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DIRECTIONS FOR IMPROVING THE CHARACTERISTICS OF PISTON INTERNAL COMBUSTION ENGINES

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Improvement of internal combustion engines continues in traditional directions – increasing efficiency, reducing emissions, improving adaptability.

Progress in three directions is provided by new technical solutions in the design of fuel and air supply systems, in the design of friction pair elements, in the control of the combustion process, and the design of anti-toxic system components. Let us consider a specific recent example - the development by the Weichai company from the People's Republic of China of the WP 13H560E65 serial diesel engine with a record effective efficiency of 50.26 %. This efficiency value corresponds to the minimum effective specific fuel consumption of 167.04 g/kWh. The authors of the achievement report on five key technologies implemented in the development: coordinated combustion technology, which allows to increase the combustion rate by 30 %; coordinated design technology, which increases the strength of the engine structure at increased combustion pressures; exhaust gas energy distribution technology, which optimizes the processes of converting harmful substances in the catalytic converter and ensures high turbine efficiency in a wide range of operating modes; zoned lubrication system technology, which reduces friction losses by 20 %; intelligent control technology, which uses accurate algorithms for predicting changes in engine parameters.

Increasing the effective efficiency to 50 % from the previous achievement of 46 % provides a reduction in fuel consumption (and a reduction in carbon dioxide emissions) by 8 %. At the same time, the new engine meets the Euro-6 requirements for limiting emissions of harmful substances.

The following modern levels of parameters of diesel engines that meet Euro-6 standards can be determined: effective specific fuel consumption – less than 190 g/kWh; liter power – more than 30 kW/l; the beginning of the frequency range of maximum torque – below 1000 min⁻¹.

It is obvious that these levels will be improved in the near future. Weichai announced that it intends to begin work together with partners to achieve an effective efficiency of 55 %.

Great hopes are placed on successes in improving the combustion process of the working mixture – the process with homogeneous compression ignition, which allows for more complete combustion at lower average temperatures.

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IMPROVING THE CHARACTERISTICS OF PISTON INTERNAL COMBUSTION ENGINES BY USING EXHAUST GAS ENERGY

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The main methods of utilizing the thermal energy of exhaust gases [1]: use of gas turbine supercharging of internal combustion engines and turbo compound systems; utilization of heat from internal combustion engine exhaust gases through preliminary thermochemical conversion of fuel; transfer of heat to the cooling system and to the air conditioning system to accelerate the heating of the internal combustion engine and the vehicle interior; use of thermoelectric converters in the components of the exhaust gas exhaust system; use of an additional heat engine to drive various units, including the air conditioner compressor, cooling fan, etc.

The widespread use of gas turbine supercharging in piston internal combustion engines is well known. Modern types of gas turbine supercharging systems allow to increase the specific energy parameters of internal combustion engines and increase the effective efficiency.

Some types of turbocharging systems allow to increase the torque in the low-speed range – from n_{is} (idle speed) to n_{Mmax} (left limit of maximum torque) on the external speed characteristic, which provides the well-known convenience of engine control, reduces the number of gearbox shifts. The following types of gas turbine supercharging systems fully possess this property:

- turbocharger with adjustable turbine nozzle;
- turbocharger with hybrid drive (with electric machine);
- register turbocharging system;
- two-stage turbocharging system;
- two-stage adjustable supercharging system;
- supercharging system with turbocharger and centrifugal electric compressor.