Steam Launch

Designing and building a c1900 R/C Live Steam Launch by **Peter Fulcher**

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Desire and Rationale

In the late 1980's I scratch-built a small R/C steam launch, 24in LOA x 6in Beam with a finished Stuart single cylinder steam engine and home built boiler fitted to a drive shaft and 1.25in plastic propeller to a scratch-built hull from a model boat plan from 'Laughing Whale' an east coast model kit manufacturer. It has only R/C rudder steering, and the run time is about 15 minutes until the 'Esbit' solid fuel tablets expire, sized to run out before the boiler consumes all the water so as not to melt down the boiler. It is mostly balsa wood construction sealed with epoxy finishing resin and painted. Incredibly the model sat perfectly on its water line without adjustment of ballast; it runs at a nice slow scale speed as the real vessel (**Photo 1**).

I had since always wanted to build a larger version (ideally 36-42in OAL) of such with speed, reversing control and a controllable fuel source.

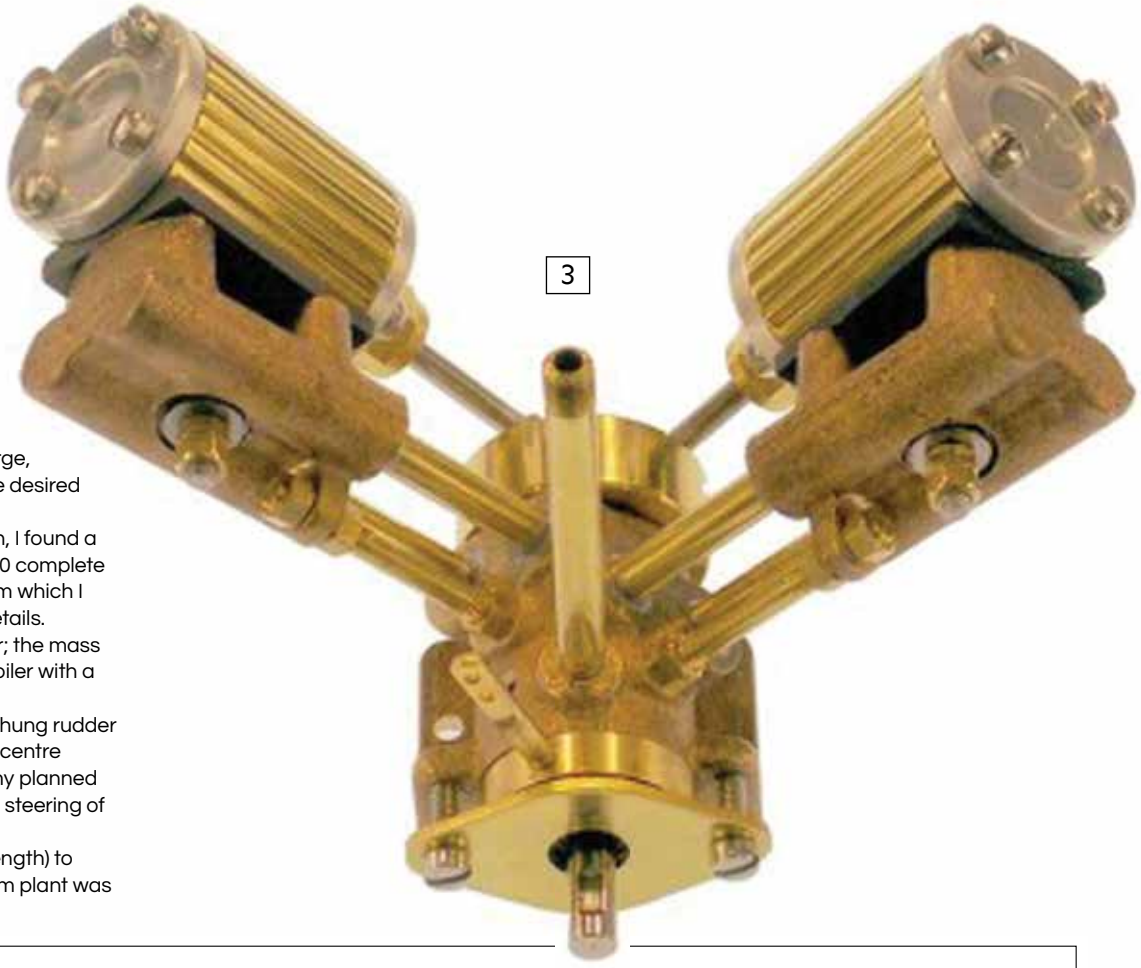
In 2013 I conducted an extensive web search of model and actual steam launch plans circa 1900s (which was the main prime era of such transportation) and model steam plant suppliers, which were mostly found in the UK and others in Japan. These offshore suppliers offer excellent, mainly finished engines, boiler and fittings, everything one needs to replicate a working vessel, but they are extremely expensive (total system typically $2,500 - $4,500 CAD delivered to Canada). I hoped to find a supplier that offered kit versions that would lower these prohibitive for me high costs.

The 'balancing act' was to find a reasonable cost steam plant then scale a model boat plan around its dimensions. I found an excellent model engine and boiler supplier in NY state called 'PM Research' which offers a wide range of steam model engines and boilers kits, plus all necessary fittings etc. https://www.pmmodelengines.com

PM offer a machined kit (i.e. no machining required just assembly) marine V-Twin ½in bore x ¾in stroke (self-starting) engine kit with a servo controlled rotating stop, forward and reverse valve and vertical boiler (requires minimal machining) and all necessary fittings and accessories (steam whistle, lubricators etc.) required. My eventual total investment in these and a gas fuel system was about one third of the cost of offshore suppliers**. Photo 2** shows a

V-Twin Engine kit and **Photo 3** a Vertical Boiler kit.

PM provides excellent instructions and guidance, typical steam plant components and general piping and arrangements guide **(Fig.1**).



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Plan, c1900

As I knew this would be a lengthy project, I initially only ordered the engine and boiler so I could find a suitable launch plan that would accommodate these relatively large, heavy components to achieve the desired scale and detail etc.

After an exhaustive web search, I found a German steam launch plan, c1900 complete with the body plan and profile from which I could create the hull and other details.

It shows a horizontal type boiler; the mass appeared similar to my vertical boiler with a similar centre of gravity.

It has an aft cock pit with stern hung rudder but could easily accommodate a centre cockpit as would be needed for my planned rear mounted engine with remote steering of the rudder via cable.

I determined the OAL (overall length) to scale the drawing to suit the steam plant was

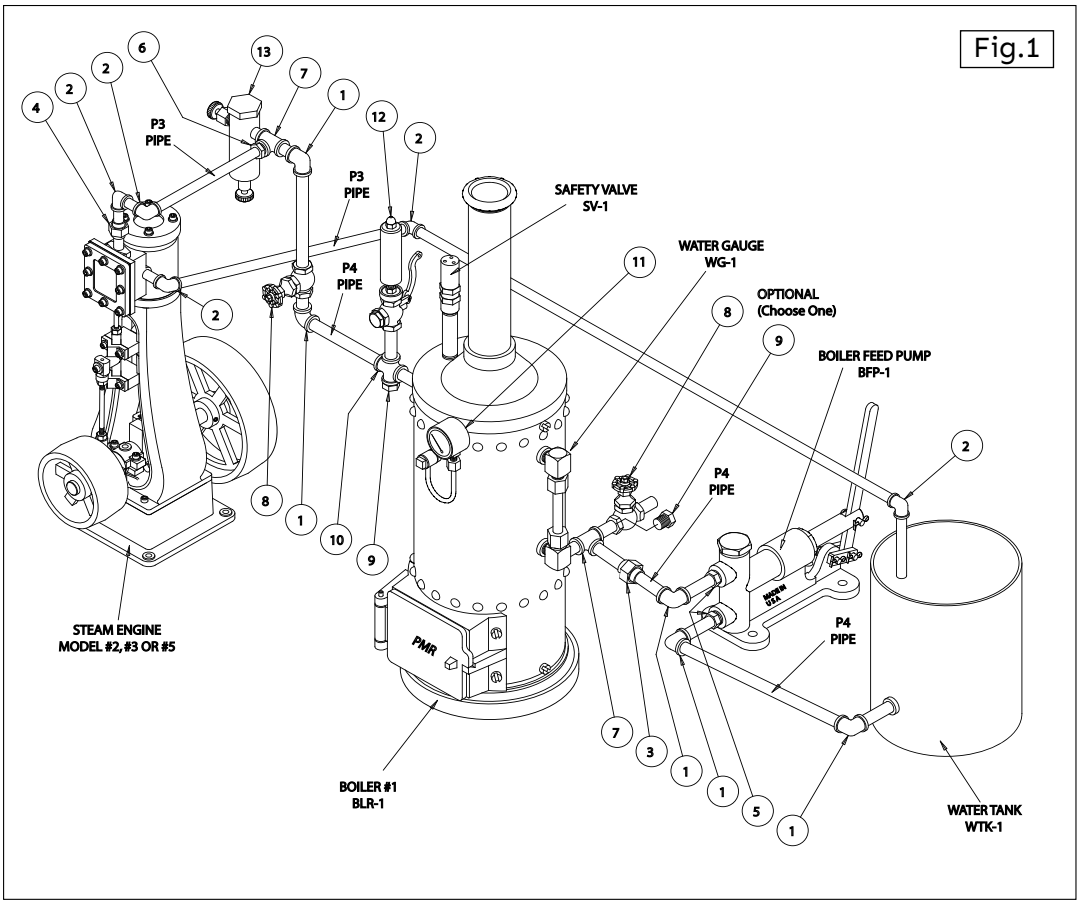
PIPING ARRANGEMENT

TYPICAL PIPING ARRANGEMENT TO CONNECT A MODEL #2, #3 OR #5 STEAM ENGINE TO THE BLR-1 VERTICAL BOILER, BFP-1 BOILER FEED PUMP AND WTK-1 WATER TANK.

PIPE LENGTHS AND EQUIPMENT MAY BE RE-ARRANGED TO SUIT YOUR INDIVIDUAL APPLICATION.

SYSTEM IS SHOWN ARRANGED IN THIS FASHION ONLY FOR CLARITY OF PRESENTATION.

ITEM	QTY	DESCRIPTION	PART NO
A/R		3/16 PIPE - Length to suit	P3
A/R		1/4 PIPE - Length to suit	P4
13	1	LUBRICATOR	LUB-1
12	1	STEAM WHISTLE	SW-4
11	1	PRESSURE GAUGE W/SYPHON	PG-1S
10	1	1/4 CROSS	PX4M
9	2	1/4 PIPE PLUG (1 Optional)	PP4M
8	2	1/4 GLOBE VALVE (1 Optional)	GV4
7	2	1/4 TEE	PT4M
6	1	1/4 - 3/16 REDUCER	PR4M
5	2	5/16 - 1/4 REDUCER	PR5M
4	1	3/16 UNION	PU3M
3	1	1/4 UNION	PU4M
2	5	3/16 90° ELL	PL3M
1	5	1/4 90° ELL	PL4M



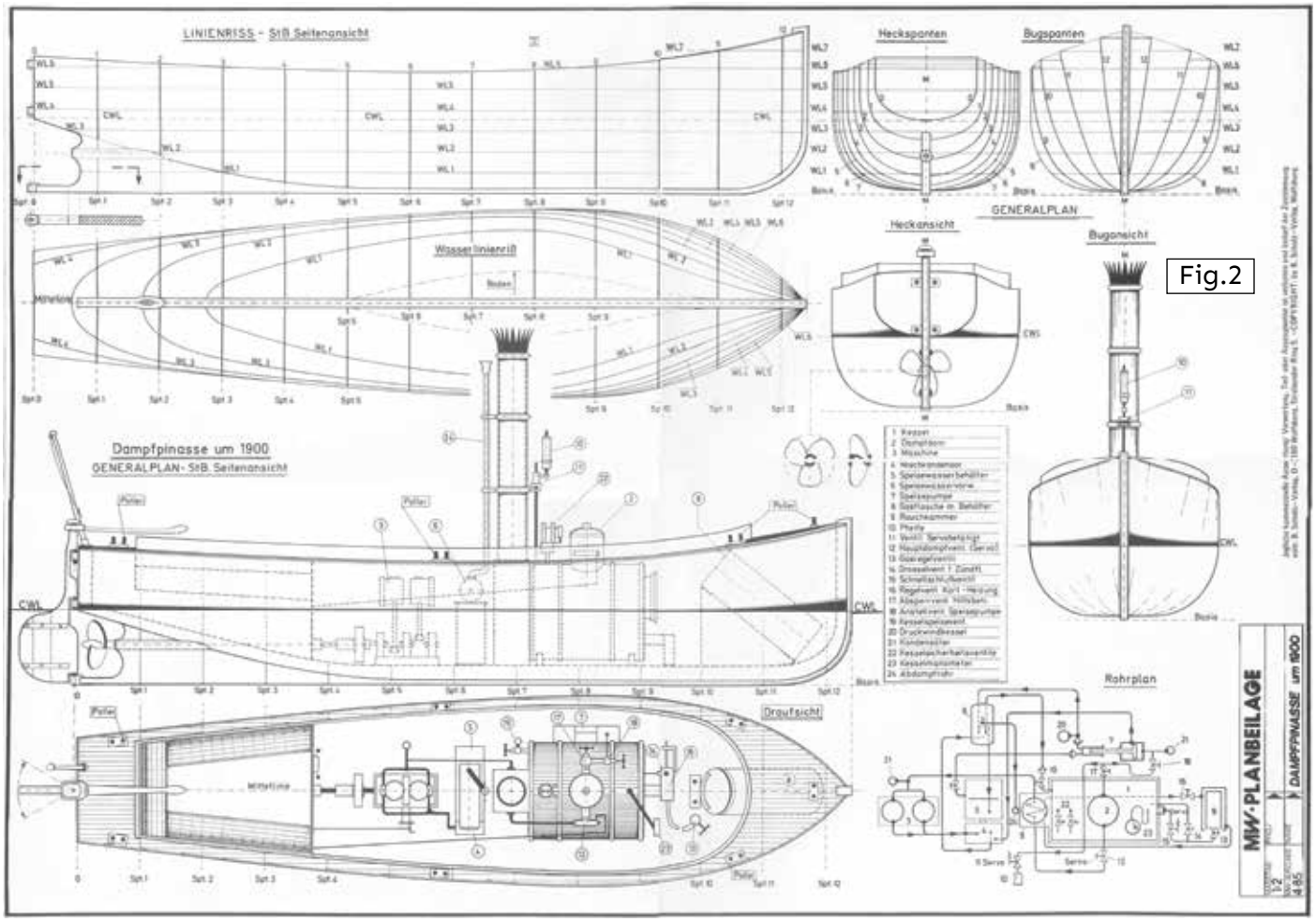


Fig.2

42in. A local document reproduction place was able to inexpensively enlarge the 8x10in web drawing to this specification (**Fig.2**).

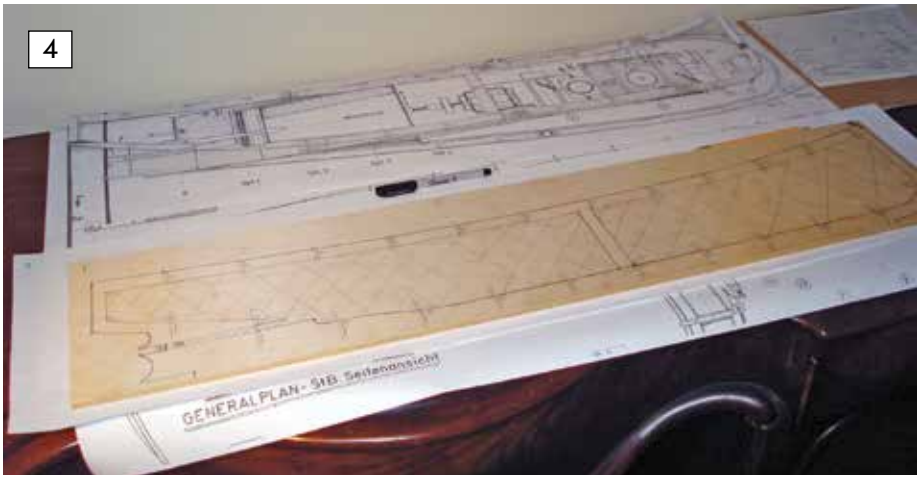
From the drawing, templates for cutting the keel and frame sections from the 'Profile' (side view drawing) and 'Body Plan' (end view drawing) are glued to standard office file folder paper stock to give them rigidity for later pencil scribing onto the wood stock. The keel and frame sections required generous openings to enable fitting of the power system and accommodations.

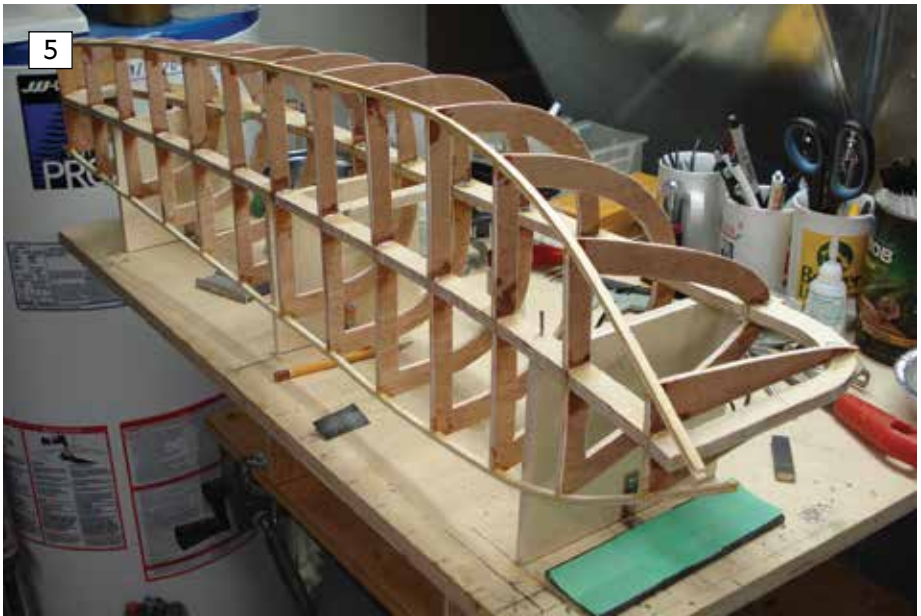
Keel/centre frame stock is 3/8in thick plywood and frames are 3/16in plywood. Examples of keel and centre frame template and transfer to plywood (**Photo 4**).

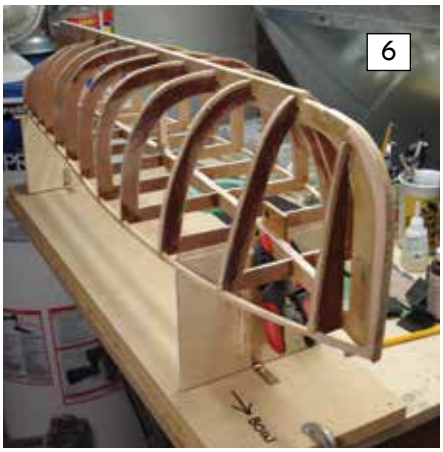
The propeller shaft casing is glued with epoxy to a cut slot were needed in the keel at this point.

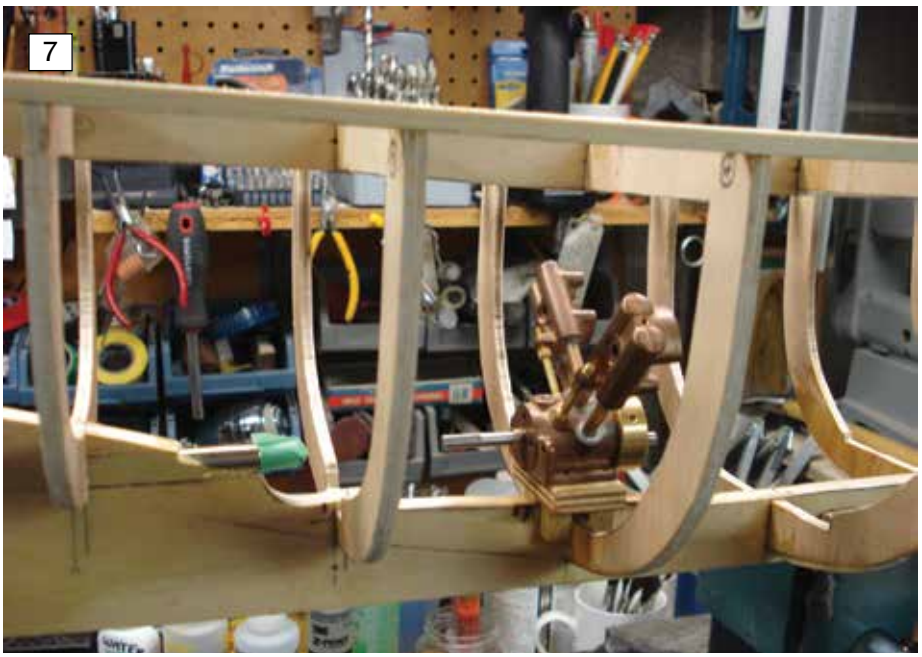
Unlike many model makers I prefer to use a similar method used by model airplane builders to create half frame sections glued to a centre frame (including keel). The keel/frame section is lightly nailed to a perfectly flat plywood base covered with waxed paper to eliminate accidental gluing to same. A 1/8in square spruce gunnel stringer is glued to the top of each frame ensuring perfect 90˚ frame fit to keel frame. To enable easier bending these strips can be split and glued in two pieces. Thick CA glue is used with a quick accelerant followed by epoxy finishing resin on each joint and left to dry overnight. Three exact frame supports are fixed to the building board to enable the same process for the other half of the hull (**Photo 5**).

This method has proven to eliminate any possibility of hull warping during further









construction. Un-needed deck area frame material can be later removed when openings are required.

The hull is placed upside down utilizing two of the same supports as needed to firmly support the hull for the planking process. No centre support is needed due to the high strength of the framed hull. The centre rib is clamped to each support to hold firmly.

Using a 12x3in sanding block, the outer edges of all frames are sanding to follow the hill shape enabling close contact with the hull planks. 1/8in balsa strips are applied to all low areas that need to be corrected then re-sanded (**Photo 6**). The engine bed should be installed at this point before commencing planking **(Photo 7**). It is critical that the engine shaft aligns well with the drive shaft, even though a universal couple will later be used.

Planking

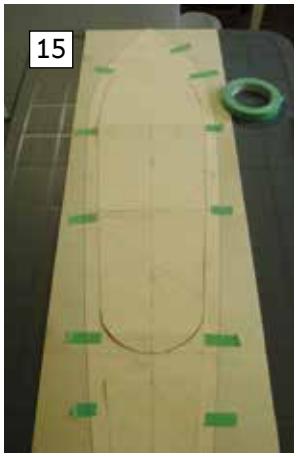
Planking commences with the garboard planks, i.e. those closest to the keel. Soaking the planks in water overnight greatly eases bending. Planks are 1/8in x 3/8in spruce strips ripped on a band saw, then sanded. These initial planks are glued in place with CA glue **(Photo 8**).

A temporary wood block is screwed into the keel to enable clamping in a vice to work upright on the hull. The first gunwale plank is installed with CA glue while subsequent planks are glued to frames with a 10-minute carpenter glue held in place with clamps.

It is not necessary to glue the plank seams (**Photo 9**). The remaining planks top and bottom are all glued this way, both sides top and bottom, two to three planks each side alternately until completed (**Photo 10**).

Once completed, all exterior plank joints are rubbed and smoothed with wood filler to fill any cracks. Once dry, the inside of the hull is brushed with epoxy finishing resin to bond the interior planking to give the exterior strength for sanding smooth (**Photo 11**).

The remaining forward lower hull openings are glued with balsa wood blocks then shape sanded



smooth along with the rest of the hull (**Photo 12**). Strips of 1/16in ply are laminated/glued to match the bow stem and keel member and mated with the forward hull planking joint (**Photo 13**).

Two separate coats of epoxy finishing resin are brushed then smoothed with disposable foam brushes to provide an initial strong hull coating and sanded between coats with 180 grit automotive abrasive sandpaper (**Photo 14**). The top of the hull deck frames is sanded to give a smooth, flat surface to which the deck will be applied.

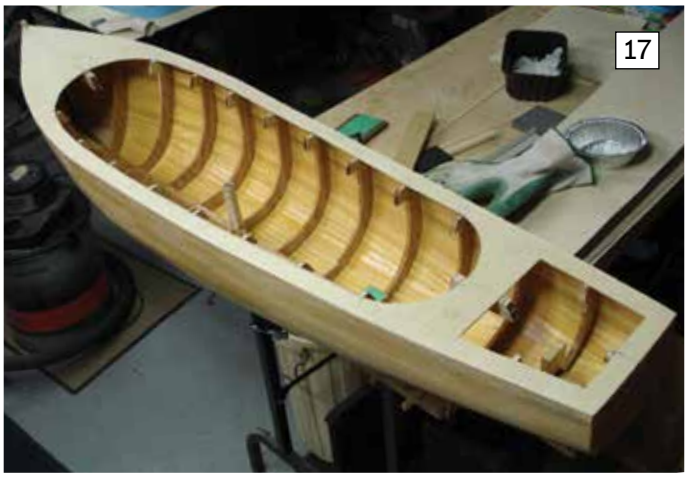
1/16in plywood with the grain running perpendicular to the centre axis of the boat enables easy bending to fit the curvature of the deck.

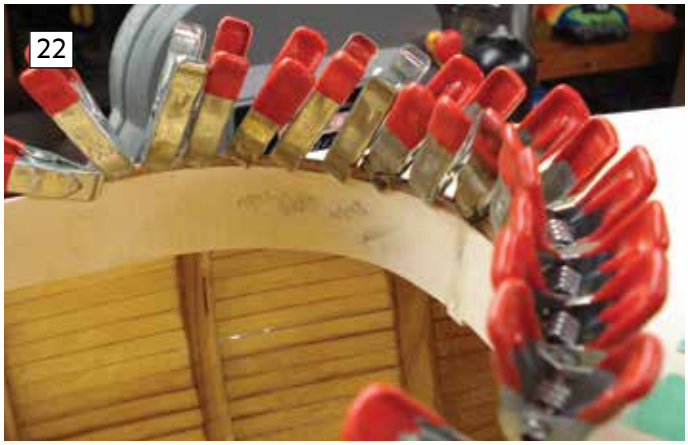
A paper file folder material is scribed with a pencil to provide the profile of the deck. Deck openings are pencilled on, then the template is cut and fitted to the deck material to trace for cutting with a reciprocating jig saw. The deck is then glued to the frames using 30-minute epoxy applied to the entire underside of the deck secured with masking tape, this also enables water sealing the inside surface (**Photo 15 & 16**).

The temporary deck structural members are cut away and vertical comings sanded square and mated to the deck (**Photo 17**). The boiler, fuel canister and engine are placed to check final location of same. The rudder is made of 3/8in poplar and brass pintles are epoxy glued into holes drilled in the stern, and keel shoe with brass plate bolted to threaded inserts in the underside of the keel. The steering servo is installed with fine twisted wire cable and aircraft fittings (**Photo 18**). Close up detail of the rudder arrangement and new building support cradle (**Photo 19**).

The propeller and shaft installed for test fit. All components removed for further hull construction. The prop is an older Dumas 2.5in dia. x 2in pitch which proved to be a good match when running.

Cockpit comings are cut from 1/16in plywood with grain running vertically to enable easy bending along curved openings and glued with 10-minute carpenters glue





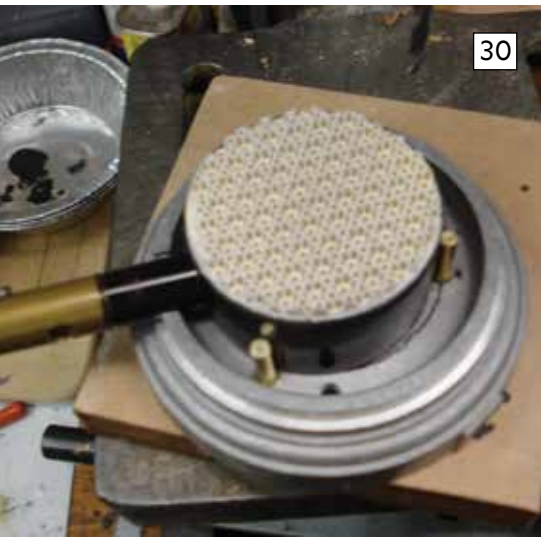
and held in place with clamps, sections at a time **(Photo 20 & 21)**.

Mahogany coming and gunwale strips are soaked overnight and glued with 10-minute carpenters glue and clamped in sections. Multiple strips applied to sides and top provide the final thickness, gunwale strips glued and taped (**Photo 22 & 23**).

All mahogany is sanded to shape and given a smooth finish; two coats of clear satin urethane brushed and foam brushed (**Photo 24**).

Threaded brass inserts are installed to the keel to enable removable boiler and cockpit floors. 1/8in aluminium plate is drilled to enable later bolting of the boiler base to it to provide heat resistance from the boiler burner. A mahogany floor is installed the same way for cockpit and gas canister holder forward **(Photo 25 & 26)**.

Mahogany cockpit benches with brass rod supports and mounting blocks enable easy removal of same. Boiler base is drilled enabling bolting to aluminium floor (**Photo 27**).

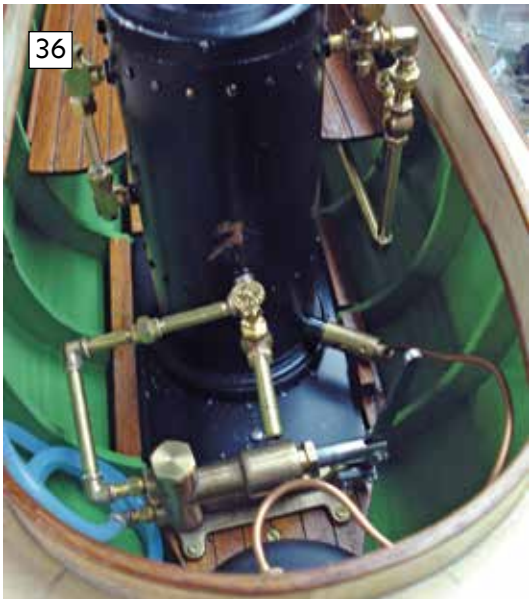


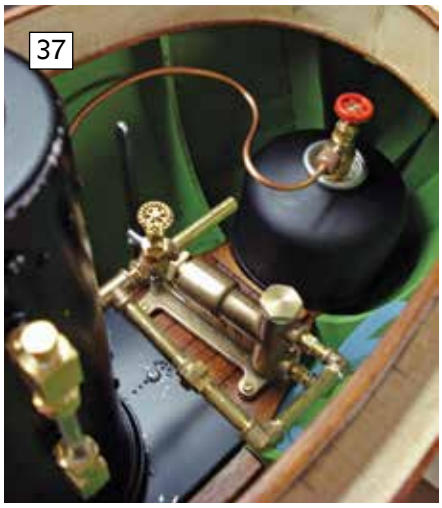
Boiler and engine

The next step was to construct the boiler; the kit required some minimal machining of the base and top aluminium castings and fitting of the smokestack, top fitting and making of riveting tools. Excellent step by step instructions, drawings and templates are provided.

The following brief summary sequence photographs show the basics; it is too exhaustive to explain in detail (**Photo 28-32**). The boiler is pressure tested for leaks with the feed water pump **(Photo 33)** and spray painted with high heat BBQ paint **(Photo 34)**.

The various fittings including pressure, water level gauges, valves, whistle, piping, connections and unions etc. are installed, all tapered threads sealed with a special locking sealant. The gauges, whistle etc. (**Photo 35**), feed water pump (**Photo 36**) and gas fuel supply (**Photo 37**) are pictured.





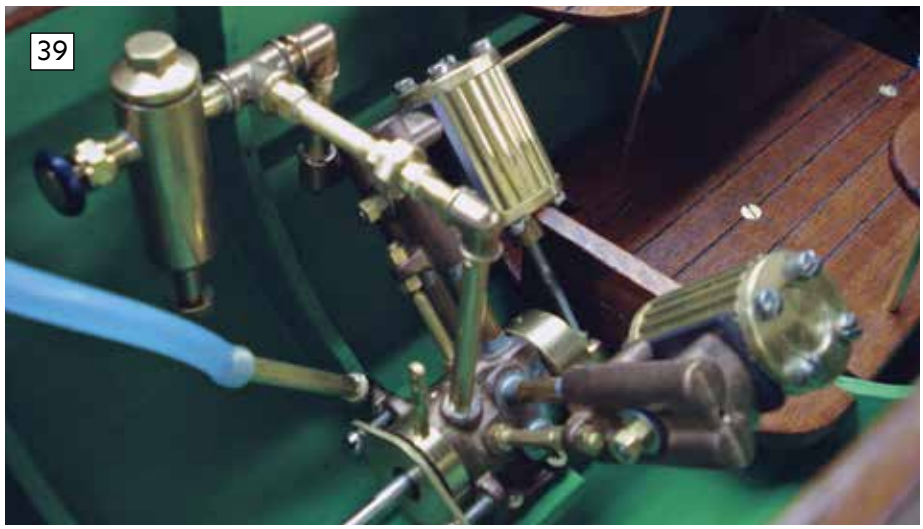
The engine is assembled from the excellent instructions provided (**Photo 38**). Piping is then installed for connection to the engine and displacement lubricator (**Photo 39**).

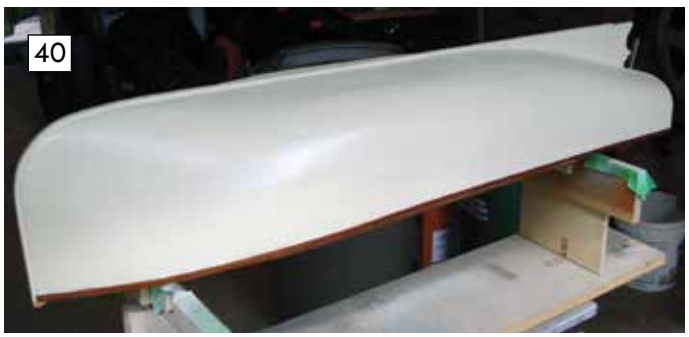
The steam exhaust is discharged through the side of the hull connected by surgical tubing. All components are then removed to enable finish painting of the hull. Two more separate coats and drying, sanding of epoxy finishing resin is applied, followed by a spray primer coating and final sprayed finish Kryon acrylic semi-gloss paint (**Photo 40**). The entire interior of the hull is painted with green, water based acrylic craft paint brushed on, two coats as are the decks and comings in white.

A bathtub test of the completely fitted hull is carried out to establish an accurate water line. Fitted, it weighed 11.2lbs dry and was somewhat 'tippy' when placed in the water. The scale waterline was established and taped to the hull (**Photo 41**).

Lead shot gun pellets were sourced and used to fill the hull bilges and mixed with epoxy resin to secure, other plastic film canisters were filled and glued in place to complete the final ballasting balance to the scale water line. 13lbs of lead shot was required giving a total displacement weight of 24lbs (**Photo 42**).

All components were re-installed and a final bathtub test completed (**Photo 43**) and final fitting out of the hull for fender deck cleats and





interior details. A 'Barbie' 'Ken' doll was found that matched the scale of the boat (**Photo 44**).

Final installation of control systems; the R/C and steering controls (**Photo 45**), mini-servo throttle speed control (**Photo 46**), ISO Butane gas tank and main valve (**Photo 47**) and servo emergency gas shut off (**Photo 48**).

I highly recommend installing an emergency R/C servo gas shut off valve in the event of a drive or steering function failure that prevents the boat from returning to shore for manual gas shut off at the tank as the burner would otherwise continue to operate and the boiler would consume all the remaining water, causing a 'melt down' of the boiler solder joints, structure and possibly the gas system resulting massive destruction and potential fire. I found an inexpensive unit from www.clevedonsteam.co.uk located in the UK, which mated well with a standard R/C mini-servo and the existing

copper gas piping and the connecting fittings that came with the valve.

Keeping with the German origins and design, I created graphics on a PC, printed onto vinyl stock decal sheets and application fluids available from www.bare-metal.com located in the USA. I also sourced a German Ensign desk top flag from the period and the name 'Dampschiff' is 'Steam Boat' in German (**Photo 49**).

Testing of the boiler and engine should be done outdoors away from combustible materials with a 2.5lb ABC fire extinguisher and water spray bottle readily available in the event of a gas leak. All gas fittings and connections should be checked for leakage prior to every launching.

The boiler is filled with distilled water with the feed water pump and surgical hose until

the boiler water level sight glass is approx 75% to the top. The main steam valve is closed to enable pressure retention in the boiler after filling (**Photo 50**). The displacement lubricator is filled with special steam oil and all lubrication points on the engine are filled until overflowing (**Photo 51**). The displacement lubricator (left in Photo 51) and pinhole lube points on cylinder valves and crankshaft housing.

The boiler door is opened to light the ceramic burner (**Photo 52**) as the main gas valve is opened slightly and the emergency shut off is open. It takes about 5-minutes to reach operating pressure of 15 to 25psi; an automatic (spring loaded) safety pressure relief valve on the top of the boiler is pre-set to 60psi (**Photo 53**). The steam whistle can be opened to relieve pressure if needed.

The throttle is set to full forward and the main valve opened. The crankshaft universal joint is rotated by hand slightly to turn the engine over until it starts. Once started the engine can be stopped, started and reversed with the RC controlled valve.

The butane gas supply lasts approx. 30-minutes, but water must be replenished about every ten minutes when the water level sight glass reaches the lower level, the boiler feed water pump is pumped until the sight gauge is again about 75%. This ensures adequate water (approx 50% full) is always available for steady steam supply and safety; this is safely done with the burner on and the boiler under pressure (**Photo 54**).

More info

http://www.confederationmarinemodellers.ca