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Development of supercharged 2-stroke engine with intake and exhaust valve for series hybrid system (First Report)

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In the engine mounted on HEV, etc., the engine size is an important element from the viewpoint of vehicle weight and mounting space. Engines used for motorcycles and the like are compact with small displacement compared with general passenger car engines, and are effective as a power source in hybrid systems. However, since it is necessary to operate in the high engine speed range in order to obtain the output, and the high efficiency point is also on the high speed side, the lowering of the engine speed is required as a power source of the series hybrid system which requires many high efficiency points. Then, in the application of the small displacement engine in the series hybrid system, the two-stroke engine was noticed, because the high power was obtained even in the low revolution operation region. The two - stroke engine can burn twice at the same engine speed as the four - stroke engine because of gas exchange and combustion in one revolution of the crankshaft, and can generate high torque even in the low revolution range. The two-stroke engine disappeared from the market because it was extremely difficult to comply with the exhaust gas regulation. However, recent engine control and devices, especially fuel direct injection technology and supercharging technology, have the potential to meet exhaust gas regulations. In this study, the improvement of the output in the low rotation range is examined by remodeling a four-stroke, four-cylinder, four-valve supercharged motorcycle engine into a two-stroke engine with a valve by synchronizing the crankshaft and camshaft, and the shape for solving the problem is proposed.

In a two-stroke engine, the residual amount of burnt gas in a cylinder is increased because the time for performing gas exchange in the cylinder is limited. Fig. 1 shows the appearance of the two-stroke engine in this study. In a 1000 cc supercharged motorcycle engine, the intake valve position is offset to the upstream side of the intake system to generate a strong flow downward from the cylinder. Thereby, a unidirectional flow like a uniflow type two-stroke engine can be formed to realize layered scavenging. Fig. 2 shows the performance measurement results of the two-stroke engine. Compared with the base engine, which is a 4 - stroke engine, the 2 - stroke engine achieved more than 40% torque improvement at the same rpm. However, in the operating range of 3000 rpm or more, the increase in torque slowed due to the decrease in air supply efficiency. In order to improve the Trapping efficiency, the shape of the engine cylinder head was examined by CFD, and as a result, sufficiently high air supply efficiency and scavenging efficiency were obtained. As shown in Fig. 3, we fabricated a prototype single-cylinder engine and verified the effectiveness of Trapping efficiency using an actual engine.

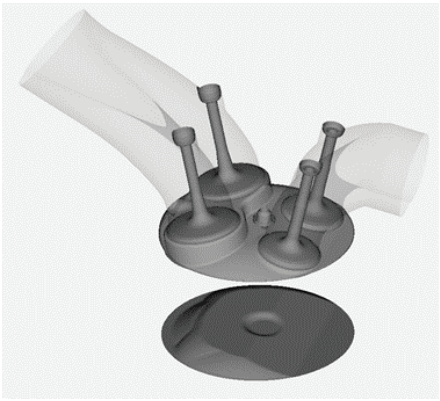

Fig.1 2Stroke Engine with Valves

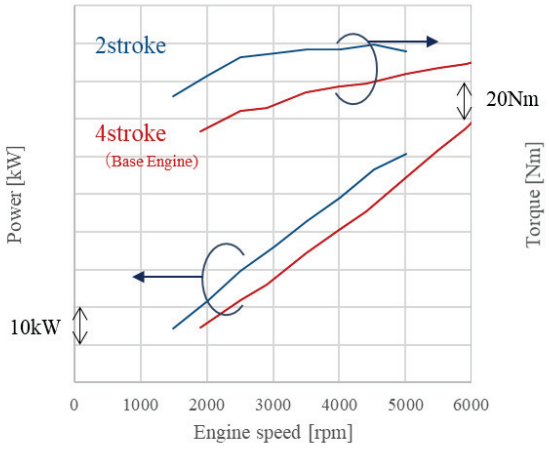

Fig.2 Power&Torque Curve

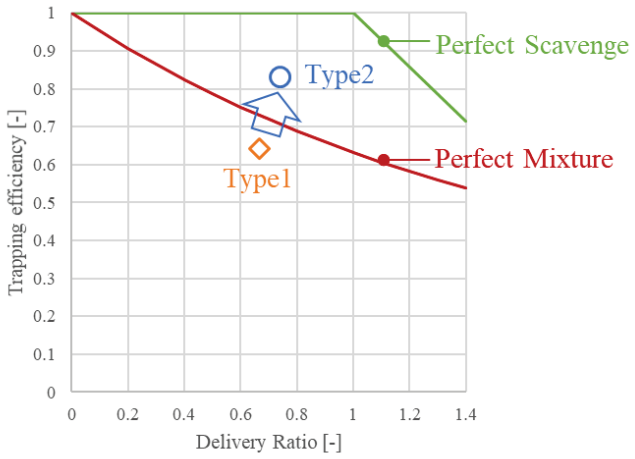

Fig.3 Results of Experiments of trapping efficiency