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A DESIGN OF AN ENGINE HEAD FOR A SMALL-VOLUME ENGINE[1]

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Summary. The paper presents a new design of cylinder head for a small-volume combustion engine with minimum fuel consumption. Valve gear in the head is DOHC-type; head consists of three construction parts and it is designed by means of SOLID EDGE 9 software. The main requirements for this new design concept are: arrangement and actuation of valves, shape of combustion chamber, shape and diameter of suction and exhaust channels, lubrication.

Key words: engine head, valve gears, valves, camshaft, combustion engine

INTRODUCTION

The head of a combustion engine creates an upper part of combustion space. It plays a very important role from the point of view of the combustion process. Together with the piston bottom it influences the process of fuel combustion. According to the motor design the engine head can be divided into several parts or consists from one integrated piece. In the head there are positioned valves, spark plugs as well as camshafts. A very important design factor of modern combustion engines is the placement of suction and exhaust channels, channel dimensions, angle of channel inclination and others. [Bugár and Sloboda 1998, 1999]. All the above-mentioned questions were already discussed in our previous contributions concerning minimisation of fuel consumption [Kožoušek 1978, Sloboda and Bugár 2002] as well as concerning engines for agricultural and forest machines, for example bush-cutters, mowing-machines, saws, etc.

MATERIAL AND METHODS

The main development trend in the area of small-volume combustion engines is application of CAD-methods for the design of the whole engine and engine parts using various software products. In our paper we describe a small-volume engine with power

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up to 1000 W and with indirect fuel injection in front of suction valves [Bugár and Sloboda 1999, Sloboda *et al.* 2004]. For an experimental engine there was applied three-valve conception (two suction valves, one exhaust valve) with valve actuating system DOHC. This system is complicated from the design point of view in the engine head part mainly. It was necessary to take into consideration the following parameters: placement and shape of suction and exhaust channels, position of spark plug, form of combustion space, arrangement and actuating of valves, shape and drive of cams, lubrication, sensor of temperature, heat flow, strength of engine head, etc. For the solution of the above-mentioned tasks there were applied software tools SOLID EDGE 9 and Cosmos M.

RESULTS

The engine head is suggested for an engine with stroke 28 mm and bore $\phi = 34$ mm. Engine volume is 25.4 cm^3; engine power 700W at revolutions level 6000 min^{-1} (min. 2500, max. 12000 min^{-1}). Specific petrol (Shell 85 Natural) consumption q is less than 400 $g \cdot kWh^{-1}$. The head is made from hardened aluminium produced in laboratories of Faculty of Metallurgy Technical University in Košice. The engine head consists of three main parts, Fig. 1.

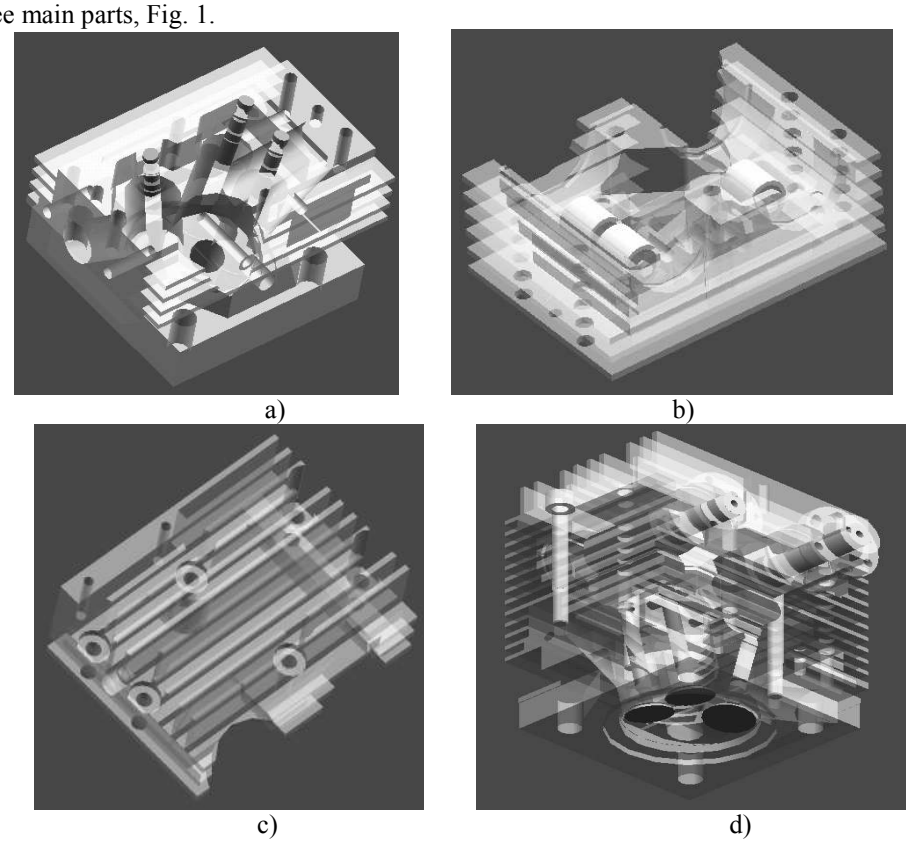

Fig. 1. The head of the cylinder for an experimental engine
a) bottom part, b) middle part, c) upper part , d) complete head

The bottom part, Fig.1a, is fitted to the cylinder with bolts. Combustion space is roof-shaped with an incline 12°. Valve seats and spark plug seats are made from the special copper-alloy produced especially for this purpose in conditions of Technical University in Košice. There are situated holes for temperature sensor and for outflow of lubrication oil in the bottom part. The incline of suction and exhaust channels to the horizontal level is 20°, the channels are polished. In this part of the head there is also a bolted spark plug. The external side of the head is equipped with ribs for engine cooling. The total surface area of ribs was determined by means of computing.

In the middle part of the engine head, Fig.1b, there are situated rocker arms with followers. The main task of the rocker arms design is to ensure the highest speed of valve actuation, i.e. the highest valve stroke. There is applied a system of follower rolling on the cam surface. This technical solution enables to reach a very high speed of rocker arms moving.

The upper part, Fig.1c, fulfils more functions. In this part there are fixed camshaft bearings for camshaft radial and axial supporting. There are in this part holes for inflow of lubrication oil and for sensor of main impulse. External side of head consists of ribs for cooling.

All the above-mentioned head parts are joined together with six head bolts and in this way there is created the complete engine head. It is possible to say that the head of an engine cylinder is one of the most important parts of a combustion engine. It influences the functional properties of the engine. The real head design is in Fig. 2.

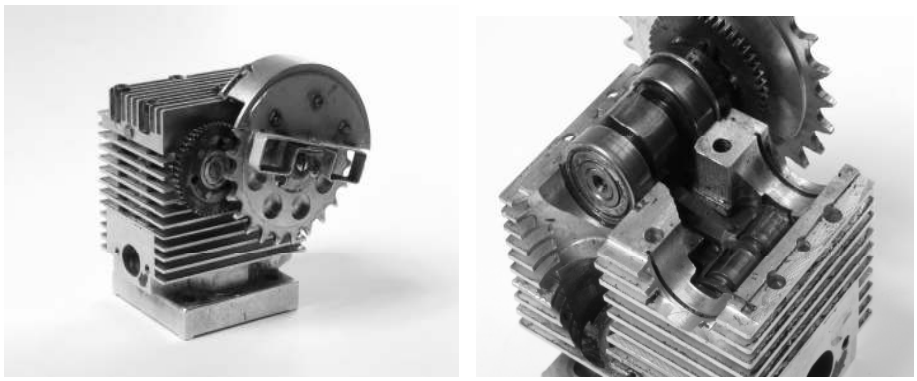

Fig. 2. View on the experimental engine head

CONCLUSION

In this paper there is described one of possible design solutions for the construction of engine head in the case of one-cylinder small-volume experimental combustion engine with minimised fuel consumption. The above-described engine head was produced and tested on a real engine. The results obtained during the engine operation fulfil the requested requirements.

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