MODERNIZATION OF EXPLOITED GASOLINE ENGINES OF CARS

Dr. sc. techn. Oleg PETROV, Dr. sc. techn. Ilie MANOLI

Technical University of Moldova

Abstract: *It is proposed to modernize gasoline engines of cars that have been in operation for more than 10 years with the help of a device that allows refused of the throttle and thus reducing engine pumping losses. The design of this device is protected by a patent. The proposed device uses a Hydraulic Valve Lifters to control the lift of the intake valves and the phases of the gas distribution of the gasoline engine. The proposed device will provide control of the operating and on emergency modes. It increases the economy of the internal combustion engine and reduces the emission of toxic gases.*

Keywords: *modernization of gasoline engines of cars; opening, lifting height and closing time control of intake valves; device for controlling the gas distribution timing of ICE.*

1. Introduction

Toxic emissions from car engines have harmful effects on people and animals. The amount of harmful emissions into the atmosphere by vehicles depends on the density of the traffic flow and the number of gases emitted by each vehicle. The traffic flow on the streets of the cities of Moldova increases from year to year, therefore, in order to reduce the gas contamination of the air, it is necessary to reduce the amount of harmful products allocated by each car.

According to the State Enterprise "Registru", as of January 1,2015, were officially registered in Chisinau 269 872 vehicles, and most of them are equipped with gasoline engines. Analyzing the results of sales of new cars in Moldova (Figure 1), with good reason we can assume that most of the cars have an age of more than 10 years - these are old cars.

The new cars are being improved by the manufacturers, and the old machines, which mostly spoil the air, are not upgrade. Therefore, modernization of gasoline engines of cars in service is an actual problem.

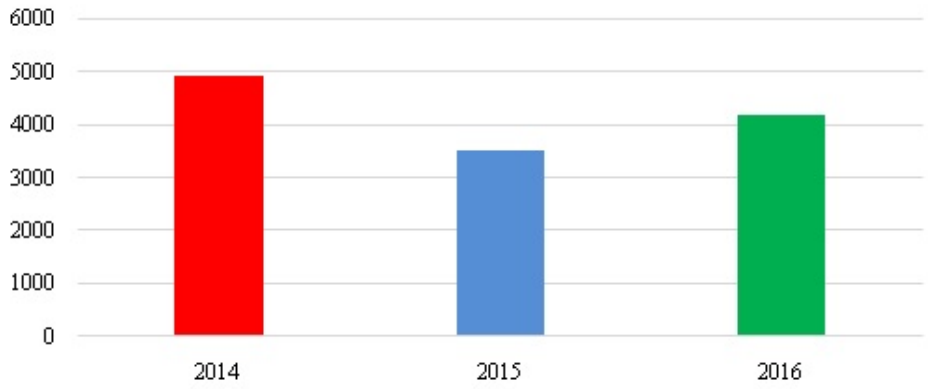

Figure 1. Results of new car sales in Moldova in 2014 - 2016.

Only from 2005 to 2015 in the world on average began to spend a liter less gasoline (and another type of fuel in an equivalent conversion) to travel 100 kilometers. By 2015, according to the International Energy Agency (IEA), this figure dropped to 7.6 liters per 100 kilometers. The global goal is to reduce this figure by 2030 to 4.4 liters. Modernization of gasoline engines will help achieve this goal.

2. Known methods of modernization of internal combustion engines

One of the reserves to reduce fuel consumption is to reduce the pumping losses of the internal combustion engine (ICE). It has long been known that with an incomplete opening of the throttle, it increases the resistance to air passage, which leads to an increase in fuel consumption and an increase in the toxicity of exhaust gases. BMW first introduced a new gas distribution system on its engines, which eliminates the need for a throttle. This system is called Valvetronic, it allows you to continuously adjust the height of the intake valves (CVVL). The system made its debut on the BMW 316Ti Compact in 2001 (Figure 2), it gives an 18 percent reduction in fuel consumption while idling and 10 percent when working at partial loads while satisfying Euro-4 standards and maintaining the injection system in the intake manifold [1].

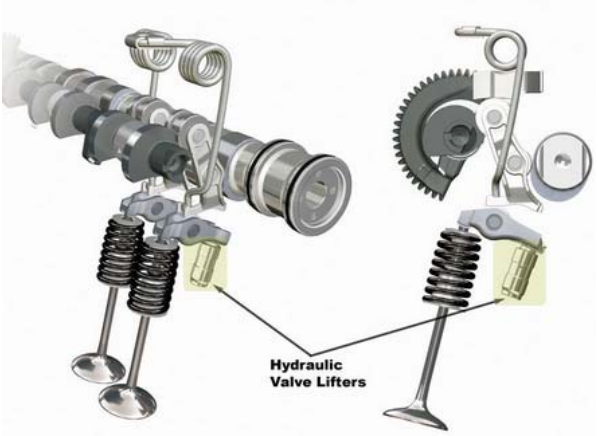

Figure 2. The Valvetronic mechanism for controlling the height of the valve lift

Later a similar system was made by other automakers:
- Valvematic from Toyota; VEL,
- Variable Valve Event and Lift System from Nissan;
- MultiAir from Fiat;
- VTI, Variable Valve and Timing Injection from Peugeot.

Continuous valve control systems with mechanically driven valves are able to vary the height of the valve in addition to the amount of the cam specified, however, these systems are still complex, expensive and require additional devices to compensate for valve clearance. The use of these systems for the modernization of ICE in service will require replacement of the cylinder head, which is expensive.

3. The proposed technical solution

For the modernization of ICE in service, a technical solution is proposed: A device for smoothly controlling the opening time, lift height and closing time, both jointly and individually, of the gas distribution valve with the help of a Hydraulic Valve Lifters in the entire range of the internal combustion engine operating modes [2].

The device automatically compensates for the gaps in the drive mechanism, does not require an increase in the engine's power consumption. It is not complicated in design and inexpensive to manufacture, allows the use of camshafts with "wide" valve timing phases and individual control valves.

The device can be used to upgrade existing engines that use valve actuators with Hydraulic Valve Lifters and throttle valves with a mechanical or electric drive with electronic control.

The device allows to provide "narrow" phases of the gas distribution for idling and partial loads with late opening and early closing of valves without overlapping phases, to prevent the emission of exhaust gases into the intake manifold and the release of part of the fuel mixture into the exhaust pipe.

To solve the task in the device for controlling the valve timing and lifting the valve with a Hydraulic Valve Lifters, comprising: a cylinder head housing 1 with a seat for the Hydraulic Valve Lifters; the bushing 2; plunger 4 with axial channel and skirt; spring-loaded ball stop valve 5, spring 6 (Fig.3), the following operations are performed: the vertical longitudinal teeth in the upper part of the plunger 4 are cut, coupled to the rack 7 or the individual electric drive to control the timing phases; adjust the position of the sleeve 2 relative to the plunger 4, the screw with a lock nut 8; a transverse cutout 9 is cut on the side wall of the sleeve 2 below the opening 3 with the upper and lower control edges for controlling the valve opening delay time; cut a transverse cutout 10 on the side wall of the skirt 2 below the notch 9, with the upper control edge for controlling the closing time of the valve; the oil-ejecting groove 11 is cut on the outer wall of the sleeve 2, to which the notches 9 and 10 are connected with the opening 3; a bypass hole 12 in the side wall of the skirt of the plunger 4 is drilled to discharge the oil from the chamber under the plunger; set the piston 13 in the skirt of the plunger 4 for transferring the pressure of the cam of the camshaft to the valve lifters plunger of the valve via the volume of oil in the chamber under the plunger 4 regulated by the proposed device.

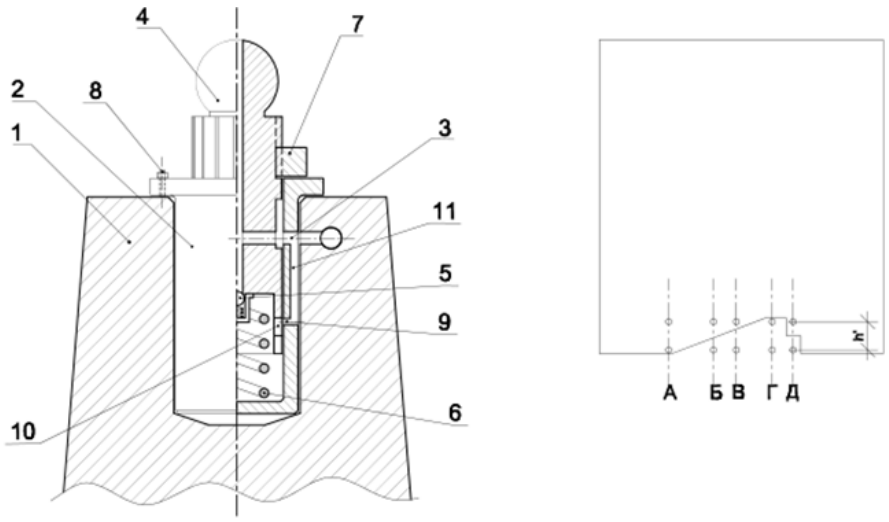

Figure 3. A device for controlling the valve timing on a Hydraulic Valve Lifters with cutouts on the skirt of the plunger

To create a device for controlling the valve timing and lifting the valve with a Hydraulic Valve Lifters [2], use the parts of the Hydraulic Valve Lifters, so it is not difficult to manufacture and allows:

- smoothly, both jointly and individually control the opening time, lift height and valve closing time in the entire range of the ICE;
- use camshafts with "wide" valve timing phases;
- do not increase the power of the generator and do not use additional units and devices to provide the energy of the proposed device;
- to carry out modernization of the engines in operation and to improve the valve drives of the new ICE;

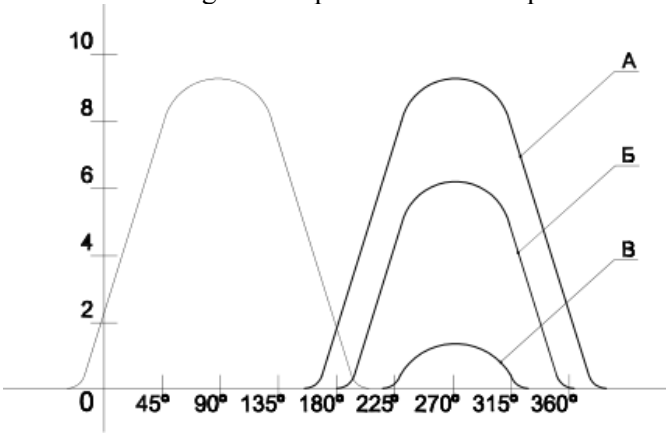

Figure 4. Dependence of the course of the intake valve on the angle of rotation of the crankshaft, A - full load mode, B - medium load mode, B - idling mode

- refuse the use of the throttle valve;
- ensure the economical operation of the engine at idle and partial load with the late opening and early closing of the valve without overlapping phases, excluding the throwing of exhaust gases into the intake manifold and the release of a portion of the fuel mixture into the exhaust pipe, providing "narrow" phases of the gas distribution;
- compensate the clearances of the gas distribution mechanism of the internal combustion engine without the use of Hydraulic Valve Lifters;
- to ensure the emergency operation mode of the internal combustion engine, if the control system of the valve drive fails, as well as the locking / locking mode of the valve to turn the cylinder off.

The proposed device [2] allows the rotation of the plunger 4 to control not only the valve lift but also the valve timing phases defined by the edges of the cutouts 9 and 10. The device allows to control by delaying the opening and closing times of the valve with respect to the time set by the cam profile. This makes it possible to realize the Atkinson-Miller cycle in the gas distribution control by the shape of the edges of the cut-outs 9 and 10. The proposed device was awarded a silver medal at the International Innovation Fair IASI Romania [3].

4. Conclusions

(1) For the modernization of gasoline engines of cars that are in operation for more than 10 years, a device is proposed that uses a Hydraulic Valve Lifters to control the lift of the intake valves and the phases of the gas distribution of the gasoline engine. The design of this device is protected by a patent.

(2) The replacement of Hydraulic Valve Lifters on gasoline engines of cars for the proposed device allows the use of throttle actuators mounted on engines for its control. Therefore, industrial introduction will not be a problem.

(3) The source of the motor energy for controlling the valve timing and the working environment for the proposed device are located in the engine itself and do not require additional power costs.

(4) The proposed device will provide control of the operating and emergency modes. It increases the economy of the internal combustion engine and reduces the emission of toxic gases.

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