A new way to create torque

Inter Motor Group

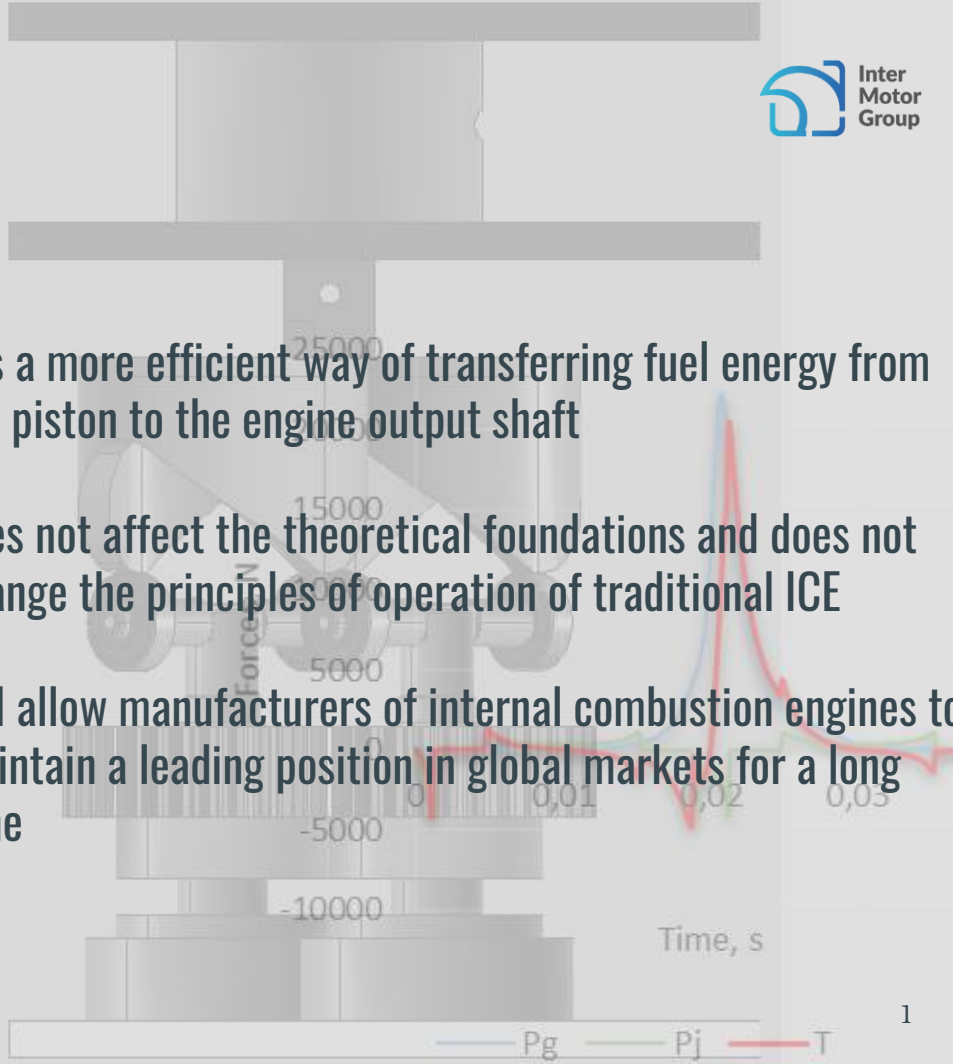
New Generation Internal Combustion Engine (ICE NG)

The invention has a world novelty

has a more efficient way of transferring fuel energy from the piston to the engine output shaft

does not affect the theoretical foundations and does not change the principles of operation of traditional ICE

will allow manufacturers of internal combustion engines to maintain a leading position in global markets for a long time



New Generation ICE Design

The ICE NG design does not have a crank mechanism

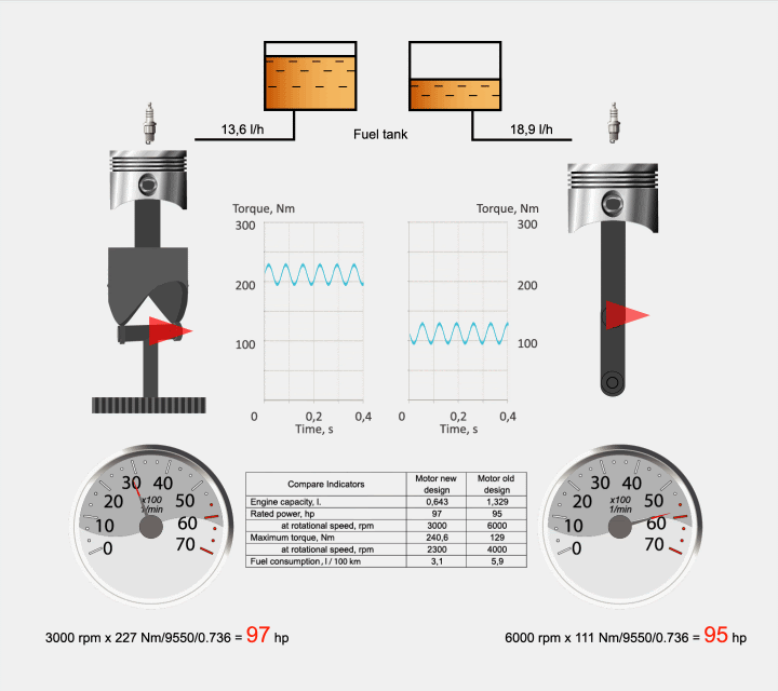
Instead, ICE NG uses a power take-off (PTO) device protected by patents from the Eurasian and European Union and the USA.

This allows:

- reduce fuel consumption by up to 40% without loss of power;
- halve the engine speed;
- greatly increase the torque and overall efficiency;
- exclude drive belts, chains and balancing mechanisms from the design.

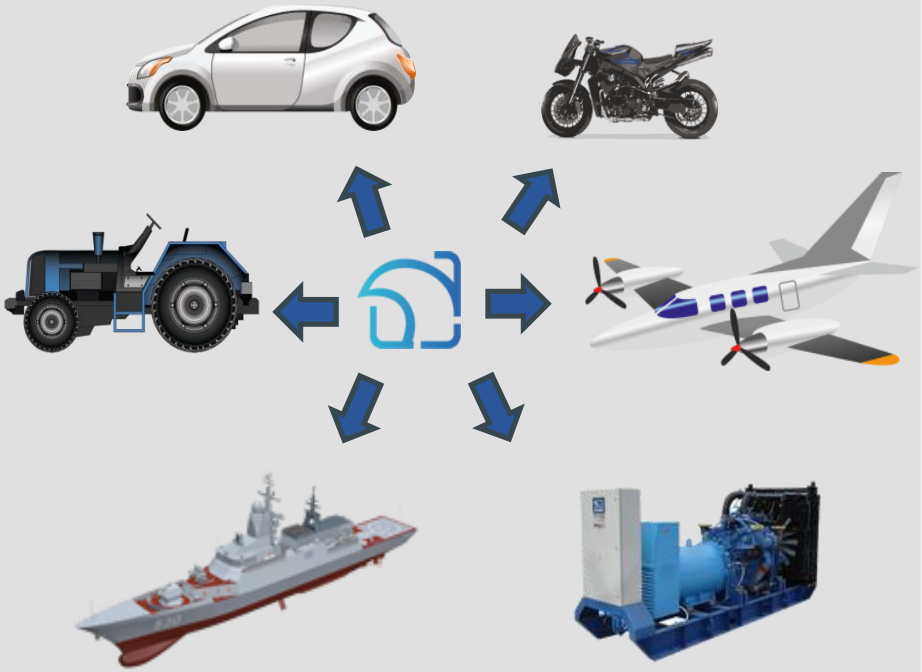
ICE of the New Generation will be compact, powerful, economical, environmentally friendly, quiet and reliable.

The manufacture of ICE NG does not require significant costs for the technological preparation of production.



Compare indicators	Motor new design	Motor old design
Engine capacity, l.	0,643	1,329
Rated power, hp	97	95
at rotational speed, rpm	3000	6000
Maximum torque, Nm	240,6	129
at rotational speed, rpm	2300	4000
Fuel consumption , l / 100 km	3,1	5,9

Scope ICE NG



ICE NG can be used in machines for various purposes, of any power, consuming gasoline, diesel fuel, gas, kerosene, hydrogen and other types of fuel.

It is equally effective both in a passenger car and in a truck, motorcycle, locomotive, ship, motor-generator, aircraft...

It does not conflict with the electric motor and is perfect for an efficient hybrid installation.

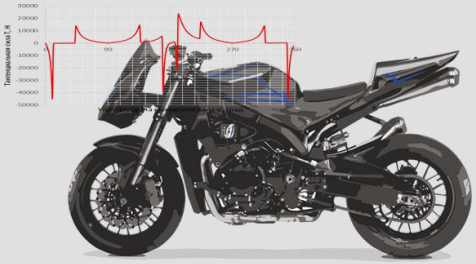
ICE NG parameters were confirmed by studies conducted by specialists of the Belarusian National Technical University using modern computer modeling tools.

The methods developed by us allow us to determine the optimal PTO parameters, as well as the power, economic and design indicators of ICE NG, necessary to assess its effectiveness in the drive of machines for various purposes: mobile and stationary, working on land, in air and on water.

Comparison of NG ICEs and Existing ICEs

Motorcycles, scooters

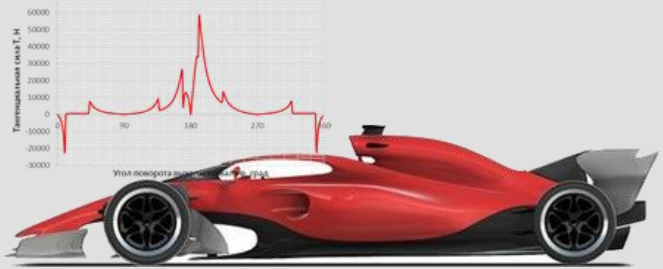
ICE NG on a motorcycle provides increased power and fuel economy



ICE for motorcycle	ICE NG	Yamaha NMAX 125	ICE NG	Yamaha XJ 6
Engine displacement, cc	120	125	340	600
Rated power, h.p.	20	12	80	77,5
at engine speed, rpm	3750	7500	5150	10000
Maximum torque, N·m	38	11,7	124	59,7
at engine speed, rpm	3600	7250	4000	8000
Fuel consumption, l/100 km	1,6	1,6	1,9	3,1

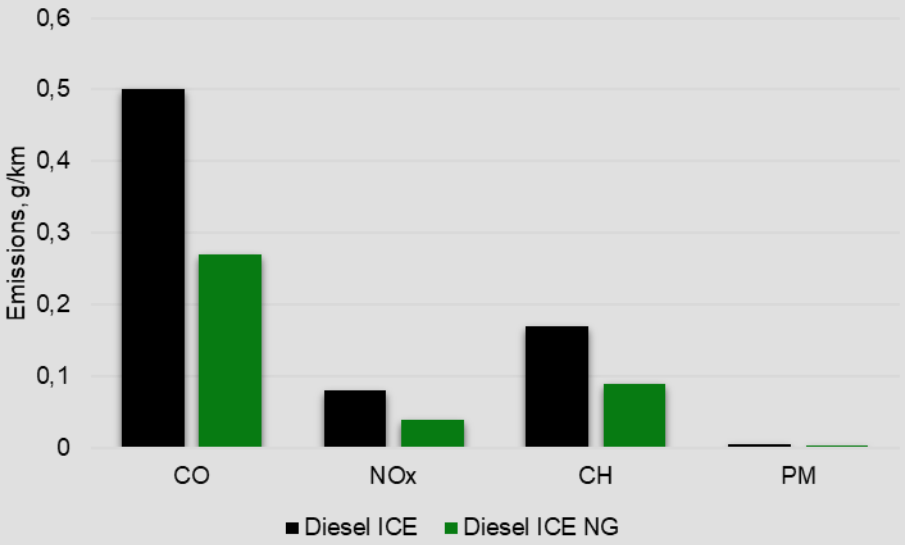
Cars

ICE NG in the car provides increased power and fuel economy



ICE for cars	ICE NG	Toyota Yaris	ICE NG	Renault Energy F1
Engine displacement, l	0,643	1,329	0,85	1,6
Rated power, h.p.	97	95	900	905
at engine speed, rpm	3000	6000	7500	15000
Maximum torque, N·m	240,6	129	1215	645
at engine speed, rpm	2300	4000	4500	8000
Fuel consumption, l/100 km	3,1	5,9	61,0	100,0

ICE of the New Generation on diesel



The ICE of the New Generation is able to save up to 40% of diesel fuel while maintaining power due to a more efficient way of transferring fuel energy to the engine output shaft.

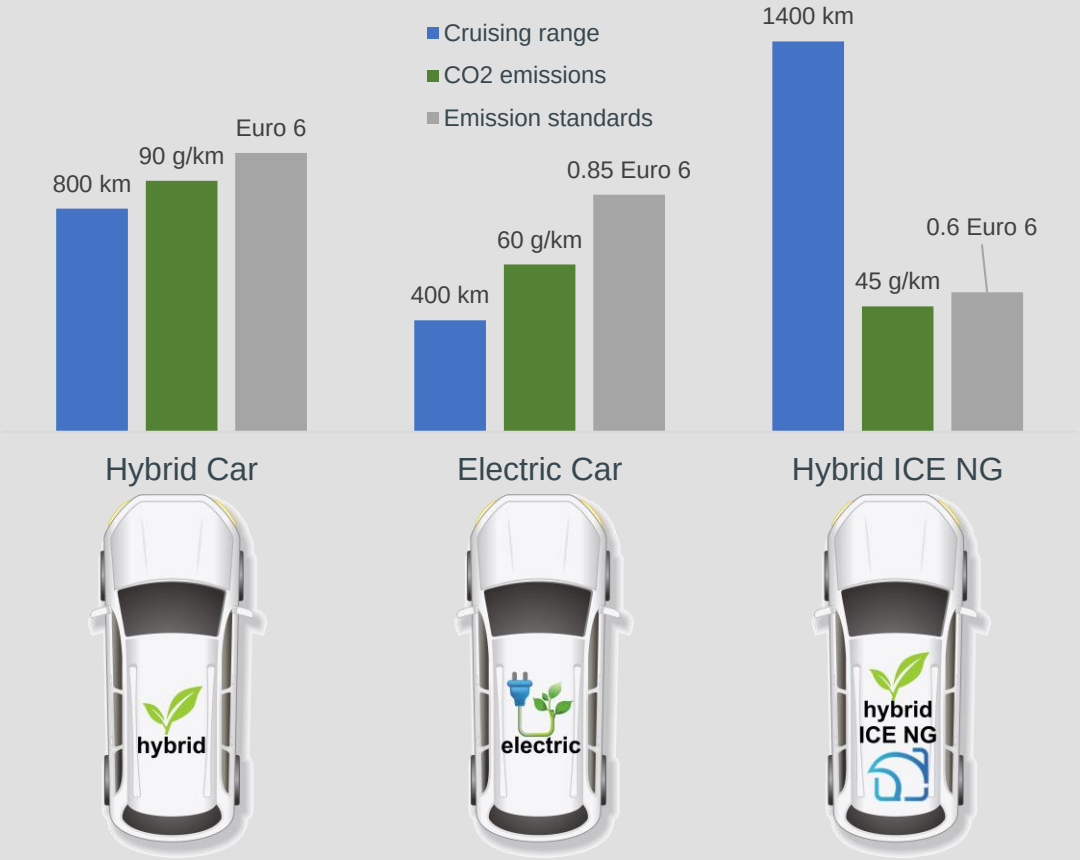
ICE NG is much more environmentally friendly, since emissions of harmful substances directly depend on the amount of fuel burned.

ICE NG has fewer parts, weight and overall dimensions, so it will be cheaper to manufacture and more unpretentious in maintenance. The selection of the optimal parameters of the patented power take-off device will provide the internal combustion engine with the required torque and minimum fuel consumption.

A decrease in engine speed reduces the heat load and increases the maintenance interval and the service life of a new generation of ICE.

High economic and environmental performance of the ICE of the New Generation on diesel fuel ensures its production in the long term.

ICE of the New Generation on gasoline fuel

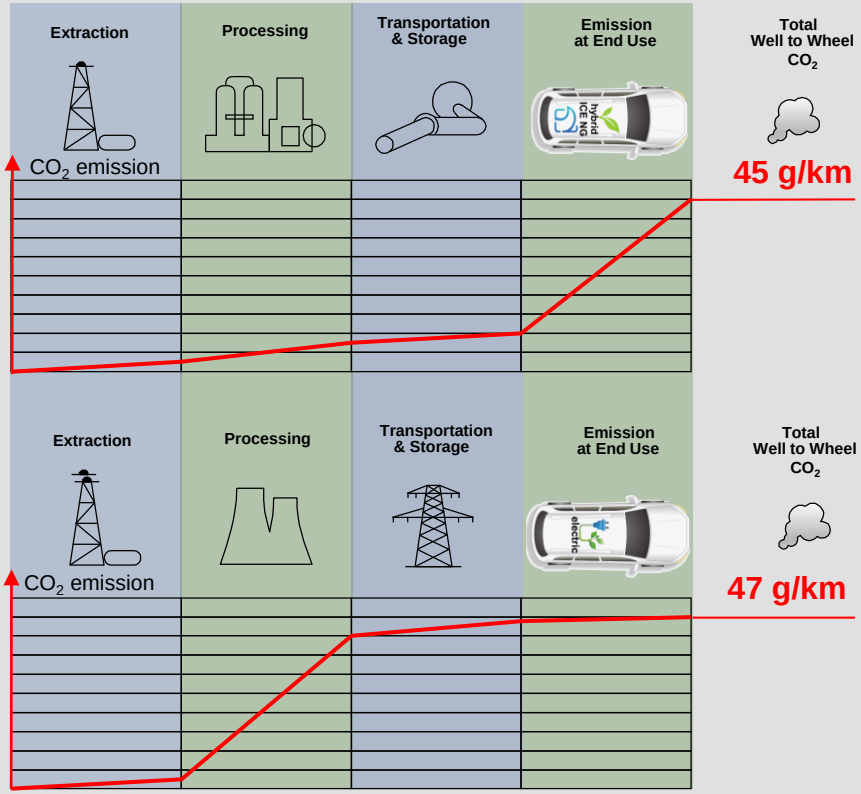


The combination of an electric motor and ICE NG is most effective in a passenger car, which is the main source of air pollution in large cities.

In the city you can only use an electric motor running on small batteries and providing a range of 40 … 50 km, and when leaving the city you can turn on the economical and powerful ICE NG.

Better adaptation of ICE NG to urban traffic conditions also helps to minimize emissions and simplify their system of neutralization.

ICE of the New Generation on gas fuel



Thermal power plants that produce more than 50% of all electricity in the world have low efficiency.

Generating electricity by burning fossil fuels is expensive and is accompanied by CO2 emissions. Therefore, an electric car that consumes electricity for its work cannot but take this into account in its indicators.

To date, gas fuel is recognized as a global alternative to traditional fuel. This is an environmentally friendly engine exhaust that meets current and future toxicity requirements. And the main advantage is the price. This is actually a finished motor fuel, so it is much cheaper than gasoline and diesel.

The use of natural gas is most effective in ICE NG running on a generator drive, including as part of a hybrid car drive.

Expert opinion

Inter Motor Group

VLADIMIR BOYKOV

Doctor of technical sciences, professor

To implement environmental approaches and eliminate the unreasonable consumption of material earth resources, the traditional way of increasing the capacity of a classic engine used is a dead end.

The proposed patented device (Eurasian patent No. 025961 (B1), in our opinion, can be used as a way out of the impasse for the further development, improvement and application of classic ICEs. **More**

VLADIMIR KOROBKIN

Doctor of technical sciences, professor

The authors proposed a unique inherently method and mechanism for transmitting a more significant force from the piston stroke with an increased lever arm.

This allows, while maintaining the required power, to use cylinders of a smaller volume, which accordingly will lead to a decrease in fuel consumption, overall dimensions and engine weight..

More

Power take-off design (PTO)

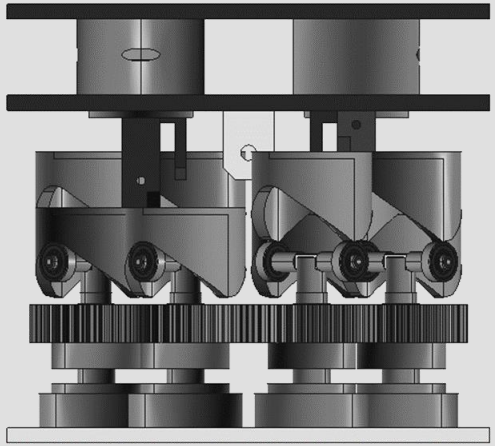
Inter Motor Group

PTO allows much more efficient to turn fuel energy into useful mechanical work due to new principles of creating torque.

PTO has a simple, technologically advanced and reliable design, which provides effective mutual connections and forced synchronization of all structural elements.

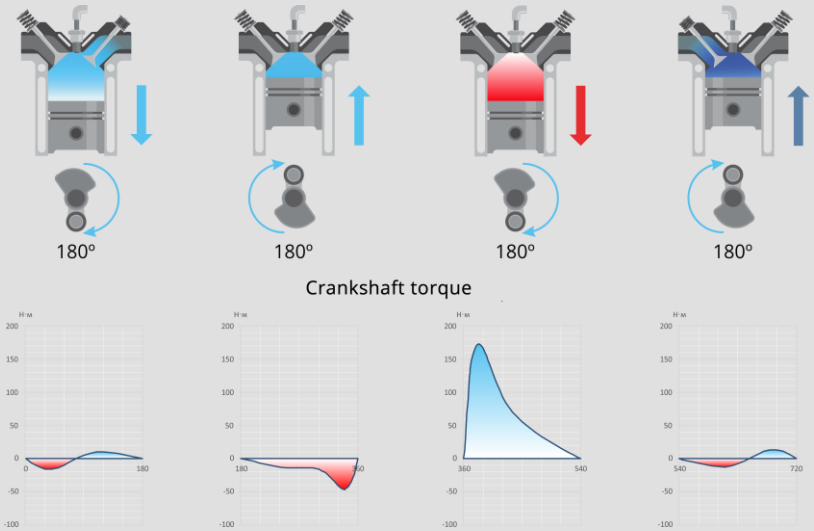
Due to the nature of the movements in different planes and the balanced distribution of masses, the resistance to movement in the patented design is negligible. The inertia force of the rotating parts of the PTO acts outside the reciprocating plane of the ICE NG parts and does not show any resistance to the movement of the piston and gear.

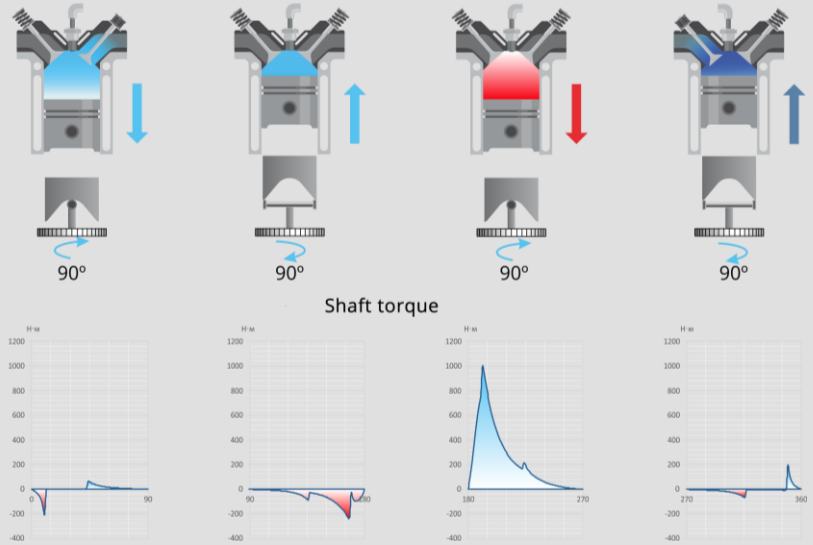
The methods developed by us allow us to determine the optimal PTO parameters, as well as the power, economic and design indicators of ICE NG, necessary to assess its effectiveness in the drive of machines for various purposes: mobile and stationary, working on land, in air and on water.



PTO prototype demonstration

Comparative evaluation of cylinder power





Bore D = 68 mm;
Piston stroke S = 56 mm;
Engine speed $\boldsymbol{n}$ **= 3000** rpm
Average torque $\boldsymbol{M_к}$ **= 12,3** Nm

Effective power:

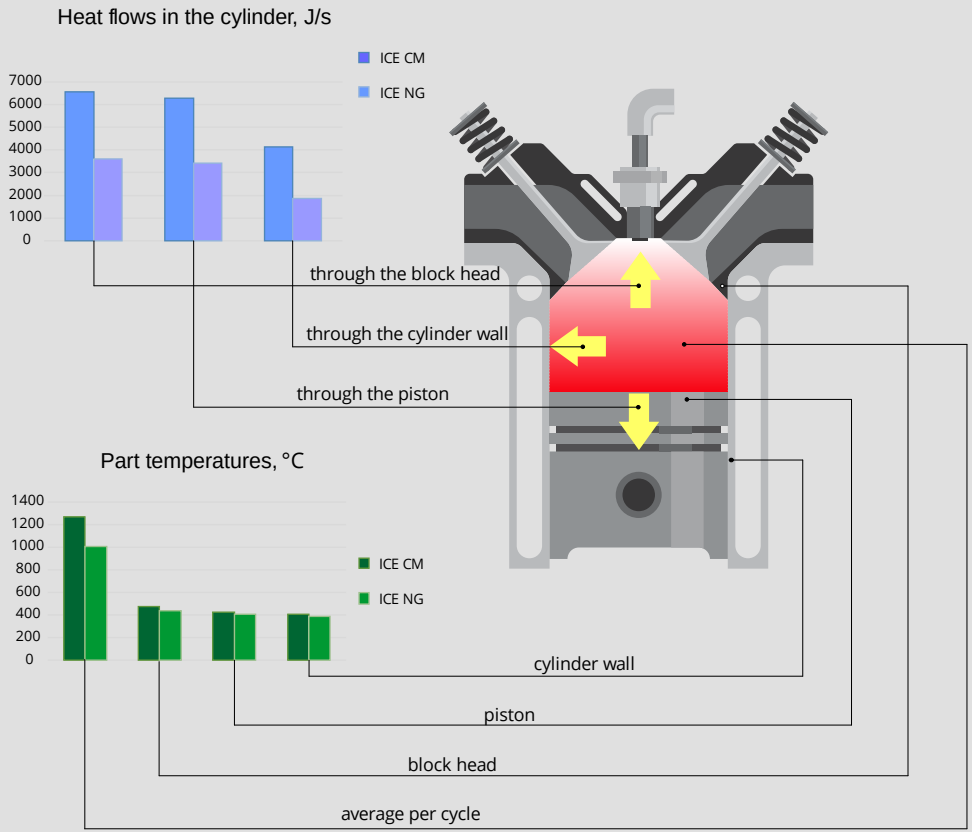
$$N_{ec} = \frac{M_к \cdot n \cdot \eta_m}{9550} = \frac{12.3 \cdot 3000 \cdot 0.8}{9550} = 3.0 \text{ kW}$$

Bore D = 68 mm;
Piston stroke S = 56 mm;
Engine speed $\boldsymbol{n}$ **= 1500** rpm.
Average torque $\boldsymbol{M_к}$ **= 45,3** Nm

Effective power:

$$N_{ec} = \frac{M_к \cdot n \cdot \eta_m}{9550} = \frac{45.3 \cdot 1500 \cdot 0.8}{9550} = 5.7 \text{ kW}$$

Comparative assessment of thermal load



The exclusion of the inertia forces inherent in the crank mechanism from the working flow, as well as a decrease in the engine speed, reduces the heat load on the parts of the cylinder-piston group and the gas distribution mechanism, increases the service interval and the service life of ICE NG.

ICE for city bus, 260 h.p.	Type of engine and fuel	
	Gas	Gas
	ICE NG	KAMAZ-820.60
Engine displacement, l	11,762	11,762
Rated power, h.p.	260	260
at engine speer, rpm	1100	2200
Maximum torque, N·m	1860	931
at engine speer, rpm	700	1400
Average temperatures of parts, ºC		
- piston;	438,6	477,6
- block heads;	406,1	422,3
- cylinder walls	387,1	407,3
Heat flows through engine parts, J / s		
- piston;	3423,7	6287,7
- block heads;	3620,3	6566,0
- cylinder walls	1855,3	4128,2
Fuel consumption, m^3 / h	29,2	53,4

A new way to create torque

Converting the energy of the thermodynamic cycle into mechanical energy on the output shaft in modern internal combustion engines (ICE) is traditionally carried out using the classic crank mechanism (CM).

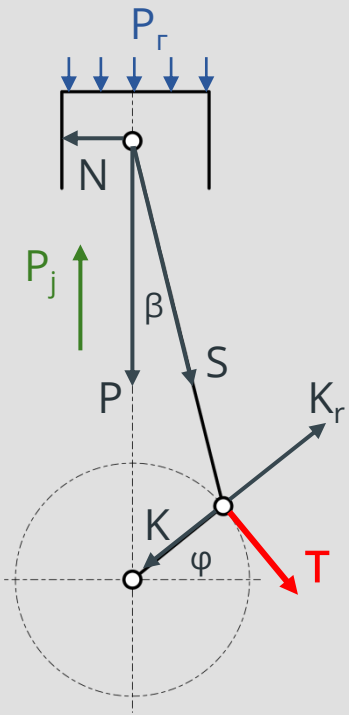
The CM design allows you to get engine characteristics that match the current level of fuel economy.

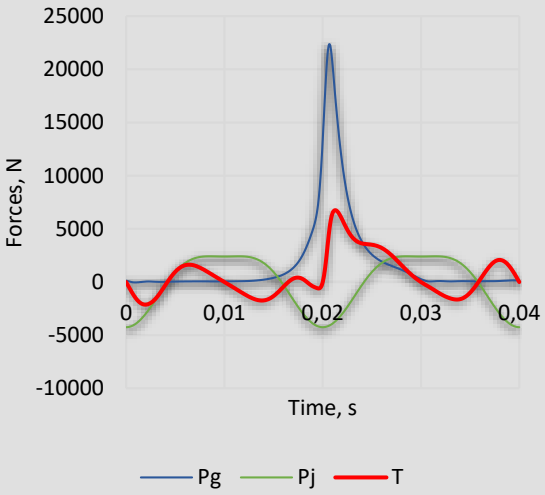
The dependence of the force T on the crankshaft on the gas pressure force P_g in the cylinder is shown in the graphs.

Calculation of the tangential force in the CM uses the dependence

$$T = \left(P_g + P_j\right) \cdot \frac{\sin\left(\varphi + \beta\right)}{\cos\beta}$$

where
P_g - is the gas pressure force in the engine cylinder;
P_j - longitudinal inertia;
ϕ - is the angle of rotation of the crankshaft;
β - the angle of deviation of the connecting rod from the vertical axis.





It is not difficult to determine that during the working stroke (when the sum of Pg + Pj has maximum values from 370° to 400° crankshaft angle) the factor sin(ϕ+β)/cos(β) in formula above has a value of 0.2...0.6. And this factor reaches its maximum value (0.8...1.1) in the range of 410°...470° crankshaft angle, i.e. closer to the completion of the piston stroke.

A new way to create torque

Thus, the kinematic characteristics of the crankshaft contribute to the loss of energy transfer of gas pressure in the engine cylinder to the useful rotation of the crankshaft.

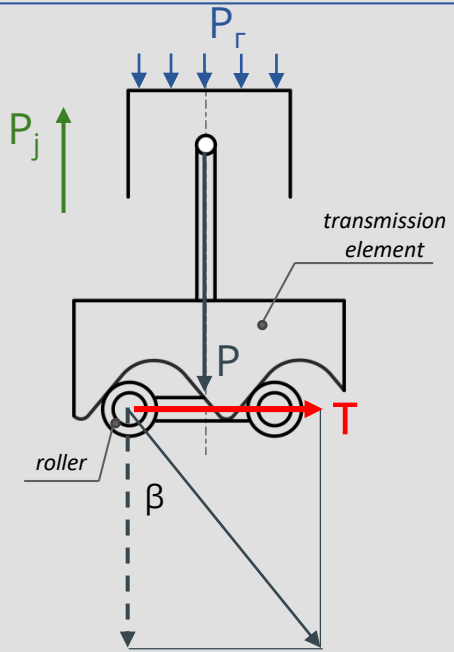
Accordingly, a clear advantage predetermines the replacement of CM with a more efficient device, which is PTO.

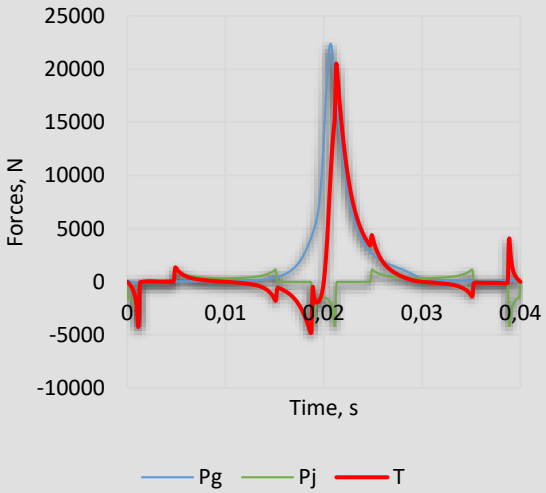
To improve the interaction of the forces transmitted to the output shaft of the engine and increase the efficiency of using the energy of the thermodynamic process, we have developed a design of an alternative mechanism for converting the longitudinal motion of the piston into the rotational motion of the output shaft of the engine (PTO-mechanism).

In this mechanism (**watch the video**), the transfer of forces from the piston to the output shaft occurs through the transmission element and the shaft with a roller.

In this case, the force on the output shaft is defined as

$$T = \left(P_g + P_j\right) \cdot \mathrm{tg}\beta$$





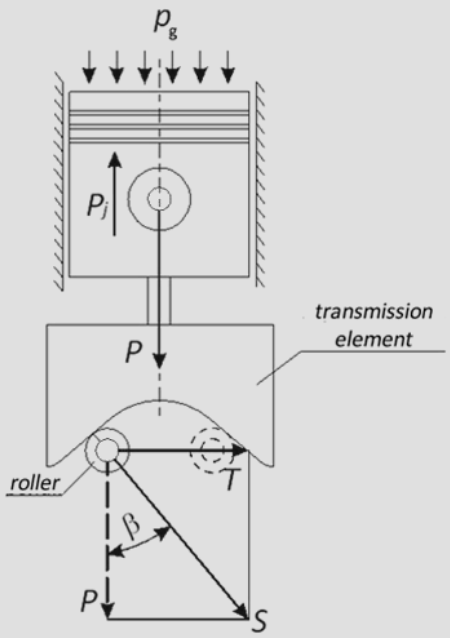
As can be seen from the figure above, the force T on the output shaft of PTO-mechanism is much higher than the force T in the CM. A full four-stroke engine cycle with a PTO-mechanism is performed in one revolution of the output shaft. Thus, an engine with a PTO has the same conditions for processes inside the engine cylinder as an engine with a CM, but with greater mechanical energy at the output.

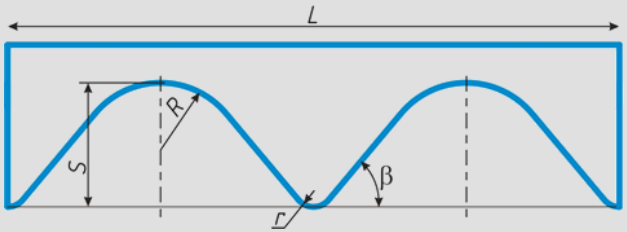
Kinematic and dynamic analysis of PTO

Transmission element is made in the form of a cylinder with a profile contact surface.

The contact surface profile has the following parameters:

- the length of the profile L, determined by the transmission element average diameter;
- the height of the profile, equal to the piston stroke S, committed during its movement from TDC to BDC;
- the inner radius of the profile R;
- the outer radius of the profile r;
- the angle of inclination of the profile β.

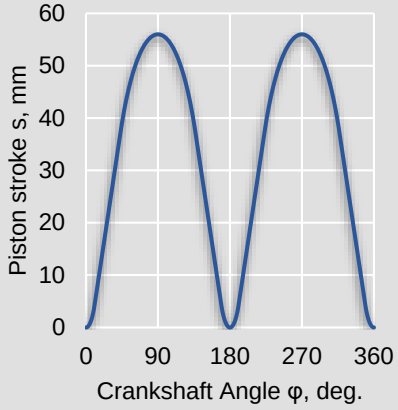


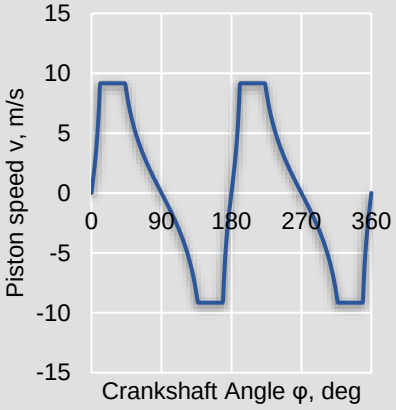


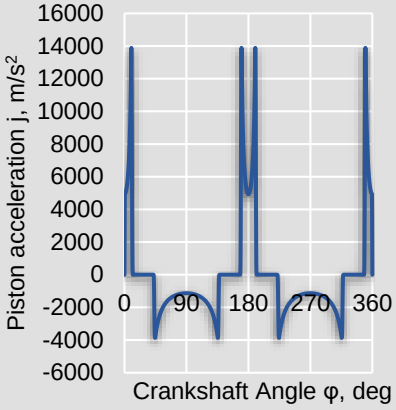
Given the parameters of the cylinder-piston part of the engine, determined by the diameter D of the cylinder and the stroke S of the piston, the parameters of the guide sweep will be determined based on its basic parameters: *R*, *r*, β.

Kinematic and dynamic analysis of PTO

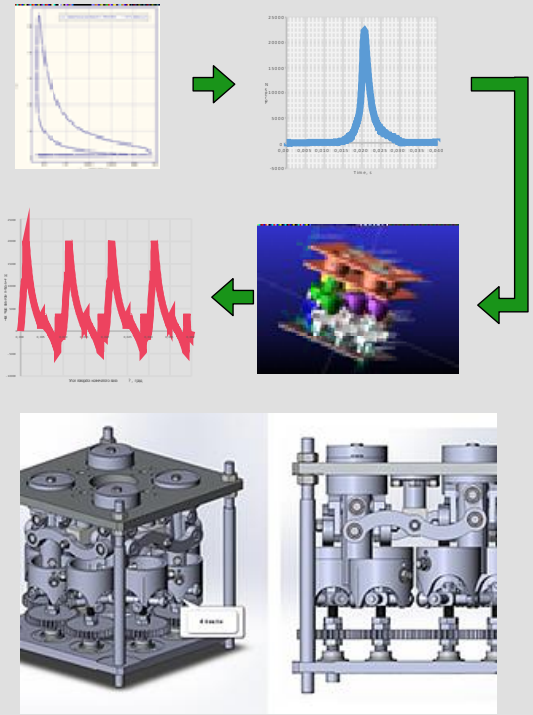
Studies of the kinematic and dynamic parameters of PTO allow a more rational selection of the design of parts to reduce the inertial loads arising from the movement of the piston.

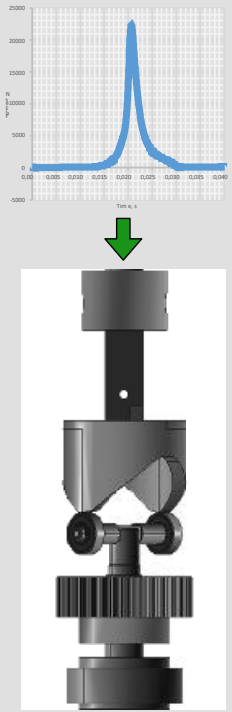






Work on a prototype ICE NG





- analysis of the design of PTO using mathematical models;
- drawings and model PTO were made;
- analysis of kinematic, dynamic and strength parameters of PTO;
- optimization of the structural parameters of the PTO by the finite element method;
- analysis of operational properties, fuel efficiency, cylinder power, thermal load ICE NG;
- development of design documentation ICE NG.

We invite you to cooperation

We invite you to cooperate and will be happy to welcome your company among our partners for the joint development of an environmentally friendly, sought-after ICE NG.

Our team includes scientists, research engineers, designers, mechanical engineers and economists.

We are confident that, due to their effectiveness, ICEs of the new generation will organically fit into the environmental and technological trends of the modern world.

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Never look back