HOW WE REMAIN CLEAN

THE TRACE OF FIRE

Those who wish to avoid harmful engine emissions must have very precise knowledge of the combustion process. At the Institute of Internal Combustion Engines, part of the TU Munich, Georg Wachtmeister and his team build test engines themselves and carry out research into how to effectively reduce methane emissions from the gas engine, CO_2 from the petrol engine and NO_X from the diesel engine.

GEORG WACHTMEISTER

Large network from research and industry

The engine laboratory is hidden away in the Kapuzinerhölzl, a wooded area not far from Nymphenburg Palace on the outskirts of the district of Moosach in Munich. An entire campus for the TU Munich was set to be built here before the Second World War, starting with the Institute of Internal Combustion Engines. And that is also where it ended. Both of the institute's buildings, arranged in parallel, remain the only ones in the Kapuzinerhölzl belonging to the TU Munich. Yet the secluded location is deceiving: more than 55 employees, including around 30 doctoral candidates, use the engine laboratory to work on the future of the combustion engine in a large network made up of people from research and industry. 'Our focus is on the entire engine, whether petrol, diesel or gas,' reports Professor Georg Wachtmeister, before proudly adding: 'We build our own engines here – in recent years nine different research engines with cylinders ranging in size from a half litre to almost five litres.'

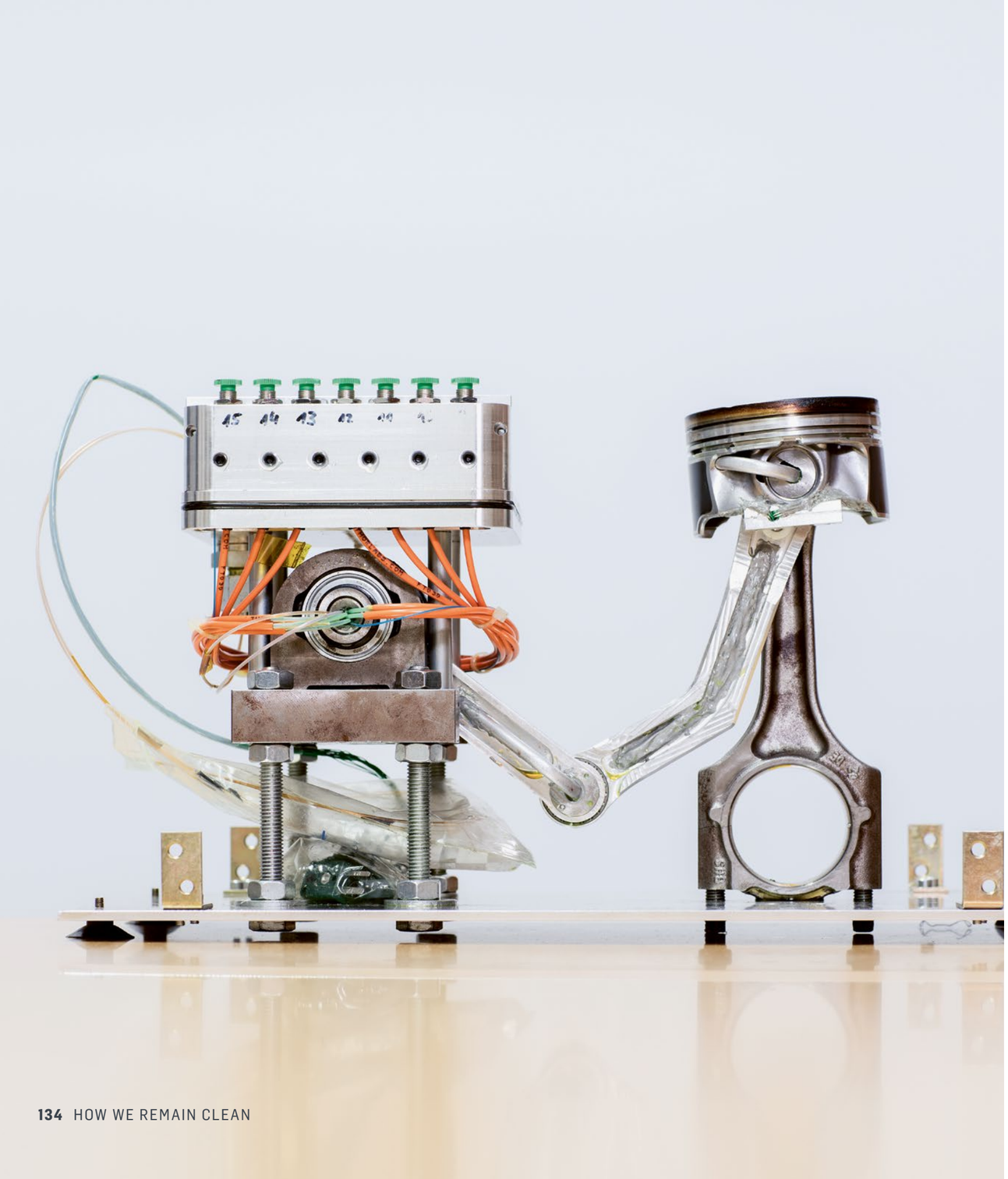
Wachtmeister has been head of the Institute of Internal Combustion Engines since 2004. Above all else, gas engines for cars, ships and power stations are traditionally an important area of research for the native of Munich. 'We are currently working on an FVV project to investigate the exhaust gas behaviour of lean-burn gas engines,' he reports. Since combustion in a lean-burn engine occurs with excess air, the temperature is lower during the combustion process. This results in fewer nitrous gases and less heat loss; the efficiency level is higher. But it is important that combustion takes place to the fullest extent possible in lean-burn mode. That's because partially burnt hydrocarbons in the gas engine lead to the emission of methane, which is 25 times more harmful to the climate than carbon dioxide. 'We have made it possible to see inside a single cylinder, 4.8-litre test engine so that we can observe the ignition points, flames and combustion process for different engine configurations and operating conditions,' says Wachtmeister. This allows the engine researchers to establish the extent to which it is possible to make the combustion process leaner. Furthermore, the tests help with the modelling and validation of CFD models developed in conjunction with the institute's cooperation partner, the Leibniz University of Hanover.

Wachtmeister, who completed his doctoral studies at the TU Munich in 1988 and subsequently worked at MAN B&W Diesel for fifteen years, considers precompetitive research by science and industry to be not just an option, but absolutely essential. 'Joint research of the kind carried out within the FVV is extremely important for ensuring that Germany and

PROF DR GEORG **WACHTMEISTER**

Born 1957

Wachtmeister is a dyed-in-the-wool Munich man. Born and raised in the city, he began studying mechanical engineering at the **TU Munich** in 1997. After graduating he started working at **Siemens,** but was persuaded by doctoral supervisor Professor Gerhard Woschni to return to the university and he successfully completed his doctoral studies in 1988. Between 1989 and 2004 he worked in Augsburg for **MAN B&W Diesel,** initially as head of the thermodynamics section, then as group manager of material strength, head of turbocharger technology and senior vice president of engineering for four-stroke engines. Since 2004 he has been head of the **Institute of Internal Combustion Engines** at the TU Munich. Wachtmeister is married and has two grown-up children and one grandchild.



Europe continue to remain competitive,' he says. Wachtmeister proved that he wasn't just paying lip service to these views shortly after being appointed professor at the TU. Together with Audi as an industry partner, he built a single-cylinder petrol test engine for determining with a high degree of precision the friction force behaviour between the piston, piston ring and cylinder liner on a running engine. The researchers have continued to optimise the test engine over the years. 'The precision of the resolution is now less than two newtons – that is the equivalent of being able to discern a fly settling on the cylinder during the test,' says Wachtmeister. The unique thing about it is that at speeds of up to 2,500 revolutions per minute and a mean pressure of up to ten bars, the test results are reproducible in a real running engine – the results are always the same both on the time axis and with replaced components.

Wachtmeister also works on diesel engines and he has a clear opinion here. 'The biggest potential in relation to the diesel engine lies in the fuel,' he says, and makes reference to a current FVV project, in which a new, synthetically produced fuel made from dimethyl ether is being tested. This is suitable as an alternative fuel for diesel engines and can be manufactured regeneratively using biomass, for instance. If the carbon chains are oxygenated during production, then the fuel also supplies the air it needs for combustion, which means that the combustion process is completely soot-free. As a result, high exhaust gas recirculation rates are possible, which in turn significantly reduces the formation of nitrous gases. Wachtmeister is now developing suitable combustion processes in the project. To this end, he is testing the flashpoint, vaporisation point and the combustion curve, among other things. 'With such fuels we can solve the key questions of diesel engine combustion – they create the possibility of combustion being CO_2-neutral and soot-free with very low levels of nitrous gases.'

Wachtmeister travels completely emission-free when pursuing his favourite hobby: sailing. He discovered his passion for the sport at the age of 14 when he and a friend camped by Chiemsee and he was given the opportunity to sail for the first time. At the same time, he was also able to embrace his love of technology – by sprucing up the old sailing boat he acquired shortly afterwards or converting the surfboards from the windsurfing school he founded on Chiemsee at the age of 16 for dry practice on land. He has remained faithful to Chiemsee to this day, but now he tends to fly across the water aboard his single-handed high-speed carbon catamaran, which is capable of reaching speeds of 40 kilometres an hour. However, most of his time is spent researching – on the campus in Garching and in the engine laboratory, hidden away in the Kapuzinerhölzl.

The diesel engine's biggest potential lies in the fuel

Photo: *TU Munich's engine laboratory in the Kapuzinerhölzl, a wooded area not far from Nymphenburg Palace.*