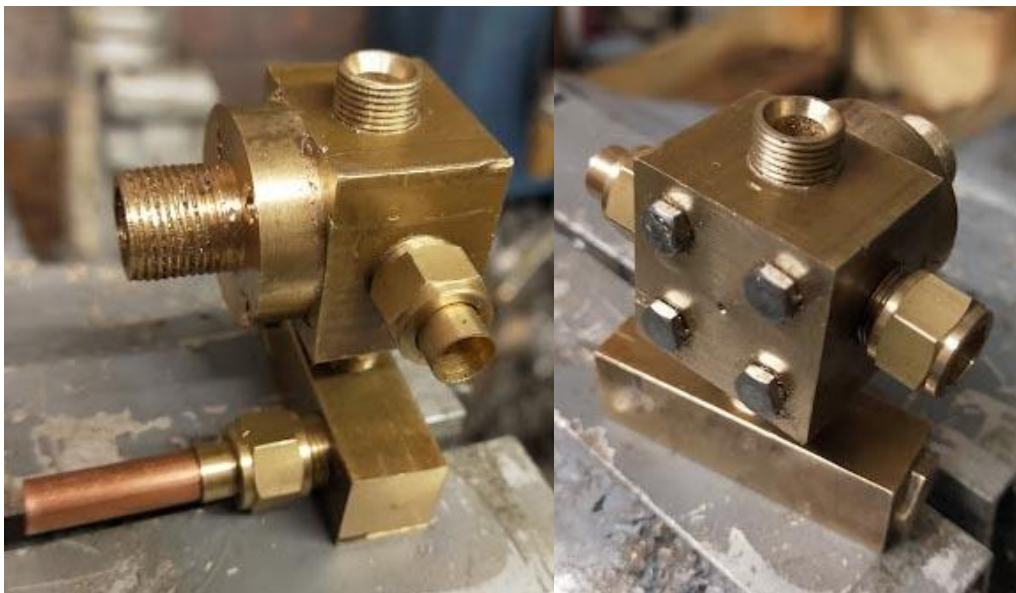
Wednesday 10th January 2023

Work stopped on the AoH project just before the end of November as I acquired a new motorcycle project (the 1966 Honda CB77). As I wanted to exhibit this at the Bristol Bike Show at the end of February 2023, everything else was dropped to concentrate on the bike. It is now finished so work resumed today on the AoH project.

One of the challenges has been the connections from the wet header to the superheaters. I came up with a design for this a while ago and today which is shown below. It will make more sense in due course as I actually fabricate it:



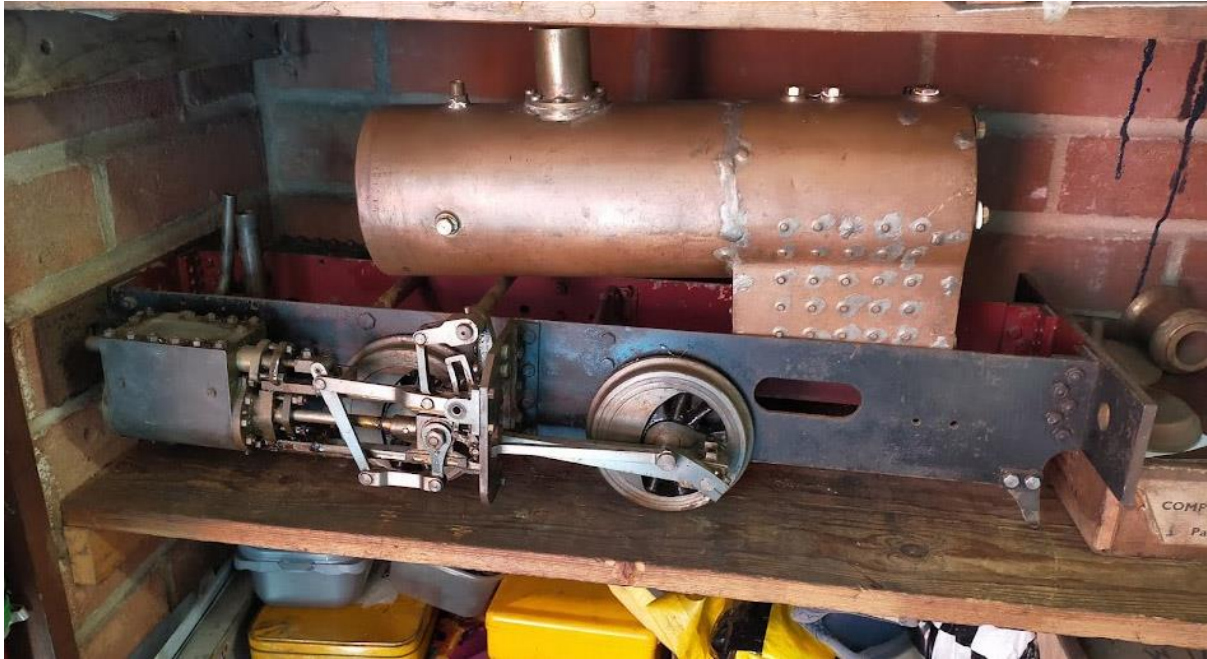
I started this afternoon making the distribution block from the wet header to the superheaters and the results so far are shown below:



Preamble October 2022

This locomotive was gifted to me by my good friend John Hill from Exeter. He bought it a number of years ago as a rolling chassis with the intention completing the build. Time moved on and he never got round to doing anything with it though he did acquire some other bits along the way, a brand new boiler being one such item. Unknown to me he had left it in his will but decided that I should

have it now and brought it with him when he came to stay in Spring 2022 – a very generous but daunting gesture. At the time I was up to my ears in other projects, the riding season was about to start and the Sweet Pea (see separate diary) was needing attention so the Anne of Holland (AoH for short) parts have sat on the shelf until very recently. A few days ago I dusted it off and made an adapter to take an air line and to my delight the locomotive worked perfectly, much better than the Sweet Pea ever had. This prompted me to make AoH my preferred winter project though it is unlikely that it will be fully completed in that time. Steam loco project typically take many years but we shall see.



What I have you can see in the picture, basically a rolling chassis which runs on compressed air, and a boiler made for the Butch locomotive which John believes will be suitable. He also gave me a set of plans for AoH and for the boiler elements of a Butch. The boiler has an out of date hydraulic test certificate from 2015 showing it was passed at 180psi (twice working pressure). I will need to have it tested at my local club in due course (though now it will only be taken to 135psi). Before I can do this I have to make all the boiler fittings including the regulator assembly so this will be a priority. The other major components I need to make include:

- The axle water pump and all its plumbing
- The hand pump and plumbing
- The smoke box with superheater connections
- Fixing the boiler
- The tank lagging
- All the bodywork
- Incidentals like the buffers and a brake assembly.

What I don't have is any written guidance on how to build an AoH as it a relatively rare model never the subject of a book nor serialised in The Model Engineer as far as I can discover. Th plans are fine but the don't always tell you the order in which to tackle things or give guidance on how to assemble things. Moreover, having the wrong boiler will undoubtedly complicate things so I suspect I am going to have to wing a lot of the design. One possible helpful factor is that Simon Bowditch and David Brierley both have AoHs so at some point I will be visiting both to take pictures and seek advice.

Unlike my other blogs, I am not going to record activities as they happen in date sequence. Instead the updates will be on specific topic areas as work progresses and in most cases no specific date will be mentioned. There will be a date at the start of the blogg showing when it was last updated – should anyone have the slightest interest.

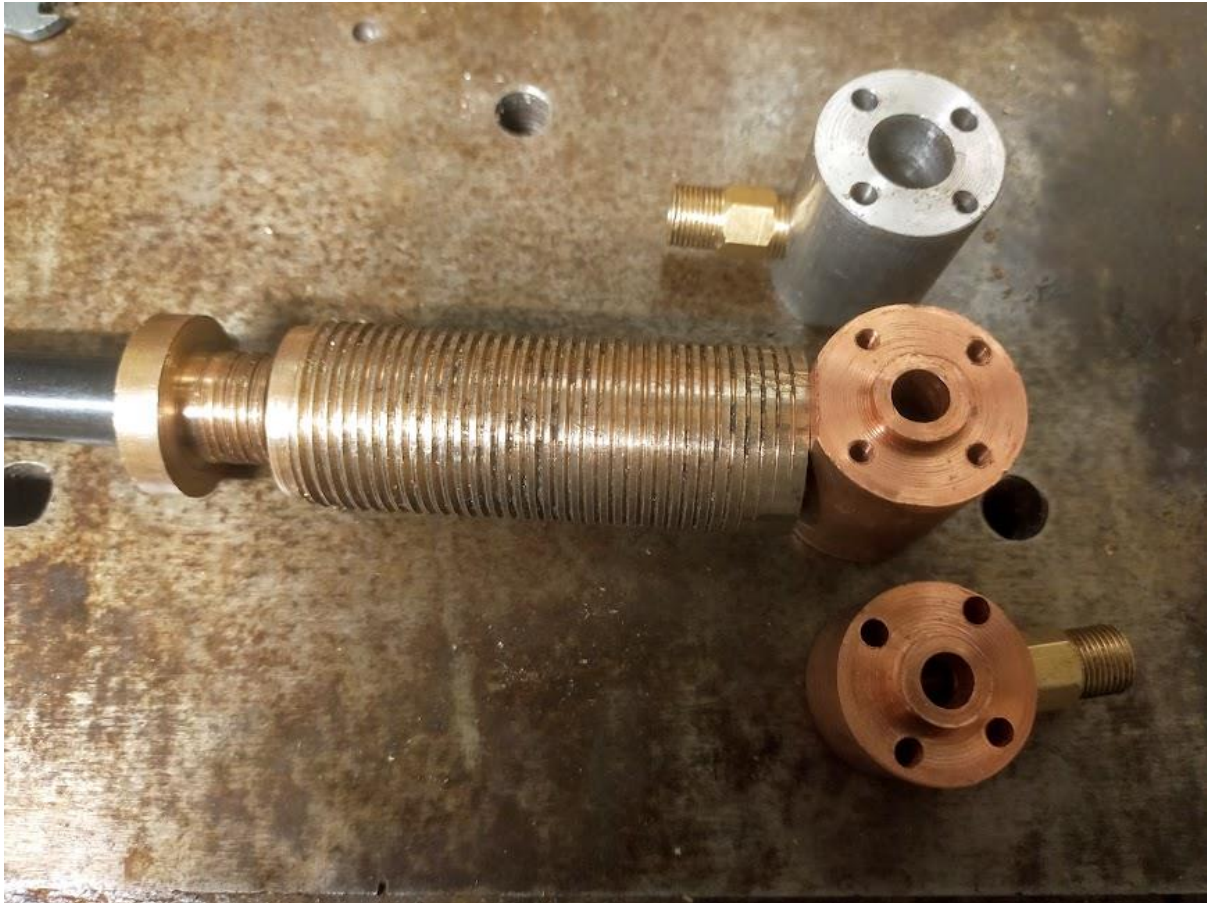
Progress to 7th November 2022

Much of the time spent has been in studying the plans and trying to get my head round things. The boiler particularly caused me difficulties as I simply could not understand how the regulator assembly could be built let lone assembled the through 1.5" diameter steam dome hole. I'll come back to that later. So to get things started I concentrated on the axle pump.

Building the Axle Pump

The design itself was fairly easy to understand but needed quite a lot of material. Fortunately during a recent visit to John H (which will be discussed later) I was able to ferret through his scrap metal bins and find a selection of bits that looked promising for this and other items I will need to build. In a previous life John was in the scrap metal business; he has more stuff squirreled away than he could ever use in two lifetimes and generously let me loose on his hoard. Otherwise the price of brass, phosphor bronze and gunmetal would make the project prohibitive and/or dictate the pace at which it could progress. Back at base I made a start. First obstacle was the mounting bracket which required a piece of 2" angle iron, something I did not have. So for now I have fabricated it out of some aluminium angle but doubled up to improve the strength. It fits ok and I think will do the job until I can find a suitable piece of steel angle.

Next problem was the main body of the water pump which according to the plans needed a piece of 1.125" diameter Gunmetal about 3" long which in turn was silver soldered to the mounting bracket. All I had was a piece of 1" diameter brass rod which fortuitously already had a ½" bore hole. But no way this could be soldered to the aluminium bracket. After some thought I decided to thread the outside of the brass rod using a ¾" BSP die borrowed from a friend. BSP threads are measured on the internal diameter of the pipe, usefully the external diameter of a ¾" BSP tap is 1". He also lent me a ¾" BSP Tap so I could make some lock nuts but I only needed to make one as I found one that fitted perfectly in a box of miscellaneous nuts & bolts. With that sorted I was able to work on the other parts. Though not difficult, it took a long time as I constantly had to figure out how to do some of the jobs. I also managed to trash one part which is why the top component is made from aluminium whereas the other two parts are phosphor bronze (pb). Don't think this will matter but time will tell. First time I have worked with pb and its much harder than I was expecting. You need very sharp tools and unlike brass it seems to need lubrication. I still need to assemble the pump in the bracket to get the alignment correct. Once I have done that I will machine the outer body to make it look much neater, only leaving the minimum threaded section for securing it to the bracket.



There is another aspect to the axle pump I have not yet resolved. There is an eccentric to drive the pump on the main shaft but no eccentric strap. This needs to be 1.675" internal diameter which is quite large, the Butch strap is only 1.125" for example. You can buy eccentric straps but not one specifically for AoH as it is not a supported model or at least as far as I have been able to discover. I am currently trying to establish which of the supported models does use this size of strap. As a backup, I have designed one which could be laser cut and am awaiting a price from a local engineering company.

Never heard from the local company about the eccentric so I have bought one in cast pb from Kennions. It is made for a different model but does provide for a large enough hole (1.675") in the centre. There are other minor differences but I should be able to work round these. The casting has to be machined and this will probably be the first use for my newly purchase 4 jaw chuck.

The outer body of the water pump has now been cleaned up and just awaits final assembly which will include silver solder some parts. Not done much of this yet and certainly not on anything as large as the axle pump. Need to practise on something smaller.

20th November 2022. The eccentric strap was successfully machined in my new 4-jaw chuck today. Since the picture was taken it has been fitted to the axle and seems fine. The bracket for the pump body is being painted and when that is dry I can mount it in the frame. Then I need to fabricate the link between eccentric and pump plunger. On my own here as the strap differs a little from the AoH drawing so it will be trial and error to make the connector. I have stamped each part to make sure it goes back together correctly.



A little more progress with the water pump. I have fabricated the link between the eccentric strap and the pump plunger and this seems very satisfactory. As the picture shows the connector is presently bolted to the side of the eccentric. I am waiting for the mill to be installed to cut the slot.

The plunger is presently a piece of $\frac{1}{2}$ " nylon rod, if for any reason it does not work I will have to make a s/s rod.



Making the regulator

I finally figured out how the regulator in the plans could be made and assembled but I was not happy about aspects of its design which is of the sliding type. These concerns are shared by John H so I have been working on alternative designs. I came up with several variants that used a screw regulator but none of them could be reduced in size to be assembled through the 1.5" hole of the steam dome. Finally I came up with a variant of the slide type which overcomes the perceived weakness in the original design of holding the slide face firmly against the inlet port. I have now built a test version to my design and it seems to work fine and can be assembled in the space available. A production version is under construction and I will include the final design as part of this document. The prototype is shown below. The steam inlet port has yet to be cut and the operating arms will be made of brass when I get some 1/8" sheet.



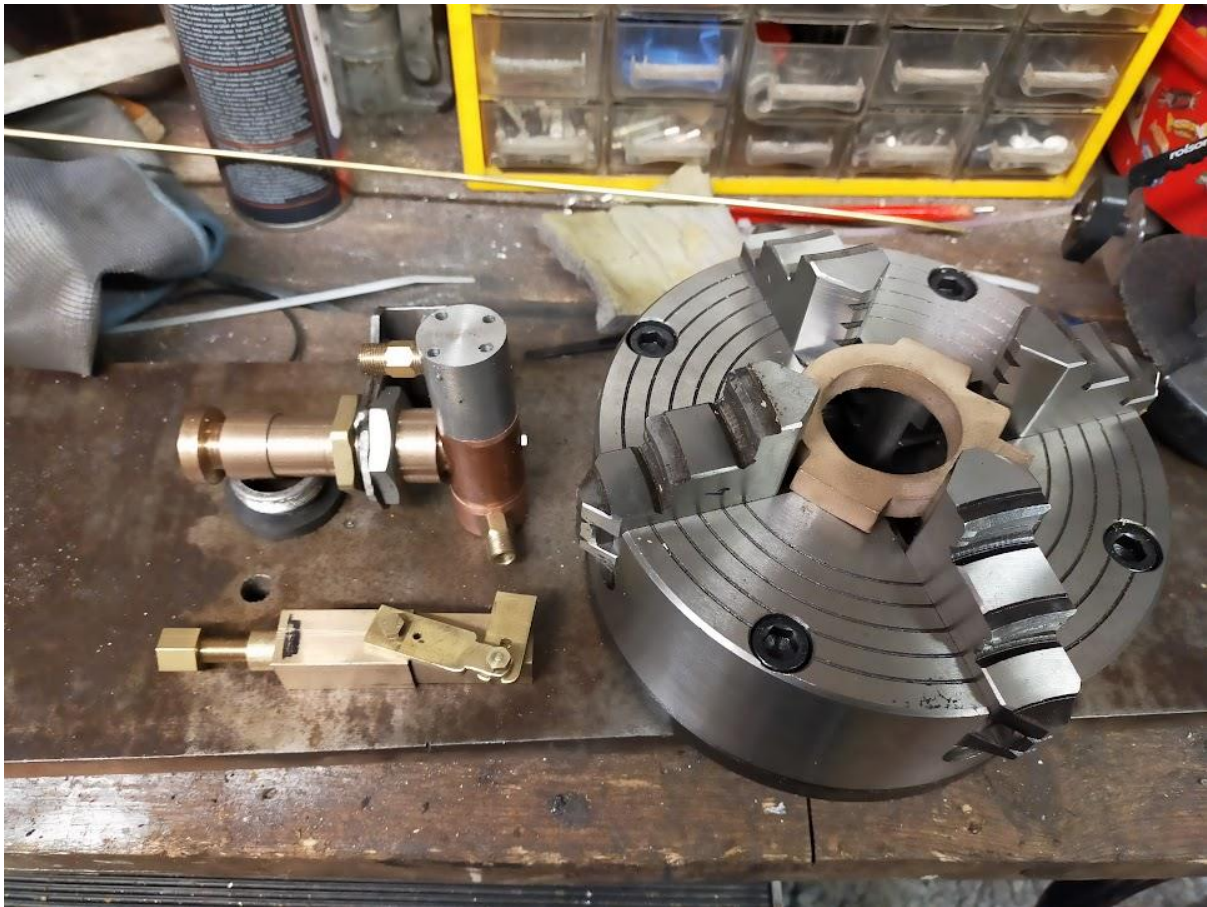
Progress on pump regulator and the eccentric strap mounted ready for machining in my new 4 jaw chuck.

Further progress on the regulator. The double threaded boss for the wet header has been made and the connection pipe cut to length and threaded. But now I am wondering if it is going to work as the outer thread diameter for the boss is different to the inner thread diameter for the pipe. The drawings state to use 32tpi for both (1/2" outer, 3/8" inner). I have cut the latter as per drawing but the outer bush turn out to be 26tpi. This is going to present problems when I try to assemble everything. I cannot do anything about the outer bush size so I am going to have to make remake both items – b****r. Why don't people stick to the drawings and why have I only just thought about this.

The port has now been cut in the regulator slide and a matching port in the central column. I cheated and drilled the port rather than try to cut a rectangle as shown in my picture above. If my calculations are correct the fully open port size is the same and the opening will be more gradual. It should work ok, we shall see in due course. I also put a plate on one side which serves two purposes; it stops the slide twisting as it moves up and down and it limits the travel of the operating arm so it cannot go over centre and reverse itself when closing. The design already included a stop to limit the max travel at the fully open point. Both seem to work.

On the other side of the regulator, I have the operating rod slimmed down and the square filed on the shaft to match the square in the short operating arm. The bushes at the firebox end of the boiler are also made. Next job here is to trim the rod to length, thread the end for a lock nut and file a

square to locate the regulator lever which has yet to be made. Takes 15 minutes to report progress that has taken me a fair chunk of two days.



Milling Machine and other workshop improvements

I have often hankered for a milling machine and the decision to complete the AoH project brought this need to a head. Having spent some time studying the market and consulting about suitable machinery I came down in favour of the Centec 2A Mill made from circa 1946 to the 1960s in various forms. This is fairly compact and offers both vertical, which will be the norm and horizontal milling which is useful for certain types of job. Coincidentally, John H has just such a mill which he wants to sell as he rarely uses it and wants the space it occupies for a shaper machine (had to look this up on the internet). A deal has been struck and it is now a question of sorting the logistics to collect the machine and install it in my workshop. First though I need to rearrange the workshop to make space and wire in a new double socket. The Mill will come with pretty much all of the tooling I will need to get started. This is picture of the Mill:



I have also long wanted a 4-jaw chuck as these are pretty much essential for working with square material. I have resisted it until now as the Clarke Lathe has a unique type of chuck fitting so only their propriety 4-jaw chuck will fit and they are ridiculously expensive compared to more common styles. However, needs must and I have now ordered one. Fortunately faceplates are a lot cheaper and one of those is on order as well. This will be needed to machine a couple of specific items during the project and I have a cunning plan to adapt it for another purpose – more later about this if it works.

Both the 4 jaw chuck (see picture above) and the face plate have now arrived though neither yet used in anger. I have succeeded in mounting my small independent 4 jaw chuck on the face plate though given that I also have the big Clarke one it may never get used in that way. Attempts to fit my rather nice concentric 4 jaw chuck to the face plate are on-going. Unlike the independent 4 jaw chuck which can cope with a degree of run-out by adjusting each jaw separately, the concentric chuck has to be perfectly mounted as there is no adjustment facility. I have yet to establish a way to drill the mounting holes with sufficient accuracy and am looking at alternatives. If I could mount this chuck satisfactorily, it could be used for most jobs as it can cope with circular, square and hex bar. I have drawn up a design for an adapter plate but it requires professional fabrication to ensure accuracy

of the mounting holes. I am hoping to get it costed as once made it could have a variety of uses beyond the concentric 4 jaw chuck. Addendum: the drawing has been sent to a friend of John Hill who has drawn it in CAD and sent it to a company he does business with for similar things. No indication of when it will be ready.

Tuesday 22nd November 2022: This Day Richard Warne and I went to Exeter and picked up the Centrec Mill plus an assortment of tooling from John Hill. We were assisted by John's friends Ern and Alan which was much appreciated as his workshop is very cramped and at the end of a long steep garden path. We were pretty tired by the time we got home so left unpacking for another day.

Saturday 26th November 2022: In the interim I had unpacked, checked over and stored away all the smaller items but left the cabinet and mill head as they were both seriously heavy. It also gave me time to plan how to achieve the job. This morning Richard kindly came round and we had head and cabinet unloaded, moved and re-erected within the hour, thanks in part to the loan of an engine hoist from the WWSME.



Richard then had to go so fitting the other parts like the vertical head, motor and table I did myself during the afternoon. Not quite so easy and my shoulder was aching by the end as quite a lot had to be done lying on the floor reaching upwards. But it is now mostly done

and working. The belt cover at the back is yet to be fitted – deliberately so as it needs a slightly shorter top belt and the suds pump needs investigation.

Sunday 27th November 2022: John told me that the suds pump had burnt out and it had been removed. He supplied a replacement pump he had sourced but when I looked at it the design was rather different and presented fitting issues, moreover it was a 3-phase motor and I don't have 3-phase. I decided to strip the old suds pump assembly and the major problem quickly became clear. The pump itself was seized solid due to congealed cutting solution which must have been water based as there was also rust corrosion. It was not difficult to strip and clean up and then worked fine. The motor itself also span so I fitted a temporary power cable and after a slight hiccup with a blown 3amp fuse, quickly replaced by a 13amp one, the motor worked fine. So the suds pump assembly can be re-fitted. Not that I had any plans to use it in the short term, just nice to know it now works.

Other boiler Fittings

I am going to cheat so far as the other boiler fittings are concerned. An order has been placed partly with Kennions and partly with Blackgates for things like the blow down valve, clacks and blower valve. I could possibly make some of them but it would undoubtedly take a lot of time based on how long it is taking me to make the water pump and the regulator, and probably a few spoilt jobs along the as well. They are relatively inexpensive in the scheme of things and there are still plenty of fittings I have to make which are not available to buy. The clacks, water gauge, blowdown valve and blower valve arrived along with some other bits today and thankfully they all fitted in their respective holes. Some 1/2" square brass also arrived so I will be able to make the turret that sits on top of the boiler and distributes steam to various location.

Smoke Box

Included in the boiler fitting parts purchased from suppliers (Kennions in this case) is a pair of pb castings for the ends of the smoke box. These are for the Butch boiler but of course the whole thing has to be fitted to the AoH chassis which will undoubtedly complicate matters. Like the eccentric strap, the rear firebox end will need to be machined to fit the boiler. The latter is 4.5" and the end fitting is nearer 4.25". At the moment this is a daunting task and can only be done by mounting it on the newly acquired face plate. Think I should practise on something easier and less expensive to start with. Making the wrapper to link the two ends will also be challenging as it has a compound curve to accommodate the saddle. Fortunately the club has a rolling machine which I shall have to learn to use. Getting the wrapper the correct length (I cannot use either the Butch or AoH boiler drawing dimensions for this) will be another challenge as will getting the holes in the correct place for steam input pipe, blast pipe and chimney. Actually I am quite looking forward to this as I enjoy sheet metal work. The more I write up this diary, the more likely it seems that a lot of work will remain at the end of the current and possibly many future winters.