Hero-a race winning steam squirter

Triumph for Hero of Alexandria and his Aelipile. John Teale describes the racing stern wheeler which trounced the rest of the field during the Cowes/Torquay powerboat race

THERE must be a conspiracy of silence over the Van der Merwe brothers when they go offshore racing. Diligent readers may recall their advanced "pop-pop" boat which spreadeagled the Cowes-Torquay fleet in 1967. Though they met with an accident in the last stages and did not finish, only this journal wrote-up their craft (12 January, 1968). Elsewhere there was nothing. Last month the brothers came over again for the Cowes-Torquay-Cowes with their new boat, *Hero*. Once more they showed up the competing fleet as a ragtag and bobtail of outmoded designs by completing the course at an average speed of very nearly 78 mph, but again no mention. Admittedly they were not official entrants for technical reasons which will be explained later but, starting half-an-hour late, they finished 21 minutes ahead of *Unowot* which surely deserves some critical acclaim.

Whether this wall of silence is because the Van der Merwes are South African or because they are highly anti-social and never, if they can possibly help it, attend parties or mix with the right people I don't know, but prefer to think that the establishment simply dislike having their prized and expensive creations shown up as inferior. That being so, pressure is brought to bear on correspondents from other magazines to keep quiet. But, the cry goes up, *Motor Boat and Yachting* cannot be muzzled. So here we go with all the inside information.

Hero came about rather by chance. The brothers were working on a South African entry for the Whitbread Round-The-World Race, which turns out to be quite a conventional craft for them, when a friend in the timber importing business offered them a load of balsa which he had acquired through a shipping error. What he had wanted was the stuff that can be chopped up and sold for model aircraft kits but what he got was baulks of much heavier balsa, weighing about 16 lb./cu.ft. In this state it was useless for his purposes but had such an excellent strength/weight ratio that the Van der Merwes fell to thinking about ways and means of using it. Eventually they came up with an idea for an offshore power boat with an ultra lightweight hull, to be powered by an adaption of the Hero steam turbine and a stern wheel. They had tried stern wheels before in their windmill sailing vessel (29 November, 1968) and were much impressed with their potential.

Balsa is used quite widely as the filling in glassfibre sandwich construction but here it was decided to employ it as normal planking. The brothers had long been devotees of the Sonny Levi "through" concept where a boat is designed to drive through waves rather than skipping and hammering over the crests and so they got down to drawing out a suitable catamaran. A cat. it had to be if a stern wheel was to be used successfully and the hulls eventually turned out to be completely circular in section with a greatest diameter of 2ft. 9in. and a length of 24ft. This, they thought, would do the job of penetrating waves to perfection while at the same time would be easy to build. Since there was to be no attempt at "flying" in the usual catamaran style a heavy and potentially dangerous bridge deck could be forgotten and a couple of struts used to tie the hulls together in its place. Finally they settled on basically an aluminium alloy framework, covered in the 1½in. balsa, and sheathed inside and out with a layer of glass cloth and epoxy resin. This last feature was in the interests of water-repelling and had no effect on the strength of the vessel.

Complete but without machinery the boat weighed 930lb. which, you must admit, is not at all bad for a 24-footer. Since the engines and stern wheel together only came out at 490lb. *Hero* was a very light boat indeed and this must account, in part, for her staggering performance.

So far as construction was concerned, the craft was unusual though not altogether revolutionary but propelling machinery was in the normal Van der Merwe style of being quite astonishing, if not unbelievable. Way back in the second century B.C., Hero, of Alexandria, built the prototype of all steam turbines. He passed steam from a crude boiler into a hollow sphere, or aelipile. From this sphere a couple of exhausts were pointed so that steam squirting from them would have the effect of turning the sphere. Fig. 1 shows his method. The sphere can rotate about the steam entry pipes which are indicated by that circle in the middle. There would be one entry pipe each side, of course.

If really high-pressure steam were used the sphere would rotate pretty rapidly but the snag for a boat was that since there could be no means of catching the steam and condensing it back into water, as is done on normal steam turbines, vast quantities of fresh water would have to be carried. The brothers solved this one by using three small boilers to pre-heat salt water. As the salt build-up became excessive in one boiler it could be swung out of the way, and a fresh chamber moved over the burner. This is vaguely shown in Fig. 2 and the diagrammatic view of the whole set-up in Fig. 3. After a race the pre-heat boilers could be dismantled and the salt cleaned out.

A burner rather like a petrol pressure stove was used and two of these were

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Fig. 1. The principle of a Hero steam turbine. Steam exhausting from a sphere will drive it about a shaft

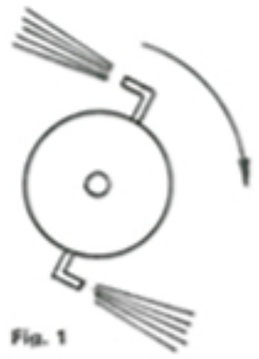

Fig. 1

Fig. 2. This rather mysterious sketch shows the three pre-heat boilers but can be better understood when it is realised that one of the boilers is lettered C on Fig. 3. Only one burner is used and the boilers are swung across over it as required

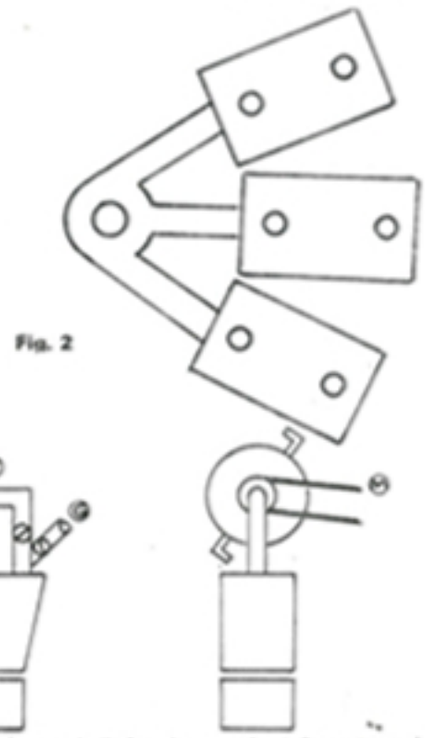

Fig. 2

Fig. 3

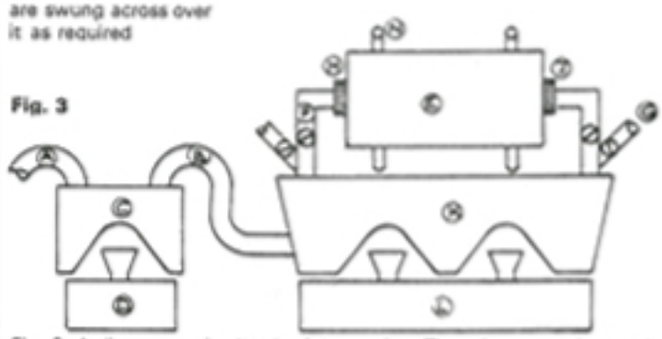

Fig. 3. A diagrammatic sketch of the engine. There is one engine per hull. A, salt water feed. B, pre-heated salt water to boiler. C, pre-heating boiler. D, petrol pressure burner. E, main boiler. F, steam pipe to turbine. G, steam bleed-off pipe. H, gear for chain drive to stern wheel or auxiliary pumps. J, gear wheel for chain drive. K, main boiler. L, double pressure petrol burner. M, chain drive. N, exhaust from turbine

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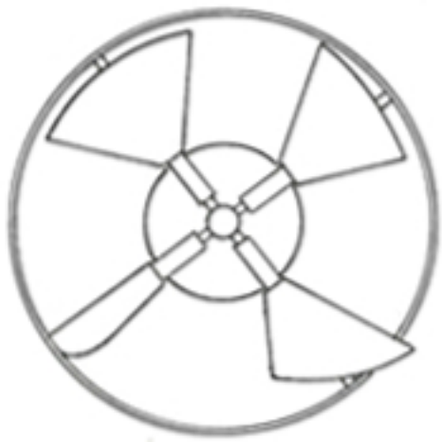
sited under each main boiler. So, very hot and relatively salt-free water was pumped into the main boiler and further heated up to a temperature of about 400 deg.F and a pressure of some 4000lb. This was led through well-lagged pipes into the cylindrical Hero reaction turbine which had two sets of exhausts and turned two sets of gears, one at each end. One set drove, through chain, the stern wheel and the other operated the pumps required to fill the pre-heat boilers and to circulate the hot water. Nothing could be simpler than that and at full power the turbines revolved at about 2000 rpm. If reverse was required the main steam valves were shut and the bleed-off valves opened, Fig. 3. This brought the turbines to a halt very quickly under the drag of the stern wheel. The exhausts were then turned so that they faced the opposite ways to their ahead positions, steam was again let into the turbines and off the boat went at full power. Going astern was a bit wet because of the blunt-ended transoms but completely effective.

The Van der Merwes had, as has been mentioned, stern wheels in their sailing boat but though these were feathering they were otherwise quite normal. For a racing vessel it was decided that something a little more sophisticated was needed such that the full area of each paddle was not waving about in the air when it had done its useful work in the water. Thus paddles that feathered into a fore and aft position were devised. Their action is a little difficult to show without going into a lot of detailed drawing but, essentially, the inner end of each float is fitted with two sets of lugs which act as teeth in turning the floats through 90 deg. twice in each revolution. The lugs are turned by projections on a circular cam surface which is attached to the vessel. Sounds complicated but it isn't really.

Stern wheels cannot be turned very fast since their paddles are very large compared with a propeller, and on this one the 2000 rpm turbine speed was geared down by the chain drive to about 90 rpm at the wheel. It was also arranged that the wheel pivoted about its drive and was sustained at a fairly constant depth in the water by floats positioned ahead of the drive. These can just be discerned on the general arrangement sketch. The idea is that as a wave rushes by the hulls, the floats lift and in doing so raise the whole stern wheel. This made for some interesting paddle positions when the craft was driving through rough water.

Anyway, suffice to say that it worked. The general layout of the craft is probably quite obvious. The brothers sat one in each hull. One did the steering and navigating — small rudders were fitted beneath the hulls but are not shown — and the other operated the "works" of the engines. He had temperature and pressure gauges for both pre-heat and main boilers fitted in his cockpit together with the various levers and switches enabling him to swing a new pre-heat boiler into position; keep up the pressure in the burners; juggle main and bleed steam valves as required; ensure that the pre-heat boilers were getting the right amount of salt water and so on. In fact he had a full-time job since nothing at all was automated in the modern style. A weird selection of bowden cables dominated his space.



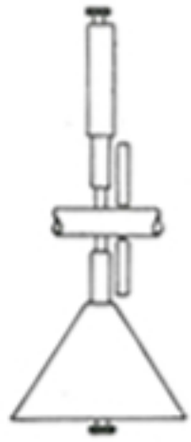


Fig. 4. The stern wheel in vertical section and profile. The four blades are segment-shaped and can be feathered so as to present a vertical surface to the air

So, you say, why wasn't *Hero* accepted for the Cowes-Torquay? The answer is that it simply did not fit into any of the categories, which catered for diesel, petrol and gas turbine motors, but not steam turbines. What was its engine capacity expressed in conventional and race rule terms? Goodness knows and the scrutineers certainly didn't despite their efforts to accommodate the two South Africans. Eventually they said that the craft could start half-an-hour after the others and should keep clear of the genuine entrants but that *Hero's* time would be taken. And so they set off on the race about which they can recall no special incidents. By the half-way stage nearly all the other competitors had been overtaken and the two leaders *Unowot* and *Nicopao* were passed on the return leg near Anvil Point. The brothers had been rather contemptuous over the gas-turbined craft and were not at all surprised when they surged by *Miss Embassy*, obviously not going at all well. Of the reputed roughish water in Lyme Bay they have no recollection but after their trip in the Roaring Forties it must all have seemed rather tame. At about 1.40pm they entered Cowes and, perhaps typically, simply made a circle inside the finishing line before heading off for Cherbourg. Whether anyone was waiting to welcome them back seemed doubtful to them and, anyway, they had been invited to join a friend on his yacht in the Mediterranean. After the comparative gloom and cold of England they couldn't wait to sample the bright lights, bikinis and balmy breezes.

Hero is being shipped to South Africa but might return next year if some sort of official position is found for her in the race. This is bound to prove difficult, especially as the Van der Merwes are rotten letter writers and, once home, tend to get completely immersed in the business of running their farm. So it may be that the Round-The-World Race boat of theirs will be the next we shall hear from them. As I said, this is not especially unconventional but bristles with original ideas and we can only hope that for once their efforts will be crowned with recognised success. □

Fig. 5. General arrangement of Hero. The brothers found the forward air rudder necessary to keep them straight when driving through waves. The floats each side of the two hulls are designed to ensure that the stern wheel runs at a fairly constant depth in the water