

# How the hybrid works



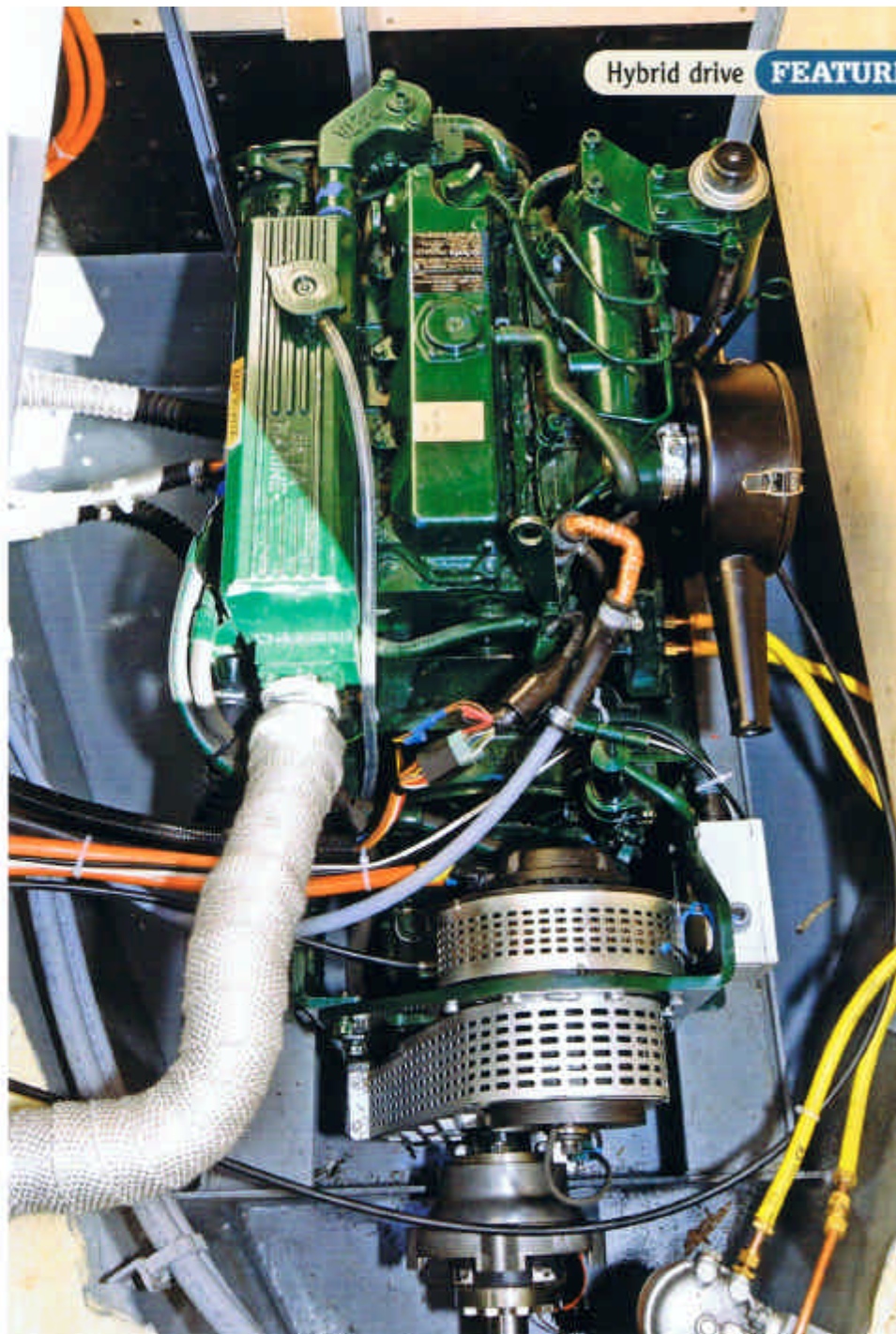
There will be three narrowboats with diesel/electric engines at Crick this year – here we take an in-depth look at the system and find out what it's like out on the water

TEXT BY NICK WALL

**A**t the very mention of a hybrid engine, you might expect us to come over all 'Green' and talk about carbon footprints and global warming, but you'd be wrong. True, Hybrid Marine's new diesel/electric engine fitted to *Felonius Mongoose* in this month's boat test does do its bit to help the planet, but it's more than just another fashionable eco statement.

The brainchild of electronics engineer Graeme Hawksley (MD of Hybrid Marine), the package has been designed to save fuel, prolong engine life and provide whisper-quiet cruising. It also produces large amounts of power for DC and AC circuits, so you can comfortably have your washer/dryer, toaster and 240v kettle without worrying about where the next volt will come from.

The basic idea is quite straightforward and was unveiled at Crick last year (this year there will be three hybrid boats at the show, *Felonius Mongoose*, *Chelonian* and one from OwnerShips): a diesel engine (currently a Beta 43) provides the main motive power and an electric motor is introduced into the drivetrain after the gearbox to be used when



**Lynch motor is bolted above the propshaft and uses a toothed belt to provide drive**



**Cooks' power: 240v toaster, kettle and oven**

the diesel is switched off. The major issue with any hybrid set up is in charging the batteries that produce the electric power. In a hybrid a diesel engine does that charging, but the really smart trick of this set up is that when the diesel powers the boat, the electric motor switches to become a 5kW generator which more than takes care of the charging job.

This does of course put extra load on the engine but, as a 43hp Beta is scarcely extended in normal running, this actually makes it work more efficiently. Supervising all this is what those of us without electronics degrees are content to call a clever box of tricks!

There's no problem actually powering a ▶



## FEATURE Hybrid drive



Twenty-four two-volt batteries should last ten years if charging is properly managed

◀ narrowboat by electricity. The 48-volt Lynch motor (designed by Cedric Lynch and sometimes called a 'pancake motor' due to flat shape) is well proven and more than up to the job, developing around 10kW (13hp) normal running and more for short periods that doesn't sound a lot compared with a diesel, remember it only needs about five horsepower to drive a boat at 4mph whatever the power source.

The Lynch motor is just a little larger than an alternator and drives by a toothed belt from a pulley on the propshaft between the gearbox and the sternshaft or a flexible coupling such as a Centaflex (in the case of *Felonius Mongoose*). Because it is effectively an 'add-on' to the drive train it can be retrofitted to existing craft as well as to new ones so long as there's space for the batteries.

Normal 'leisure' batteries used in conventional narrowboats simply aren't up to the job and the two boats we tested (see the panel right about the second boat, *Chelonix*) both have proper deep-cycle batteries – no less than 24 two-volt, heavy duty deep-cycle batteries; these are very different in construction to 'leisure' batteries and with the correct charging and watering regime a

## HYBRID MARINE

HYBRID MARINE BEGAN life when electronics engineer Graeme Hawksley took redundancy in 2003, although the company wasn't actually formed until 2004.

A long-distance cruising sailor, Graeme had been giving thought to the idea of replacing diesel engines in boats with some kind of hybrid while a steel-hulled yacht was being built for him. He took the idea further and won a DTI grant to investigate the feasibility of using hybrid engines for small watercraft.

After two years studying the concept, he came up with the 'parallel hybrid' design in

which an electric motor acts on the propeller shaft in parallel with the engine, rather than the better-known serial system where a diesel simply powers a DC generator or batteries to drive an electric motor.

Plenty of components were already available, motors, batteries, generators etc, so his main task was to develop the hardware and software to draw it all together and make it work. He chose the Lynch motor because it was already well proven and compact; it also produced good power for its size, 10kW for a weight of 11kg. Latterly Graeme has



been joined at Hybrid by sales and marketing director Mark Tilley. As with many small start-up companies now that they are in production they face their biggest challenge – finding an investor so that they can ramp up production and grow into markets such as yachts and motorboats.





'Clever box of tricks' (top): Morse-type lever (right) operates clutch for using diesel just for charging



## 'A clutch in the drivetrain allows you to use the engine simply as a generator if you are moored up'

claimed to be able to last at least ten years. To deal with the amount of inflammable hydrogen gas released during the charging of these batteries a clever system of linked tubes joins the battery vent caps together and ducts hydrogen safely to the exterior where it can vent to the atmosphere. A parallel set of tubes enables topping up from a single source – each battery cap has a visible float valve which indicates if topping up is needed and then closes it off when it's full, with the water flowing on to the next. Topping up is done by a simple small manual pressure pump.

This battery set up isn't cheap and costs around £3,200, although that price can be weighed against the claimed life of ten years

with proper battery management. A cheaper alternative would be to use four 'upgraded' domestic batteries which would cost around £1000, but that would produce only around one hour's electric cruising before they needed recharging. The set up in *Chelonian* and *Felonius Mongoose* should provide five hours' silent cruising. As a rule of thumb, you can expect one hour's electric cruising for one hour's charging. A clutch in the drivetrain allows you to use the engine as a generator if you are moored up.

The guiding principle behind the system is that the electric power is designed around low and medium speed cruising needs when it offers the most in efficiency improvements, ▶

## THE TEST BOAT

IT MIGHT NOT look it from the outside, but *Chelonian* is a rather special boat – the South-West Durham Steelcraft 60-footer was the first narrowboat to be fitted with the hybrid drive to test the system.

It came about through a convenient set of coincidences: Hybrid Marine wanted to fit the system to a boat to iron out any bugs, while *Chelonian's* owner, electrical engineer Dave McInerney, was looking at propulsion options to potentially replace his BMC 1.8. After reading about the hybrid system he enquired about the possibility of retro-fitting the Lynch motor, and that conversation soon turned into the fitting of a complete Beta 43 hybrid and using *Chelonian* as a test-bed.

The engine was changed by Reading Marine but that was just the start. The electrical motor was then fitted at Frouds Bridge marina a mile or so down the K&A, the prop was replaced with one an inch larger and the whole electrical system was modified. The battery bank, like *Felonius Mongoose*, became 24 two-volt cells, a 48v to 12v converter was fitted, as was a 48v to 240v inverter.

With so much power to spare much of the boat now runs on 240v, which means Dave has a 240v TV, Freeview, a satellite receiver, washer/dryer, an electric toaster, kettle, hob and oven. The boat is gas-free.

His plan now is to use the diesel for half the day and the electric motor for the other half saving a lot of fuel – Hybrid Marine suggest around 35 percent. It will reduce his engine hours and be kinder to the Beta by cutting the time on tickover: going down the Caen Hill flight, for example, uses 20 minutes of electrical power rather than running the diesel for around three hours, mostly on tickover.





Dave McInerney thoroughly enjoys his silent cruising – and we can see why



**HOW MUCH DOES IT COST?**

BETA CAN FIT the hybrid to any of their engines, the additional price is in the region of £7000-£8000 plus vat.

To this you need to add £1000-£3000 for an upgraded battery bank, bringing the extra for a new build to around £10,000. From this you deduct items you no longer need to purchase, for example a separate marine generator or a Travel Power system, which brings the actual cost of the hybrid set up down to around £5000-£7000.

For a retrofit the Hybrid base price is £5000; to this you need to add £1000 to £3000 for an enhanced battery bank, £1500 for fitting and around £1500 for a high power charger/inverter, giving a total installed price tag of around £10,000 plus vat.



**Control box with buttons for Slower (left), Stop (centre) and Faster, plus info readout**

while the more powerful diesel engine is there when extra power is required (for example, in strong river conditions) as well as for charging. That means the size, complexity and cost of the electric system can be kept down.

From the user's perspective, the usual diesel single drive lever remains while the electric motor is operated by a small control box that can sit on the cabin top by the steerer, or slot into a mount above the Morse lever. This has three push buttons – Faster, Slower, Stop – and read-outs of battery charge state, current consumption and engine revs.

The motor has been set up to give a rapid response when accelerating from stop and a slower one when decelerating. This allows the most rapid transition from stop to full forward revs, to stop and reverse which is what's needed for quick response when manoeuvring. Normal practice when cruising is to rev the engine briskly up from a standstill and then gently knock the revs back to the cruising speed. The electric drive enables the prop to be driven at very, very slow speeds and, of course, when you're stopped at locks, you stop the engine so there's no battery drain!

It's quite unusual to use. If you have fully charged batteries there's no need to start the diesel in the marina in the morning (which will please the neighbours), you simply reverse out of your slot on electric

power and slip away without anyone even knowing you've gone. Out on the cut with no diesel noise or vibration to interfere, the boating experience is lifted to another level with just the swish of water along the side and a watery rustle from the wash behind, the sounds of nature are enhanced and the whole experience becomes more relaxing.

While the electric motor is quite capable pushing a large boat along at normal cruising speeds and more (flat out it will produce 2400rpm, the equivalent of 1800rpm using diesel) you actually feel as if you want to travel more slowly because the experience is just so peaceful and pleasant – it must be rather as it was in the days on the canals when horsepower meant just that.

At the tiller there's little difference whether you're using diesel or electric power; the feel though the tiller bar is the same and the boat handles similarly, though you might use the horn a tad more to let people know you're coming. It is, however, very strange to swish into a lock, stop the electric motor and then hear... nothing apart from the waterfall of the gates. It's also nice not to overdose on fume.

There's no doubt this isn't a cheap system but it works well and needs looking at in perspective: for example, if you like the sound of a good old thumper you might fit a Gardner or Russell Newbery to your boat, and if you like the sound of silence you might fit this.

Oh – and you will also be doing your small bit to help the planet... **CB**