The Streamlinia Project (4)

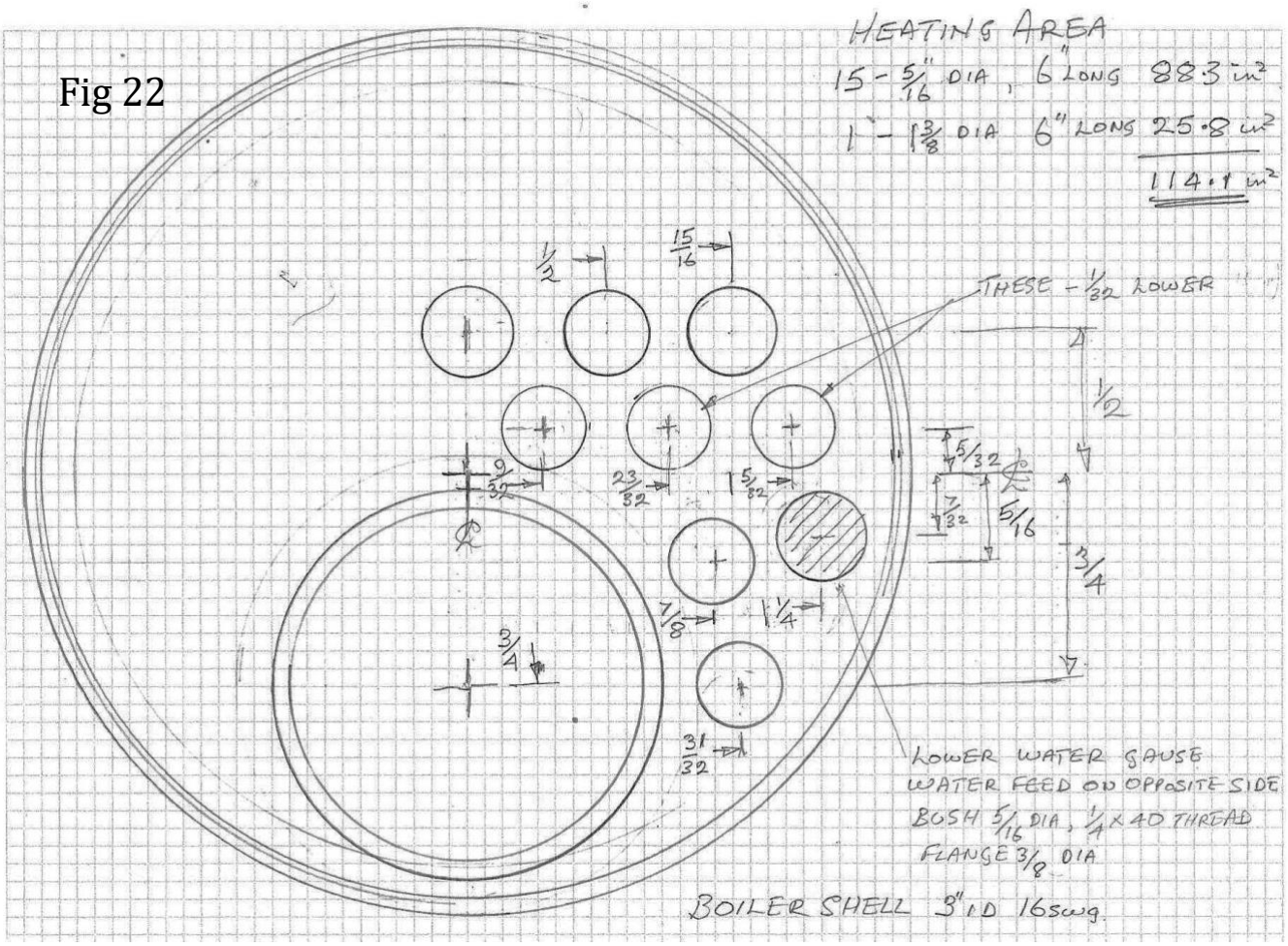
I was a bit concerned about how stiff the engine seemed to be and was not at all sure if it would even turn over on 20 lb. of air. It turned out that I had done the glands up tightly and had not backed them off slightly. The engine started - still a bit stiff – but soon picked up nicely. It self starts (most times) and on 30 lb. of air it runs up to 5000 rpm which is well over what I had hoped for.

The second engine was then assembled and performs even better than the first. It will turn over quite nicely down to about 5 psi and the forward, neutral, reverse selection works well on both engines.

I set up one of the engines in a small test tank driving the prop I intend to use on the boat. With 20 psi on the airline it performed really well. *See the video here*. Should be enough to get Streamlinia to plane. All I need now is enough steam!

So now it's time for the boiler. As I mentioned earlier the intention is to make it close to the original dimensions. That is about 8 ½" long and 3" wide and 4 ½" high. The original was meths fired so the casing was quite high, but this one is to be gas fired with return flues, so will be nothing like as high.

The main shell is 3" dia. 16 swg copper tube, 7" long with a heating length of 6". The layout of the flues etc. was drawn out at twice full size on 1/8" graph paper. Fig. 22



But before I get started on the end plates I need to make sure I can make a burner that works properly.

Over the years I have been building steam plant I have noticed that what looks the most complicated part – the engine – usually turns out to be the easiest to get working. The second item in order of difficulty is the boiler design and what looks like the simplest part but turns out to be the hardest to get to perform well is the burner. In this case the burner is basically a tube just under the length of the main flue with lots of narrow slits across it. The main difficulty is usually to get equal size flames from the slits for the whole length. This

boiler has much longer main and return flues than any other I have made and hence a much longer flame tube is needed. So I have decided that it will probably be best to get this sorted out first.

This gave more trouble than I was expecting. Most burners take air to mix with the gas in two ways – Primary air which is sucked into the mixing tube adjacent to the jet and Secondary air at the point where the flame is formed.

In this case, the burner tube is inside another tube so there is no chance of getting secondary air to the far end, so all the air is taken in as primary air. This means that the burner will not light if in the open.

Another point to get right is the width of the slots compared to the thickness of the burner tube. It seems that if the slots are wider than the thickness of the tube wall it is quite likely to light back and burn inside the tube which we DO NOT WANT. My first try was using a piercing saw with a .015" wide blade on a piece of 5/8" stainless water pipe. This did not work and the flame was coming out of the far end of the surrounding tube which I did not want. After several attempts with more/less slots I came up with the arrangement seen in Fig 23. In this case the tube is 16 swg 5/8" dia. mild steel and a junior hacksaw used to cut .025" wide slots. The primary air intake is governed by an adjustable slide. A photo of the burner working is shown in Fig 24

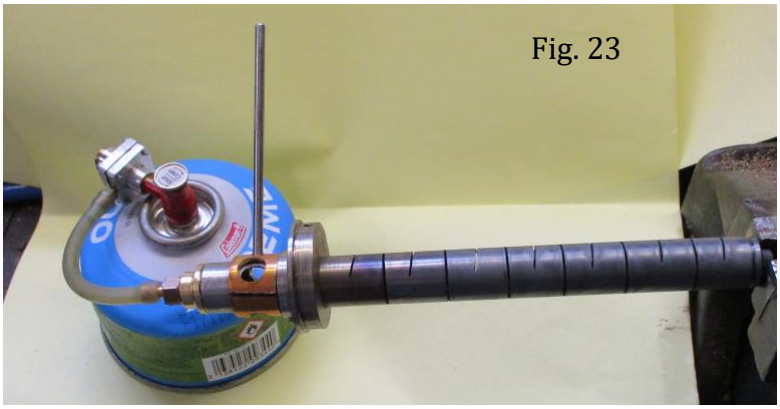


Fig. 23


Fig. 24

Now that the burner seems to work OK, it's time to get on with the boiler. First the main shell was cut to length with the ends nice and square. This was a piece of 3" i.d. 16 swg copper tube. It was supposed to be 7" long, but ended up 6 7/8".

The shell needed several holes in it. There are three threaded bushes for the safety valve, the water level probe and the top water gauge fitting. Also needed were a series of small holes under the steam dome. The steam dome itself is a short length of 1" copper tube with a bronze bush on top for the main steam feed and a smaller one at each side for the pressure gauge and a feed to the gas control. This was soldered up first as a single unit


Fig. 25

The end plates are made from 16 swg copper sheet. Two circles about 3 3/8" dia. were cut out and the various holes required were drilled, the large hole for the flue was cut with a Q Max cutter and filed out to fit the 1 3/8" flue tube. There was also a 1/16" hole drilled through the centre. Fig 25. A former 2 7/8" dia. was cut from about 1" thick hardwood and one edge given a radius of about 1/16". A clamping piece from hardwood was also produced, not forgetting the 1/16" hole in each centre.

The ends were then annealed and in turn clamped in the vice between the hardwood pieces with a short length of 1/16 brass wire locating them. The flanges were then gently formed in stages. Four annealing's were needed to complete the process. It was during this process that I realised that it had been a mistake to cut the hole for the flue before forming the flanges as it ended up rather distorted and made silver soldering the flue in place a bit of a problem. Fig. 26.

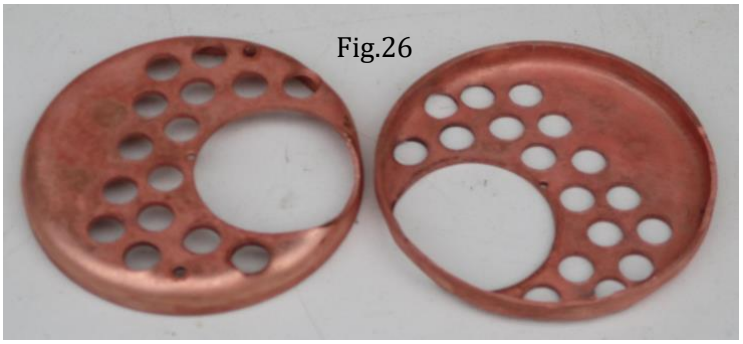
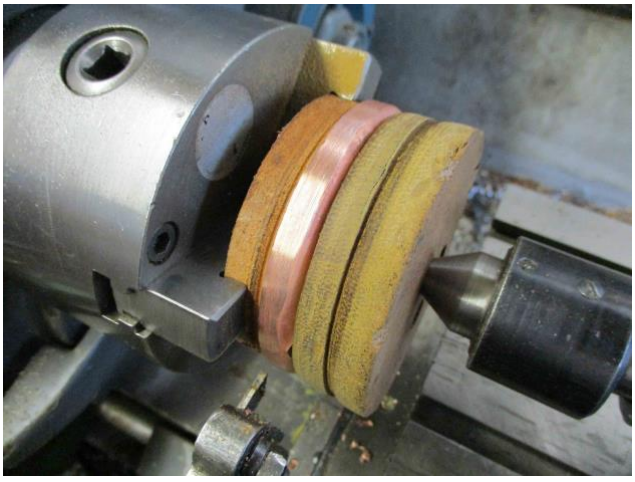


Fig.26



I now needed to clean up the flanges so they were a nice fit in the boiler shell. So with an end plate still on the hardwood former, that was gripped in the lathe chuck and the clamping plate was brought into contact with the end plate and forced against it using a rotating centre mounted in the tailstock. The o.d. of the flange could now be carefully turned to size so it was a light fit in the boiler shell. Fig.27.

The end plates were then pushed in, flange first, at their correct ends making sure that everything lined up i.e. not rotated with respect to each other or the holes in the boiler shell. The ends were held in place by drilling through the shell and flange in three places each end and pushing in 1/16" short rivets. The silver soldering was carried out in four phases. Before each phase, parts were cleaned by dipping in dilute sulphuric acid then rinsing well with clean water, dried and plenty of flux applied. First, the end plates were soldered into the shell (including the three rivets at each end). Second, the tubes were assembled, each end being slightly expanded and soldered at one end. Thirdly, the other end of all the tubes as well as the two bushes for the water feed and the lower water gauge fitting. Lastly, the bushes on top of the shell and the steam dome. Blanking plugs and a connection for an airline were fitted to check for leaks (only up to about 10 psi). The basic boiler is shown in Fig. 28.


Fig. 28

Still quite a lot to be done, the various fittings for the boiler, the end plates, exhaust flue/funnel, lagging, and a casing to give some semblance of the original boiler. Also a water pump to be designed and fitted to the engine. Then the whole lot mounted on a suitable base. Still an instalment or two to go before I get onto making the actual boat!