The development of *Cyril* and her steam plant

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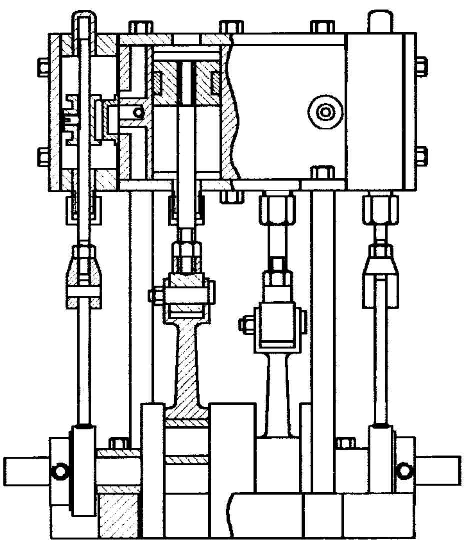
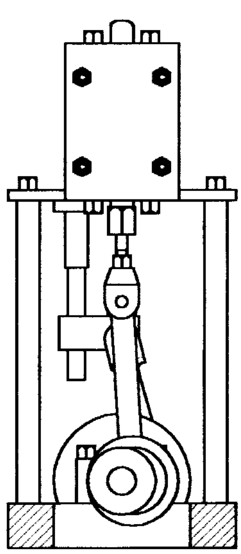
By Malcolm Beak

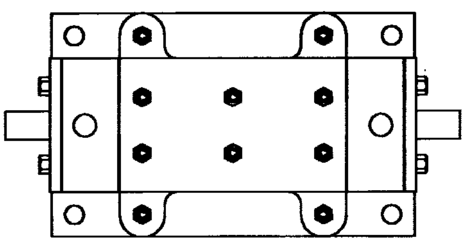
Cyril was built in the early 1980's. A carvel planked version of Vic Smeed's *River Queen* design, and, as far as I know, the first model steamer to have automatic water level and fire control. The basic boat was built by Cyril Spurrier (anyone remember a chain of bakers in the South East with that name?). I was given the hull on condition that I fit a "reasonably scale looking steam plant" in it. That was almost 40 years ago. Just in case you don't know, *River Queen* is a 1/8 scale model of a typical steam launch from the early 1900's and designed by Vic Smeed. Nice drawings showing how the model should be built in the same manner as the full size boat. It is 36" long with a beam of 10", and displaces about 14 lbs.

The hull I now had was quite nicely made, planked with 1/16" mahogany with ribs and stringers of 1/16" ply about 3/32" wide. The hull had been made over shadows (bulkheads), all being removed except the transom, one about 2" forward of the transom and another some 4" from the stem. There was permanent decking ahead of the forward bulkhead (which also had a large hatch in it), and removable decking between the transom and aft bulkhead. The stern gear and rudder were also fitted. So now all I had to do was to design that "reasonably scale plant".





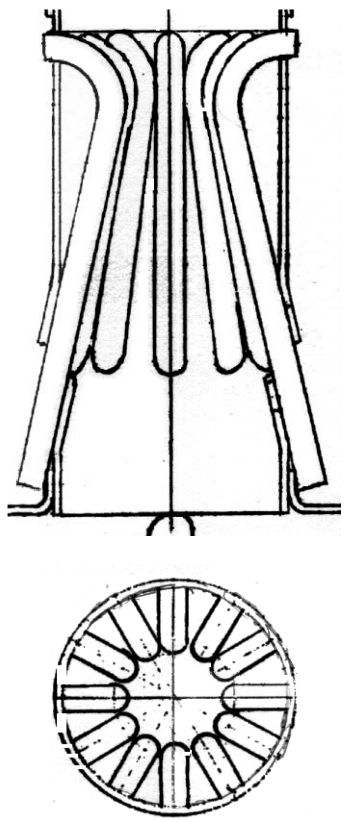
General arrangement of engine



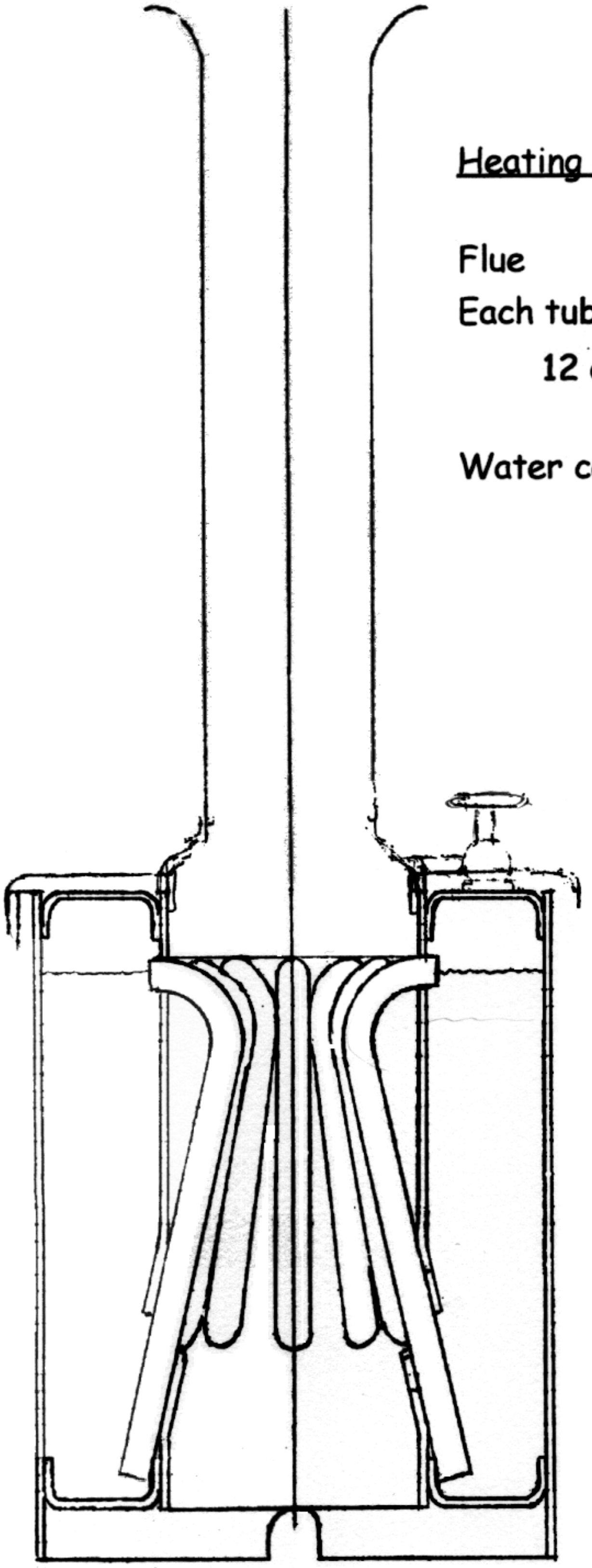
In the past I had only seen *River Queens* fitted with a Stuart 10 and correspondingly large boiler – to my eyes this looked ridiculous. Thinking about the full size boat – 24 feet long – a typical engine installation would be a Stuart 6a Compound. Scaling this down gave an engine overall size 2.5" high, 2.25" long and 1.8" wide. I had no intention of making a scale engine, merely a scale *looking* engine. So it had to be a double acting in line twin simple (for reliable self starting) with slide valves (I didn't feel that I could make piston valves accurately enough in that size). Also reversing gear was out of the question – valve travel would be small enough anyway, and by the time all the inevitable backlash was taken up in the reversing linkage there would be precious little valve travel left and self starting would be problematical. Previous experience indicated that with bore and stroke equal at ⅜" there would be sufficient power. With these thoughts in mind, I came up with the design shown here. By the time a water pump had been fitted across one end, the dimensions are not far removed from those aimed for. Actually the pump wasn't fitted for several years. In the interests of simplicity and keeping the length to the minimum, only two main bearings are fitted. This also means that a large centre web can be incorporated, thus doing away with a separate flywheel. As no reversing gear is fitted, the crosshead was only fitted to one side, rotation being anti-clockwise when viewed in the end elevation shown, in order that the load on the crosshead guide is always towards the big end (i.e. the crosshead is in tension) Think about it!

The engine took about twenty hours to build, and another fifteen to get running properly. Later versions now run straight away. Drawings are in the Download section of the Paddleducks website. Over the years, there have been a few modifications. For the latest version I suggest that you contact me.

After the engine, the boiler. Again, thinking about the full size boat, a vertical boiler with a maximum overall diameter of 3 feet and a height over the casing of 4 feet should look about right. After hunting through the assortment of available copper tube, a suitable piece of 16swg some 3⅛″ diameter was located. For some time I had been toying with various heating tube arrangements, and finally decided on that shown. The central flue is 1⅝″ o.d. x 16swg, and the 12 circulating tubes are 3/16″ o.d. The maximum water depth is 3″, just below the circulating tube outlets. This gives a total heating area of about 30 square inches. One advantage with this design is that the whole boiler with the exception of the top plate can be assembled, silver soldered, and checked for circulation with a suitable burner. The answer was excellent. With only an inch of water in the boiler, it came gushing out of the circulating tubes. The boiler was therefore completed with ferrules for the various connections that I expected to fit: - Water gauge, water feed, safety valve, pressure gauge and main steam pipe. A concentric superheater was made to fit down the centre of the ring of circulating pipes. This consisted of a ⅛″ pipe feeding steam from top to the bottom of the ⅜″ return tube. The steam therefore travels relatively slowly gaining a lot of heat. Originally the superheater was 3″ long reaching well into the flame, but when first steamed, the nice red paint on the steam line fittings turned black, and the soft packing round the pistons was no longer soft. I'm not sure why the plug silver soldered in the lower end if the ⅜″ tube didn't blow out. So an inch was taken off the end, and the plug brazed in this time. Now the paint has just gone a dark red! The boiler is lagged with mahogany strips held on with brass bands. The top is covered with a shallow conical cover into which is riveted the funnel. The exhaust is directed up the funnel with the end of the pipe being belled to give a "soft" exhaust. In the past I had had trouble with exhaust blast pulling the flame off the burner and extinguishing it.



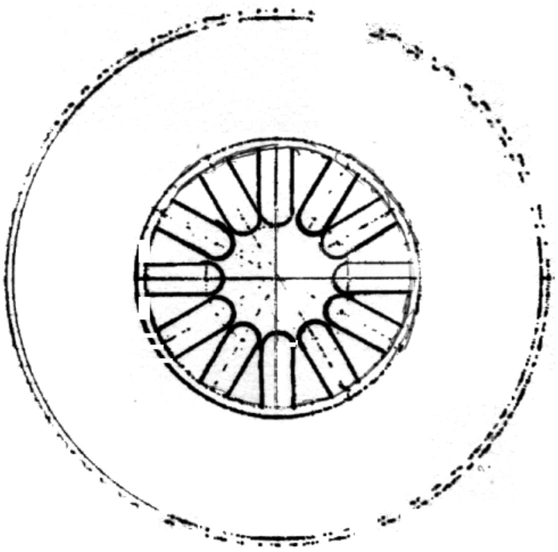
Arrangement of circulating tubes in the central flue



<u>Heating areas with 3" water depth</u>

Flue	1 5/8" dia.	12.5 sq.in.
Each tube 3/16" dia.x 2 1/4" long		
12 off		17.5 sq.in.
		30.0 sq.in.

Water capacity 15 cu.in.



Suggested fittings

- Safety valve
- Water gauge
- Main stop valve
- Pressure gauge
- 2 - clack valves
- Water level sensor

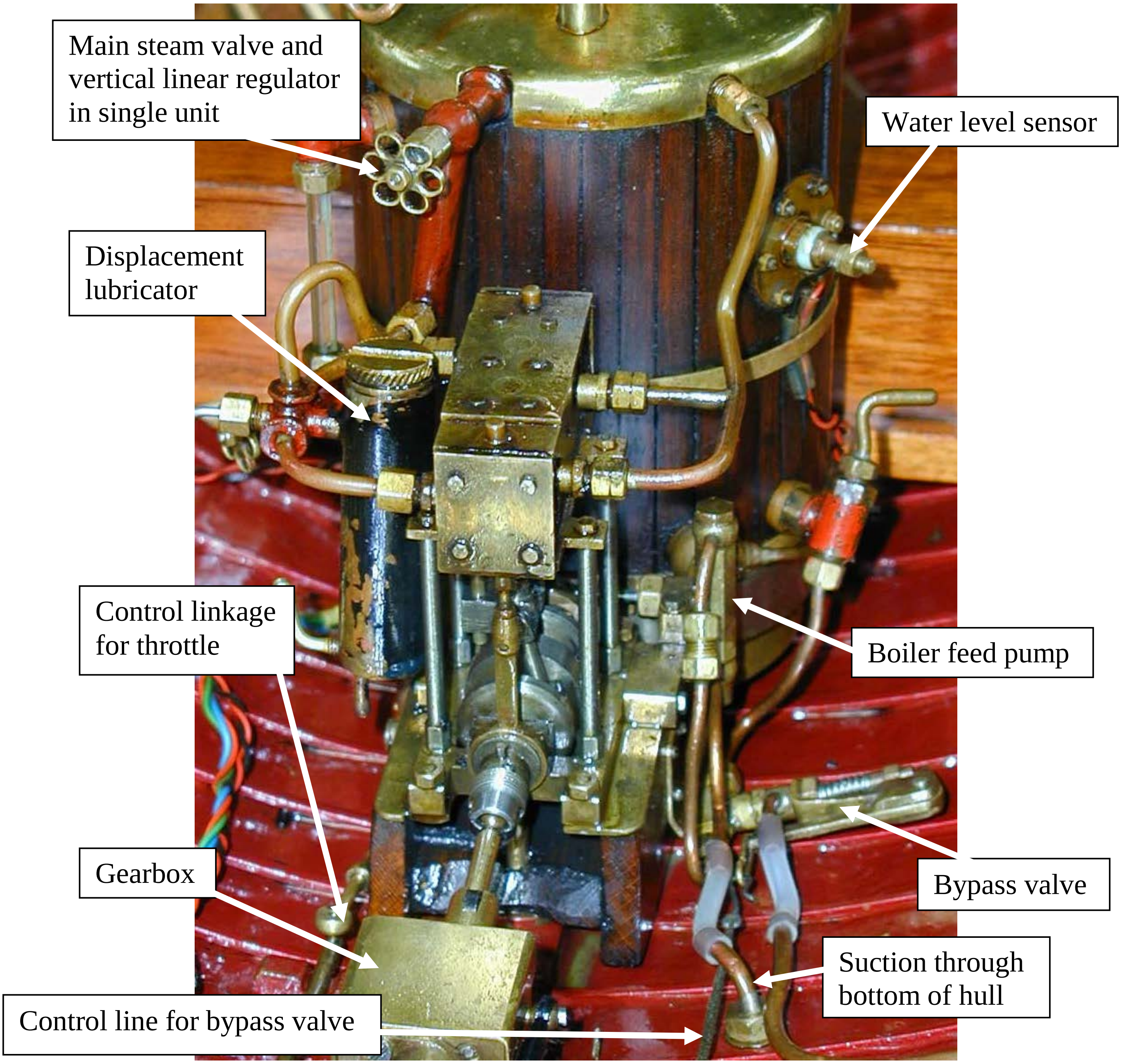
This is approximately what Cyril's boiler is like. A simpler version would have the circulating tubes in the form of a shallow U rather than as shown.
A concentric superheater is fitted, down the gap in the centre. A 1/8" feed pipe goes down the centre of a 3/8" return tube which is only a couple of inches long.

So to the burner. Needless to say this is gas. I happened to have a burner off a small camping stove. It had a domed brass top about 18swg, perforated with lots of approx 1/16″ holes. Where the brass had stretched when it had been pressed to shape, the holes had got rather elongated. The gas feed was changed to horizontal rather than vertical, and the whole burner mounted on a tray that fitted inside the boiler shell which extended some ½″ below the lower end plate. The brass dome fitted up into the flue with a small gap left all round for secondary air to enter. This seems to be quite critical as too large a gap causes the flame to become unstable. In this model I use propane in a tank under the foredeck, the main gas valve protrudes through the deck and is disguised as a Samson post. The gas then passes through a regulator lowering the pressure to around 15psi.

Gas tank and regulator installation. Note the level glass.

All this worked quite nicely. The gas is lit at the top of the funnel. When cold however, several attempts are necessary as the flame stays at the funnel exit. Gently closing the main valve persuades the flame to drop down to the burner. When properly alight one can look down the funnel and see a nice blue flame, and steam is raised in about five minutes. On one occasion, it seemed to be taking rather a long time for pressure to come up, and on looking down the funnel I saw a bright red glow instead of the usual blue. On investigation, I discovered that the flame had lit inside the burner cap, which had then overheated (the red glow) and proceeded to partially collapse. I seemed to remember reading somewhere – possibly an article by Westbury - that to prevent this happening, the thickness of the burner cap should be greater than the diameter of the holes in it. This was very obviously not the case in the dome of this burner. So another cap was made, this time in the form of a shallow cone about 120˚ included angle. It was 2mm thick with three rings of 1mm holes drilled around it. About 50 holes in total I think. Since then there have been no problems.

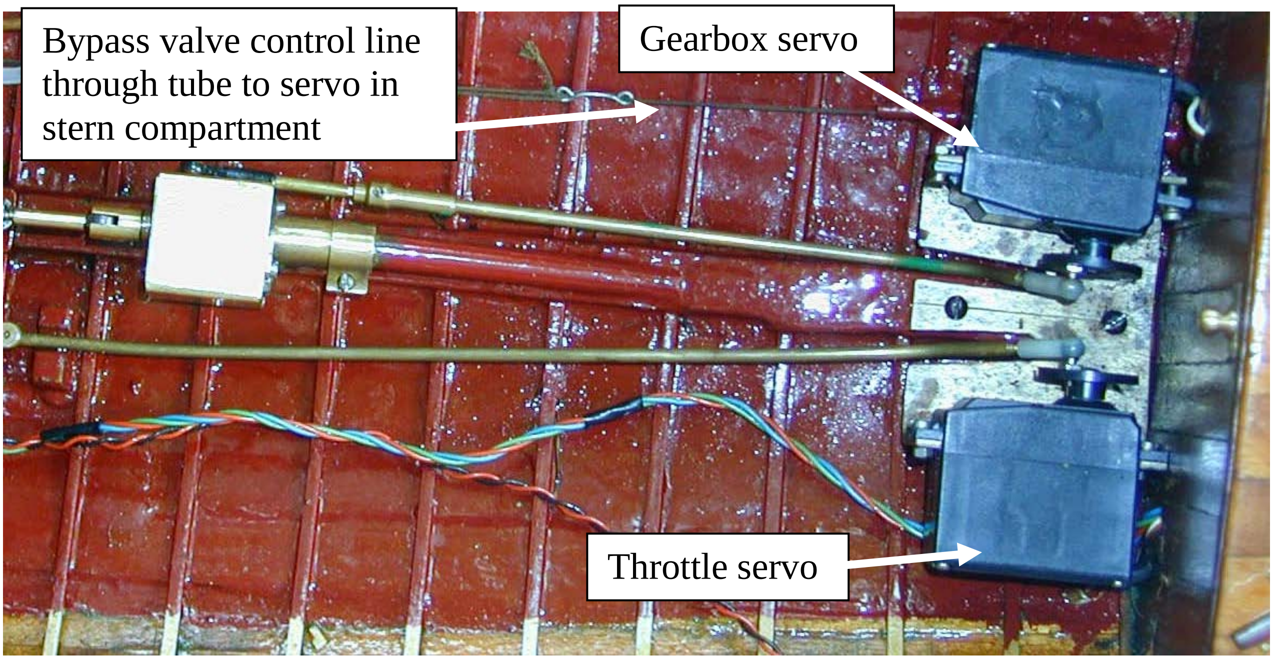
After a few years, a water pump was fitted together with water level and gas control systems. These had been sorted out on my steam picket boat. Basically, the water level is controlled by measuring the resistance between an insulated probe and the boiler shell. If the resistance is high (MΩ), the probe is in steam and water is pumped in. If the resistance is low (KΩ) the probe is in water and the bypass valve is opened. An adjustable time delay is fitted so that once filling has started, it continues for a fixed period (about six seconds in this case). This prevents the system switching in and out in rapid succession if the boat is in choppy water. In practice, the level remains constant within about an eighth of an inch. The gas control uses something similar to the gas regulator, but with the addition of a connection for the boiler pressure. This causes the gas supply to be gently reduced as working pressure is reached. The result of this is that the boat can trickle about gently without the safety valve continually blowing off.



Details of the water level control was published in Radio Control Boat Modeller in Nov/Dec 1988, and the gas control system appeared in Model Boats in November 1989. Both these articles can be found in the Paddleducks Download section. About the only problem encountered here was due to my lack of memory. The level probe was fitted in a new ferrule in the side of the boiler, but when fired up, the indicator leds showed that the water was up to the maximum level – but I knew that it wasn't because the water gauge showed it to be well down. Eventually I cut the ferrule out leaving a hole about ⅝″ diameter. This showed that the probe had been exactly in line with the outlet of one of the circulating tubes. With about half a glass of water, the burner was lit, and almost immediately water was being squirted out of the hole. When boiling, a jet some two to three inches long was seen. Obviously the probe was constantly being covered with water and registering a full boiler. To overcome the problem, a piece of copper tube ⅝″ diameter had the inner end blanked off, a ferrule in the outer end, and an ⅛″ hole top and bottom was silver soldered in position. This mod has worked well.

As the engine is not fitted with reversing gear, a forward/neutral/reverse gearbox is fitted. This uses a dog clutch to engage forward, and sliding gears for reverse. It is fitted to the inner end of the stern tube, and connected to the engine by a shaft with simple universal joints at each end. Details of the gearbox are in a previous article on this website.

Installation of the radio and other control gear was not too much of a problem. As mentioned earlier, the gas tank is mounted under the forward deck with access through a hatch in the forward bulkhead. As a matter of interest, a ‘water gauge’ is fitted to the tank to show the fuel level. The gas regulator also lives under the forward deck. The gas feed continues under the floorboards to the attenuator, which is under the starboard side of the seat just forward of the boiler. The end of the burner also emerges into this space. The box of electronics for the water level control is hidden under the port side of the same seat. Gearbox and throttle servos are fitted under the seats at the stern with their control rods under the floor. In between the rear bulkhead and the transom are the receiver, batteries and servo for the water bypass. All wiring fits under seats and floorboards.



Amazingly the whole lot seems to work reliably (sometimes better than others) and has done so for many years. The hull was showing signs of hard use with some of the plank joints no longer joining – luckily above the waterline. The engine also needed a jolly good overhaul, the glands in particular needing attention. In August 2003, all these details were attended to, including a new set of ribs for the hull.