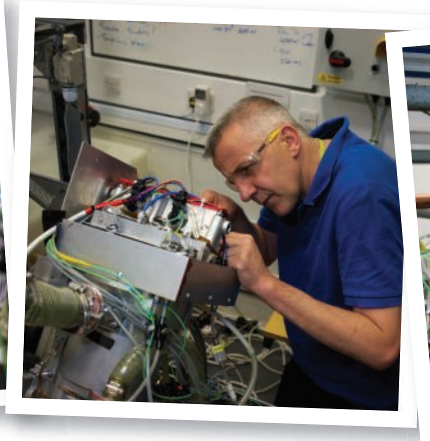
Michael Dearman (right) explains the engine's principles



Inventor Peter Dearman with the engine

AIR TO THE THRONE

Could a small liquid nitrogen-powered engine have a big impact on temperature-controlled transport operators' running costs? John Challen finds out

News about the Dearman engine – a liquid air/liquid nitrogen-based unit – first surfaced in *Transport Engineer* in March this year. But temperature-controlled transport operators now need to take note, because the first application sees the device replacing an 18kW diesel engine used to drive a compressor in a conventional refrigeration cycle – and it looks very promising.

"The Dearman engine is similar to, but simpler than, a diesel engine," states Toby Peters, chief executive of Dearman Engine Company. "It is a single-cylinder unit, has zero emissions at the point of use, and can save operators money." Key to its operation, he explains, is the expansion of liquid air injected into the cylinder. When mixed with relatively warm heat exchanger fluid, it vaporises rapidly, instantaneously increasing pressure and forcing the piston down. When it reaches bottom dead centre, the exhaust mix leaves the cylinder, with the gas returning to atmosphere and the fluid reheated and reused.

"That process of boiling the liquid nitrogen in a fluid inside a piston is patented," says Peters. "This is the novel bit," he adds, stating that Peter Dearman (the engine's inventor) looked at the refrigeration cycle from a new angle. "Whereas a diesel engine drives the compressor and refrigeration loop, at the other end of the spectrum [we have] a liquid nitrogen evaporation stream," he continues. "We are using the cold to get about two-thirds of the coolant, and the engine to drive the other third."

Cool advantages

What about operating advantages? In part, they stem from the componentry, with Peters explaining that, for example, the development team has been able to use a low-cost, high-volume 5kW compressor (as built for large cars and SUVs) instead of a traditional 15kW unit. Further, given that it operates at ambient temperature, there is a potential for light-weighting. "We used metal for the engine currently on the test bed, but we will explore other options," confirms Peters.

As well as capital and operational cost improvements, there are environmental benefits. On a 40ft multi-compartment body, a diesel-powered refrigeration unit consumes up to 20% of the truck's fuel, and emits six times as much NOx and 29 times more particulate matter than a Euro 6 engine. In contrast, the Dearman engine has zero emissions and is also quieter.

"Our engine will probably cost £200-£300 more than the diesel approach, once we get up to commercial production levels, but its annual operational costs will be about £1,200 less," insists Peters. "We think it makes a very interesting proposition as a first entry product, with a payback in under three months."

And he adds that the company is in talks with the refrigeration industry, with an announcement on progress due in early June when its 'Liquid air on the highway' report will be published. "Major supermarkets and distributors have been involved and are keen to see the results," says Peters.

Following that, the company will have a mule vehicle in operation at MIRA over the summer, before moving into on-road trials in 2015 and low-volume manufacture by 2016. TE

On the buses

Another application for the Dearman engine is as a waste heat recovery unit "for urban commercial vehicles" (but specifically buses), says CEO Toby Peters (right).

"What we are looking to do is use a 40–50kW Dearman engine that doesn't run all of the time, but is like a classic hybrid and does the peak shaving – allowing the primary engine to be downsized. Unlike an electric hybrid, you can't drive this engine as a generator and make liquid air, but you can shift the ICE (internal combustion engine) down in size, as the duty cycle allows," he explains.

The project has already been awarded £2 million of government funding through the Technology Strategy Board, and engine testing is due to start mid-2015.