SCORPION

A Fast-Electric hydroplane by Glynn Guest

Fast electric models have a great appeal to me. They are easy to build and offer good performance at a modest cost. These factors encourage you to try new ideas since the time and money spent is not too great.

Hydroplanes are ideal subjects and a few years ago a very simple model was built, see RCBM Sept/Oct '87. This model worked quite well but because of its low bows it was not one that I dared to sail in rough conditions. The large turning circle was another drawback on smaller waters.

The stimulation for another electric hydroplane came with the appearance of Graupner's Hydrospeed unit. This used a surface piercing propellor mounted on a steerable strut which was fixed to the transom. It was, naturally, intended for use on Graupner kits and personal experience with the *Arrow* model convinced me of its potential.

Design

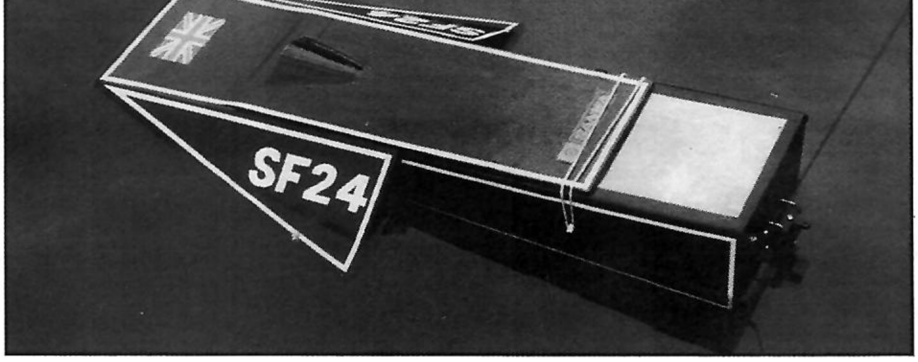
As with the previous model, balsa sheet construction was used to produce the angular lines that seem to suit hydroplanes. To cope with rough water the bows were lifted and the sponsons enlarged. Experimenting with the layout of motor unit, batteries and R/C gear led to a high transom which ran straight down to the bows. This "tail high" attitude suggested the idea of naming the model after a well known, if not notorious arachnid.

Despite its unorthodox appearance the model was easily built. The simple paint scheme of gloss black with white trim lines courtesy of the local car accessory shop(!), seemed to match its sinister image.

Testing

The first sailing trials showed that confidence based upon past experience and optimism is no substitute for going out and doing it! The *Arrow* model suggested that these Hydrospeed models should briskly accelerate up to top speed. My model slurped and gurgled across the water at an embarrassingly slow crawl. Severe aeration of the propellor was obvious to all. Trying every propellor in my possession proved fruitless; the noise might change but the model would not go!

The final conclusion from these



fiascos was that the problem lay with the model rather than the drive unit. All hydroplanes start to move in a very high drag mode before the hull lifts and resistance decreases dramatically. The surface piercing propellor did not seem to be able to create sufficient thrust to accelerate the model through this initial high drag state before aeration occurred.

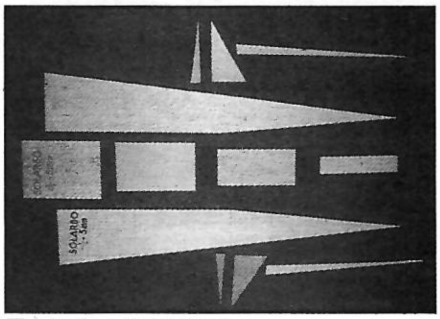
Salvage operation

Clearly the Hydrospeed unit, despite its potential, was never going to get the *Scorpion* onto the plane. Perhaps a more "slippery" hull would accelerate quickly enough to avoid aeration but this is something to try on another model. Reluctant to abandon this design I opted to convert it to a conventional submerged drive but with the propellor just under the transom and the rudder behind the transom.

Luckily I had a Robbe Navy Direkt drive unit in the spares box. This comprises a 550 motor rigidly connected to the prop-shaft, the motor and tube being held together with a plastic moulding. Thus, the whole assembly

approaching at high speed, the motor was cut whilst keeping the rudder deflected. During the rapid deceleration and "flop" back into the water the model finally turned. It was then discovered that putting the rudder hard over before switching the motor on would produce a turn through about 90 degrees whilst the model accelerated onto the plane. A little more experimentation showed that small rudder angles (about 5-10 degrees) could produce gentle turns with a 120 foot (35m) diameter! Any more rudder deflection and the skipping started leading to prop aeration and a loss in speed but no tighter turn. Despite the different characteristics it was not too hard to master the model and have great fun sprinting across the lake.

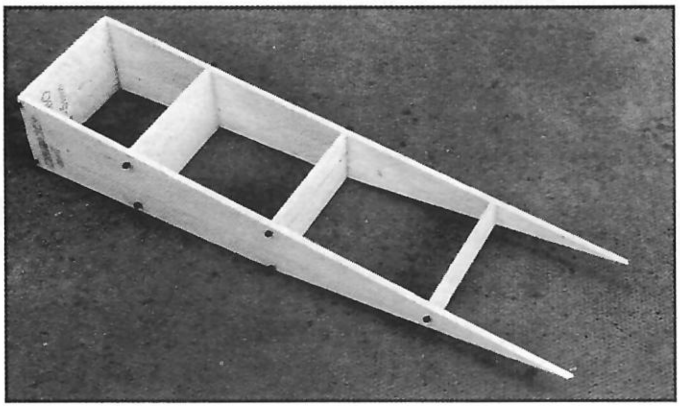
Having proved the new drive system trials were carried out with different propellors. Of all the commercial plastic props tried none could better the P35, anything larger or smaller lost speed or aerated badly. Out of interest I tried a high speed brass propellor, this promptly overloaded the motor, aerated like mad and tried to chew its way through the



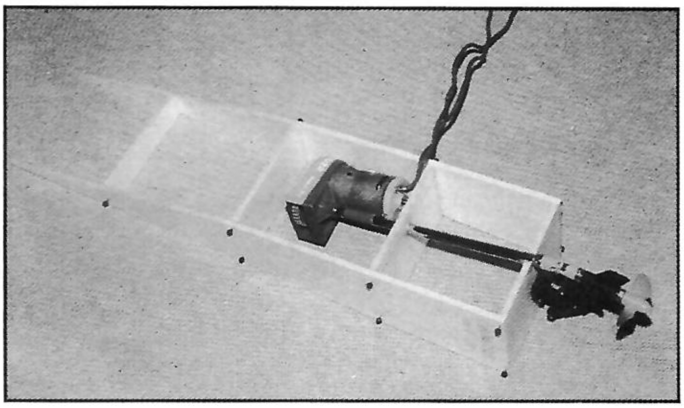
The hull parts laid out.

called for to avoid movement whilst sailing. These changes also moved the propeller some 1/2 inch (12mm) forward from the previous position. This had no noticeable effect on the performance and behaviour although the "rooster tail" might have been a little less prominent. The same trials as before gave the same results, ie a P35 propellor and CG 1/2 inch (12mm) behind the sponsons seemed to be optimum.

As a further experiment two five cell nicad packs were tried, that is 12 volts as opposed to 9.6 volts from two four cell packs. The top speed was probably raised but not dramatically so. The final experiment was a turn fin on one of the



Hull and bulkheads assembled.



Ill-fated Hydrospeed unit fitted into hull.

forms a one-piece power unit which requires only a single hole in the hull bottom and some support for the motor. Another stroke of luck was the discovery of a suitable outrigger rudder assembly in the same spares box. This was an all plastic affair from an old kit model.

What a difference the new drive system made! On the next outing the model leapt forwards in the characteristic fast electric fashion, onto the plane with a spectacular "rooster tail" of spray from the propellor. Only the bottom edges of the sponsons cut through the water as the rear of the hull seemed to skim over the surface with little disturbance.

The grin was soon removed from my face when a turn was attempted. The rudder had little effect at first, and increasing the angle only served to slew the model and produce a sort of oscillating skipping action across the water. The propellor started to aerate at this stage but the model still did not want to turn. As the bank was

hull bottom!

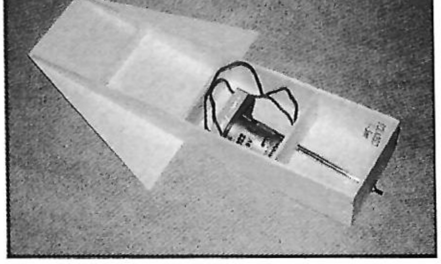
Moving the Centre of Gravity about was then tried as this can be critical on high speed models. Too far to the rear and the model ran in a nose high fashion and lost speed. Too far forward and the bows would not lift sufficiently, so the optimum seemed to be about 1/2inch (12mm) behind the rear face of the sponsons.

At this stage the model became very noisy when running at full speed. Upon checking the model the motor could be seen to vibrate vigorously. After stripping down the drive unit it was clear that the propshaft was noticeably bent. I suspect that the large brass propellor had caused it through overloading and being out of balance.

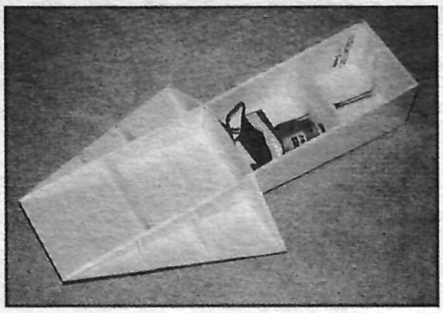
An attempt to straighten the shaft failed so the whole unit was removed. A conventional drive system of motor, coupling and propshaft was then installed. This gave minimal clearance between the coupling and the two nicad packs. Careful packing and securing was

sponsons. These fins can tighten the turn of hydroplanes by reducing the tendency to slip sideways. The *Scorpion* model had other ideas and ignored the rudder as before.

With the drive system and operating technique sorted out the model was tried in some rougher conditions. A steady wind across the lake produced waves with a height, from trough to crest, of about 1-1.5 inches (25-37mm). These were conditions in which I would never dared to have operated the



Hull bottom and sponson sheets after trimming excess away.



Sponson formers in place.

previous hydroplane model. Much to my delight the *Scorpion* stormed over the water in a safe and predictable fashion. The bows were always well clear with no danger of "digging in" at any time. A good time to get the plans drawn up!

Construction

The model makes extensive use of balsa to give a light, strong yet easy-to-build structure. Medium grades of wood ought to be adequate; quarter-grain is ideal but not essential. Do try to avoid any of the light but brittle wood that sometimes appears in a model shop stock. With careful cutting most of the model can be built from two 4 inch (100mm) wide sheets of 3/16 (5mm) and 1/8 (3mm) thick balsa.

The simple angular nature of this design ought not to lull you into any poor building habits. All the joints need to be sharp and well fitting with no suggestion of weakness. On the prototype a fast drying PVA type of adhesive was used. The drying time of 15-30 minutes proved to very convenient in allowing the pieces to be adjusted to their correct position before pinning into place.

A numerical building sequence might be best as the construction is a little different to the normal model boat.

1) The first stage is to cut out the hull and sponson pieces. All the cut edges need to be clean and square, so use a new blade, straight edge and care! If you are planning on using nicad cells larger than the sub-C (1.2 AHr) size then widening the bulkheads might be a good idea.

2) The two sides and bulkheads are then glued together. They must be square and true before pinning in place. Drawing the positions of the bulkheads on the side pieces can be helpful.

3) In the original Hydrospeed equipped model the motor unit had to be added at this stage. With a conventional drive system the prop-tube is fitted later. The hull bottom is sheeted with 1/8 inch (3mm) balsa. It is easier to glue oversize pieces in place, then trim to the correct shape when dry.

4) The sponson formers are added next to both the top and bottom of the sheet. Again it is important to keep them square to the hull.

5) The sponsons are then covered on the top and bottom with 1/8in (3mm) sheet. The best method seemed to be to make the joint between these sheets and the top edge of the hull sides accurately, the other edges can be oversize and trimmed later. The fixed fore deck sheet can be glued across the hull sides. It ought to fit neatly between the sponson sheets.

6) The hull can be sanded now. A sanding block is desirable since all the edges except the bows need to be sharp, not rounded. Any cracks and gaps need filling at this stage.

7) The propellor tube can be fitted now. Use the plans as a guide for the position of the hole in the bottom sheet. Epoxy could be used to stick the tube to the bottom and B2. I used balsa cement and a strip of fabric reinforcement. This proved strong enough for operating stresses yet could be removed without destroying the model.

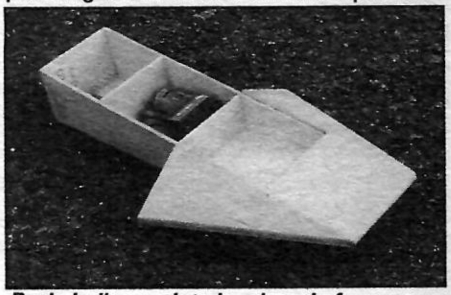
8) The motor and coupling are best installed at this stage. A little packing might be needed under the motor to get the two shafts correctly aligned. The motor is held in place by an aluminium strap secured by screws into two balsa blocks either side of the motor.

9) The hatch over the motor-battery compartment can be made. I used a piece of light plywood from an old scrap of wall boarding. This was light but stiff enough without the need for internal reinforcement. A sheet of balsa could be used but would probably need some stiffening. A cowl needs making in the hatch to create clearance for the motor and allow cooling air to circulate. Thin aluminium is the ideal material to use. The hole in the hatch and cowl shape is best found from a "cut and try" technique. Do not fix the hatch to the hull until painted.

First modification to take Robbe Navy Direkt unit.

Surface Finishing

A balsa surface can be sealed for painting with thinned domestic primer.



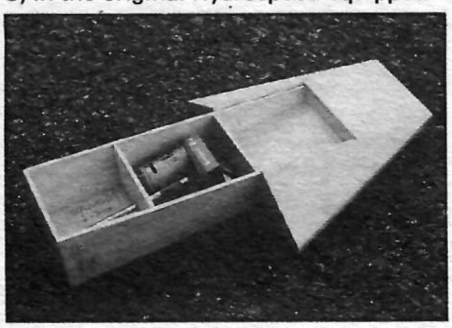
Basic hull completed and ready for finishing.

My preference has always been to use cellulose dope. A couple of thinned coats, rubbing down between each, gives a base for a layer of model aircraft tissue. The angular nature of this model makes this task quite easy. The tissue is cut to be slightly larger than the flat area to be covered then laid in place. Unthinned dope is then brushed through the tissue, starting at the centre and working outwards. Any wrinkles can be removed by lifting up the tissue then doping down again. The edges of the tissue could be trimmed off but a better method can be bend them around the corners and dope them down. Another couple of coats of dope, with very light sanding, will produce a tough surface which is a sound base for the paint.

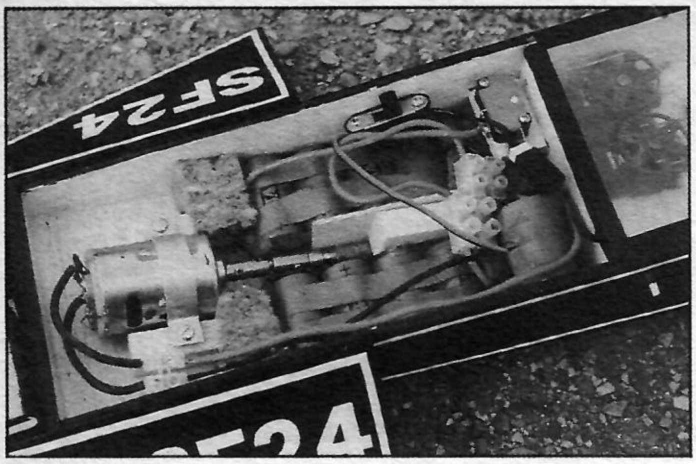
How you paint the model is entirely in your hands. A single colour enlivened with some self-adhesive trim tape worked well on the original.

Outfitting

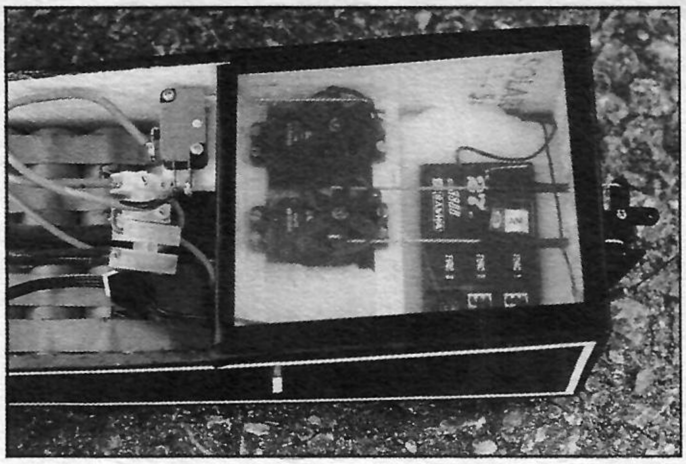
Lubricating the prop-shaft seems a good idea before going too far. If the coupling is slackened off then the shaft can be removed. I use an old oil can to squirt motor oil into the tube, then quickly reinsert the shaft and secure the coupling. Motor oil is a reasonable compromise, it is not too fluid to weep past the bearings nor too viscous to create excessive drag on the shaft. It does have the drawback of emulsifying



Hull completed.



Second modification for conventional motor-coupling-propeller tube.



Close up of R/C compartment which is sealed with a clear plastic sheet and self-adhesive tape around edges.

when any water mixes with it. However, if you set the drive system up correctly, that is with the propellor washer pressing lightly on the lower bearing, then water penetration should be minimal. Anyway, it gives you a reason for re-oiling the tube every so often!

The plans show details of how to make up the rudder assembly. A little metal sheet and rod will produce a robust item. The only problem might be the tiller arm but a suitable collet for the shaft should not be too hard to find. Alternatively a commercial rudder could be used but the tube might need discarding. The rudder assembly is screwed to the transom so that the blade is directly behind the propellor.

The radio installation centres around the rudder servo. A double linkage to the tiller is highly recommended to minimise any play in the rudder action. A simple way to mount the servos is with a strip of balsa on the rear face of B3. A second transverse strip can be glued across the radio compartment to provide a pair of rails into which the servo lug screws can be secured. The rudder linkage on the prototype was just two pieces of wire very carefully bent and cut. To allow smooth movement they fitted into a couple of plastic tubes glued through the transom. Adjustable commercial linkages might be a little easier.

The prototype used a simple ON-OFF motor control via a microswitch. This was placed in the battery compartment and operated by a wire link through a plastic tube to the servo in the R/C compartment. This left enough space in the rear of this compartment for the receiver. A wire whip aerial was secured to the transom and connected to the receiver by flying leads. If you use this method then ensure that the total aerial length is the same as the original. The associated battery pack was placed in the motor-battery compartment, partly for better access for recharging but also for trimming adjustments. This allowed the R/C gear to be well sealed with a clear plastic sheet held down by self-adhesive tape around the edges.

The hatch can be fitted now. It can be held down along the front edge with suitable self-adhesive tape. This creates a hinge for internal access. The rear of the hatch can be secured with an elastic band stretched between two dowels either side of the hull.

The nicads should fit snugly if they are in two identical packs either side of the prop-tube. Their position should be adjusted to give the CG about 1/2in (12mm) behind the sponsons. Make sure that they cannot move whilst sailing though!

Sailing

Having described the development of this model earlier, you should have a good idea what to expect. Give yourself the best chance of success by choosing a calm day for the maiden voyage. Likewise a large lake is desirable if you want to have a reasonable run at full speed.

Double check the operation of the radio and drive system. With the recommended CG position the model should float level with the bow edge at the water surface. If the bows appear to be under the surface then check the balance position. It might also be a sensible precaution to cover the cowl opening with a strip of tape until the proper trim is obtained.

When happy point the model towards the middle of the lake, well away from any dangers, and switch on. Until you get accustomed to the model's idiosyncrasies, the best reaction to any problem is to switch off. The model will quickly decelerate to rest and give you a chance to sort things out.

Close up of rudder assembly.

Underside view showing drive and rudder system. Note turn fin on one sponson. All photos: Author.

Conclusions

Hydroplanes are still full of unpredictable challenges. Fortunately the use of fast electric technology can minimise propulsion problems and let us concentrate on the performance and handling areas. The *Scorpion* model has, in its present form, been developed to avoid serious problems and give an exciting yet reliable performance. There is still scope for experimentation. So if you build one and manage to make it turn tightly at full speed, let us all know how you did it!