SECTION 7. POWER ENGINEERING

USE OF A VALVE SPOOL DEVICE FOR CONTROLLING VALVES OF THE GAS EXCHANGE SYSTEM OF MOTOR VEHICLES

ЗАСТОСУВАННЯ ЗОЛОТНИКОВОГО ПРИСТРОЮ ДЛЯ КЕРУВАННЯ КЛАПАНАМИ ГАЗООБМІННОЇ СИСТЕМИ АВТОТРАНСПОРТНИХ ЗАСОБІВ

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Analyzing the prospects of engine building development in Ukraine and abroad, we can say that one of the main directions in this area is the ecologization of ICE, increase of specific power indicators, fuel efficiency and durability.

To further increase the forcing limits and reduce the thermal load of the ICE, it is necessary to modernize the traditional (valve) gas distribution

mechanism to create an unconventional gas distribution mechanism consisting of a traditional valve and an additional spool [1].

The purpose of this study is to improve the power, environmental and economic performance of a 4-stroke engine by improving gas exchange through the use of spool control.

The continuous improvement of internal combustion engines (ICEs) requires revision of the design of their nodes and systems. This is especially true for the gas distribution systems of engines.

The most common systems for controlling the operation of gas exchange systems are listed in the Table (Fig. 1, 2).
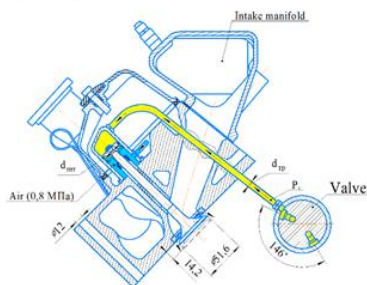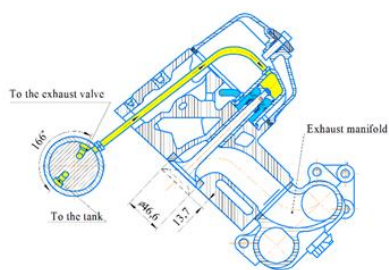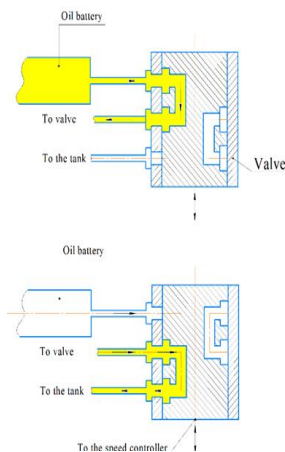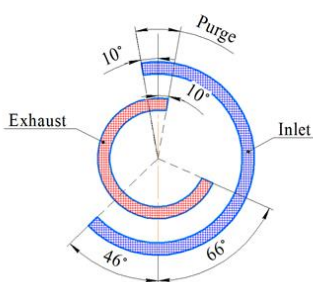

Fig. 1. Scheme of the spool hydro-pneumatic control of the exhaust valve of the automobile engine Kamaz-740

Fig. 2. Structural diagram of the spool and circular gas distribution diagram

The last two systems are the most modern, have common disadvantages and advantages. Each of these systems does not use camshafts, uses oil pressure that is located in the accumulators.

To evaluate each system in terms of advantages and disadvantages, a table showing the most important characteristics of the systems is presented. The table shows the characteristics that are evaluated when compared with the first (classical) mechanical system. The "+" sign evaluates the advantages and the "-" signs evaluate the disadvantages [2].

Based on the analysis of Table 1, the last two systems are the most effective, which differ in the way of controlling the gas distribution phases. But from the last two ,the advantage of the hydropneumatic battery system with spool control should be highlighted for the following reasons.

Table 1

Comparison of advantages and disadvantages of the main control systems of gas exchange processes in a diesel engine

The main characteristics of the systems	Types of gas distribution systems				
	Mechanical system	Hydromechanical	Hydropneumatic system	Hydraulic-accumulator system with electronic control	Hydropneumatic battery with spool control
Simplicity of design	+	±	±	−	−
Reliability of work	−	+	+	±	±
Resource of work	±	+	+	+	+
Low noise level	−	+	+	+	+
Cost of operation	−	±	±	+	+
The cost of the system	+	±	±	±	±
Adjustment of thermal gap	−	+	+	+	+
The mechanism of rotation of the valve	−	−	+	+	+
Easy adjustment of gas distribution phases	−	−	−	±	+
Readiness for work	+	+	±	−	−
Quality of gas exchange	−	±	+	+	+
Speed of action	−	±	+	+	+

As can be seen from Fig. 3 the real law of the movement of the valve almost coincides with the counting, which confirms the correctness of the calculation. Using the hydrodynamic model of the valve movement, it is possible to solve the main problem that holds back the obtaining of the law of motion of "mechanically free valve".

Proceeding from this, in this paper the task is to find the law of motion of the "mechanically free" valve in gas exchange systems with hydraulic accumulators and valve control valves.

Here is a scheme for calculating the motion law of such a valve, on the basis of which the algorithm of the program for numerical solution of the problem with the help of a computer is developed. In this case, the final decision will consist of calculating individual components that are combined in on.
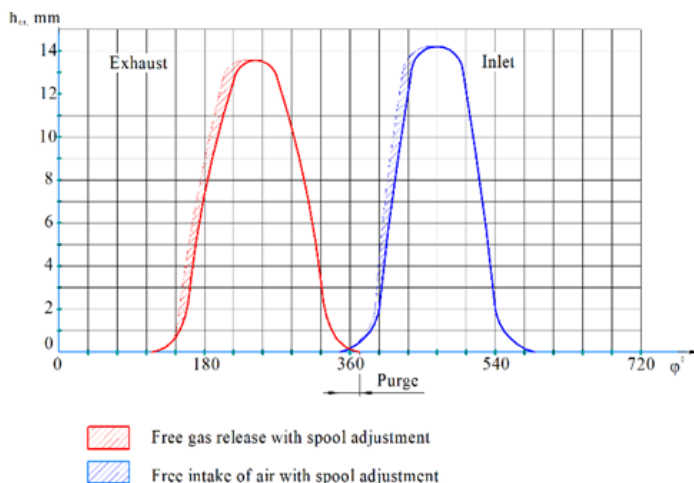

Fig. 3 The law of opening the valve of the engine Kamaz-740

A four-stroke engine KamAZ-740 was deliberately chosen as an object for calculating the motion of a mechanically free valve, for which the firm gives the real law (solid line) of valve opening.

Conclusions:

1.   The created hydrodynamic model allows obtaining the calculated results of the motion of the "free" valve. The calculation results sufficiently coincide with the law of motion of the valve of the real engine Kamaz-740, which allows us to recommend the proposed model for calculations of gas exchange processes (e.g., the existing "time section"), valve speed, etc.

2.   Due to the early opening of the valve, the filling of the cylinder improves, as a result, the capacity increases.

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