DAPHNE

An electric launch

BY BRUCE HALABISKY

I've always had an uneasy relationship with electricity. Perhaps it has to do with my first encounter with it as a child. I vividly remember the smell of burning toast, a butter knife thrust into the toaster to save the charred wreckage, an unfamiliar tingling in my hand, more tingling, more sensation, then—"Ouch!" as I quickly drew back my hand in horror. After a moment of confused recuperation, I swore that whatever the mysterious force was, I wanted nothing to do with it.

This deeply held prejudice against electricity went unchallenged until recently when a client came to me and expressed interest in an electric boat. An electric boat! Perhaps electricity is fine for burning bread, and it seems to work well for late-night reading, but propelling a boat?! I told him I would think about it.

I soon discovered that electric-powered boats are not a new idea. As early as 1893, the Electric Launch Company (Elco) produced 55 electric launches, each 36′ long, for the Chicago World's Fair. During that summer of 1893, the Elco launches carried more than 1,000,000 passengers on 66,000 trips for 25 cents a ride. For the next 56 years, until they closed in 1949, Elco designed and built thousands of electric boats. Not only were these boats devoid of smoke and noise, but (as Elco's 1902 catalog proudly points out) they did not explode. Gasoline and naphtha alternatives sometimes did explode. Safety was a big selling point for Elco.

The present-day obscurity of electric-powered boats is not necessarily because they don't work well, but rather that petroleum engines became more efficient and much safer than they once were. Compared to internal combustion engines, electric motors are not yet a viable option if one is only concerned with power and speed. We take for granted a lobsterboat that planes at 25 knots with a full load of traps, despite the impracticality of pushing a vessel above hull speed. The low cost of fuel and a general disregard for the marine environment allow us to cruise at full throttle without much concern.

As I learned more about the union of electricity and boats, I realized that quiet, clean power could enhance the beauty and serenity inherent in any boat—particularly in a wooden boat. Wooden boats are by nature graceful creatures, and the installation of a loud, smoking power source, crying for attention at every revolution, detracts from the tranquility of the wooden boat. Because most electric boats don't cruise above hull speed, it seemed to me that a wooden electric boat might achieve a grace akin to that of a wooden sailboat.

With this idea in mind, despite memories of the angry toaster, I warily laid the keel for a 21′ launch to be powered not with the 8-hp Sabb diesel that had been intended for it, but with a 3-hp electric motor.

Hull Design and Interior Layout

Designed by Nelson Zimmer, the plans show a launch 21′3″ long with 7′ of beam and drawing 1′9″. DAPHNE, as she was to be called, proved to be a good choice for an electric power plant. She has a displacement hull shaped for efficient cruising at low speeds with enough volume to easily carry the necessary batteries. While most launches operate on protected lakes, DAPHNE was to travel the semi-protected waters of Penobscot Bay in Maine. Unlike many of the more delicate fantail launches, she has considerable freeboard forward and a healthy amount of beam to give her stability. The launch was designed with a small house to cover the engine. DAPHNE's owner, however, favored an open cockpit in order to carry more passengers.

Compared to the immobile mass of an internal combustion engine, batteries offer considerable flexibility in their placement and can be shifted to the best advantage for boat trim and stability. Modern glass-mat batteries like those used in DAPHNE can be mounted in almost any orientation, even on their sides, but it makes sense to get them as low and as near the centerline as possible. The total battery weight of about 900 lbs is comparable to that of the diesel engine and fuel tanks, while DAPHNE's electric motor is about the size of an oatmeal container

BENJAMIN MENDLOWITZ

Bruce Halabisky built this striking launch to Nelson Zimmer's plans. He powered the boat with electrical components specified by Elco. The result: 6.5 clean, silent knots.

(7″ in diameter by 14″ long) and weighs less than 60 lbs. The motor is belt-driven and mounted parallel to the shaft on a plate bolted to the engine beds.

The low profile height of less than 14″ was a welcome advantage in laying out the interior of the launch. By raising the floorboards by only 2″, they could run the length of the interior without the batteries or engine box interfering. Because the motor drives the shaft through a V-belt, a variety of arrangements are possible. I have seen installations on sailboats which tucked the motor up into gear lockers so as not to visually change the cockpit layout. With this degree of flexibility, DAPHNE's power source promised to be quiet and conveniently out of sight.

The Electrical System

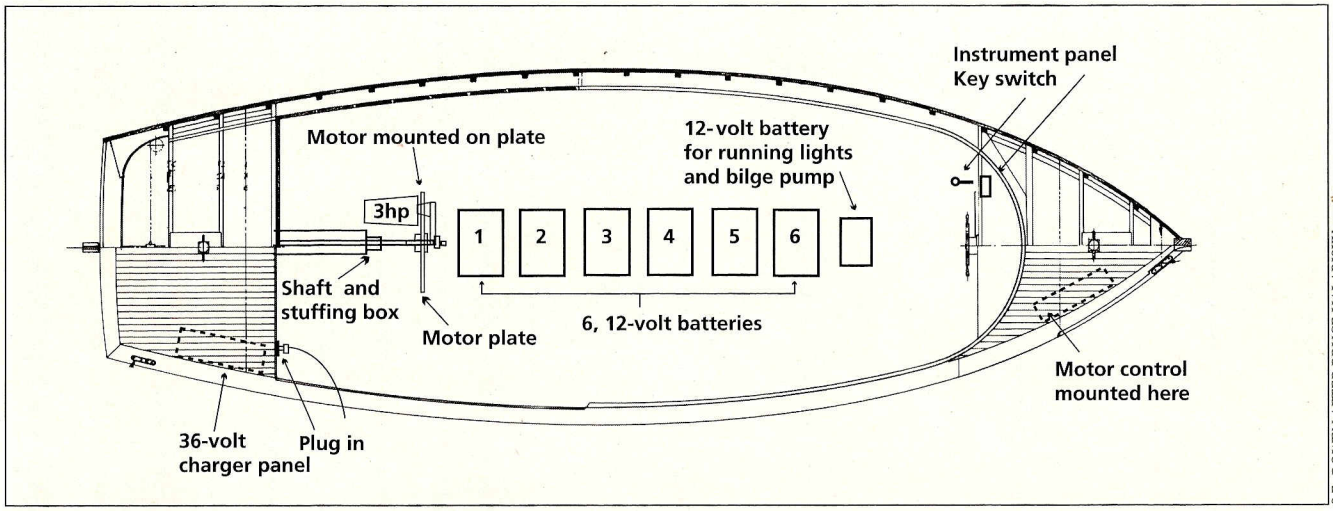
For the electrical system I went to Elco, located in Highland, New York, a revival of the same company that built the launches for the 1893 World's Fair. The components amounted to four basic elements: six 4D batteries, a 3-hp motor, the battery chargers, and a control panel. The batteries and motor can be partially exposed to the environment, but the control panel and the chargers must remain dry. I placed the controller and charger under the forward and after decks, respectively. The batteries and motor were set amidships between floor timbers.

Included in the Elco system is a meter to be mounted near the helm so that its digital readout can be easily viewed. This meter shows at a glance how many amps the system is drawing and, perhaps most important, how many hours of power remain if one continues at the current speed.

To change from forward to reverse, the control unit simply switches the direction of current flow in the field windings, making it possible to go instantly, even aggressively, from full forward to full reverse without harming the system. The three-bladed 15″-diameter propeller is about as large as the keel would allow. Its pitch is 12″.

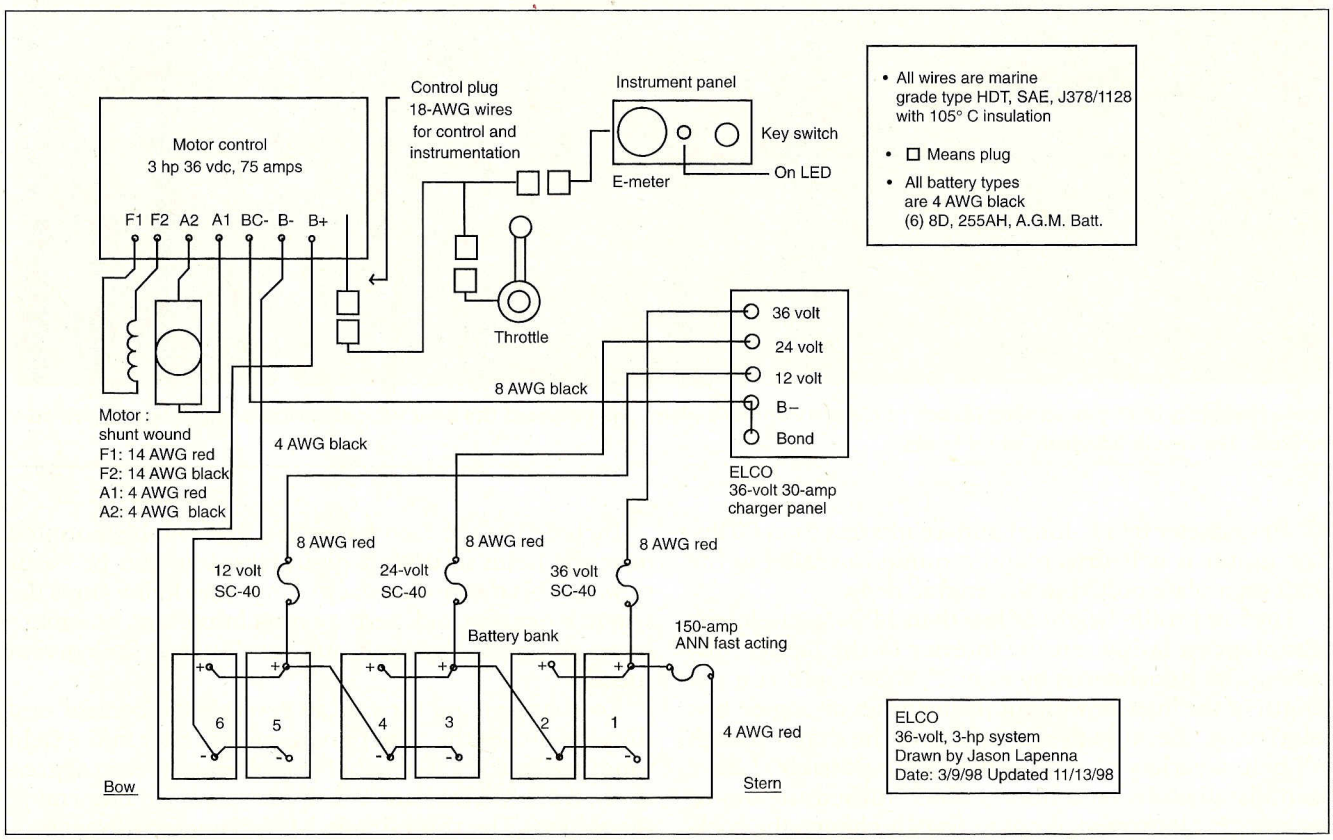
Before wiring the system, I intensely studied the wiring diagram and interrogated any electrician who wandered into the shop. I had my doubts that the tangle of black and red noodles would actually transmit power to push the launch through the water, but I suppressed my misgivings.

The chargers consist of three units, each wired to a pair of batteries. The 110-volt AC shore power comes aboard through a cord plugged into the chargers, sized and fused for 30 amps. A full charge takes about six hours, during which time the chargers regulate the amount of current into the batteries. This ensures maximum battery life and safeguards against over- or under-charging the system.



S.E. BOWEN AFTER BRUCE HALABISKY

DAPHNE's electrical components sit low and spread out in the bilge.



JASON LAPENNA

Elco prepared this schematic diagram of the electrical propulsion system for builder Bruce Halabisky.

Specifications for DAPHNE's Propulsion System

Motor Controller
Operating voltage: 30–45 VDC
Current limit setting: 110 amps
Maximum continuous current: 75 amps
Dimensions: 16 × 12 × 5″

Battery Charging System
One panel with three 12–VDC chargers
Input: 100–130 VAC, 50–60 Hz
1,245 total watts, 0.7 power factor
Output: 30 amps per charger below 12 VDC
tapering current per charger 12.0–14.2 VDC
Four-hour hold at 14.2 VDC (constant potential)
13.2 VDC end-of-cycle flat voltage

Throttle
Modified side-mount

Instrument Panel
On/off key switch
On LED
E-meter

Motor
Kostov, 36 VDC, 1,750 rpm, 3 hp, 75-amp full-load armature current, 3-amp shunt-wound field, ⅞″ shaft, open frame, fan cooled

Fuses
Battery bank, main: ANN 150
Elco chargers: SC 40 (three each)
On motor control: AGC 10

The entire electric propulsion system came to roughly the same cost as a new diesel with fuel tanks and controls.

Trial Run

Once the batteries were charged and the wiring completed, a launching date was set. For lack of a proper trailer, DAPHNE was launched from a Travelift. The new owner and I sat nervously in the cockpit while DAPHNE swung in the slings, suspended as if in flight. A crowd of curious onlookers lined the dock as we were lowered to the water. A moment later we were floating. To my great relief, considering all the interior alterations to the original design, DAPHNE floated on her lines. I turned the key. A little red light went on. I took this to be a good sign.

For some reason, it had never occurred to me that the electric motor wouldn't "idle" at rest. When it is turned on and is in neutral, everything (except for the little red light) looks and sounds the same as when the motor is turned off.

I carefully nudged the throttle into reverse. To my amazement, there was no fire, no smoke, no jagged arcs of blue energy, and no strange tingling in my fingertips. As the shaft slowly turned there was a gentle hum, and DAPHNE backed out of the slings. She spun gracefully out toward the harbor, and I gave a little forward throttle. Still no explosions, no tingling fingertips. With growing confidence I increased the speed. At full throttle, about 750 rpm, there was a pleasant whirring with hardly any vibration. DAPHNE moved out into the bay, not at breakneck speed, but with vigorous determination and not a whiff of smoke or fumes. Full throttle pushed her along at 6.5 knots, the only noise being a quiet hum and the slapping of the waves against the hull.

DAPHNE now ferries her owner on a regular basis between two islands in Penobscot Bay. Conveniently, both islands have a dock and a power cord for plug-in charging. In a less ideal environment with no access to electricity, solar cells could be mounted on a canopy or an onboard generator could supply power. At the dock, a six-hour charge allows about four hours running time at top speed, ten hours at three-quarters speed, and nearly 20 hours at half speed. On a full charge this allows DAPHNE a 20- to 30-mile range. Although 6 knots may seem painfully slow after stepping out of a Boston Whaler, one has enough speed to keep up with most sailboats—and the quiet permits easy conversation.

I imagine many people are as wary as I was of electric propulsion. However, gliding along in DAPHNE, it's possible to imagine a cleaner, quieter future for small powerboats. One can picture the peacefulness in a large marina devoid of obstreperous engines and the sheen of oil so common today. Electric boats take their passengers to a realm of enjoyment otherwise reserved for sailors, rowers, and paddlers. Silent motion and the beauty of a wooden boat are a combination that combustion powerboats have failed to achieve. True elegance is an electric boat, without exhaust or oil, cruising quietly across the water.

BENJAMIN MENDLOWITZ

The batteries and motor fit neatly under the floorboards.

Bruce Halabisky works for the Atlantic Challenge Foundation. With help from apprentices, he built DAPHNE as a private project at the Apprenticeshop of Rockland (Maine).

You can contact the Electric Launch Company at 261 Upper North Rd., Highland, NY 12528; 914–691–3777.

Plans for the original launch (powered by an internal-combustion engine) are available from The WoodenBoat Store, 800–273–7447.