A Study on the Oil Film Thickness on the Lower Side Surface of the Oil Ring of a Gasoline Engine

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Engine lubricating oil consumption causes particulate matter and poisoning of catalyst, and increase exhaust gas emissions. Oil consumption, therefore, must be reduced and clarifying its mechanism is an important issue. Oil upward transport around the piston is one of the important factor of oil consumption. Oil transports via the sliding surface, gap, and side and back of a piston ring. This study aimed clarifying the mechanism of oil transport via the side and back of the lower rail of an oil ring.

The oil film thickness between the lower rail and lower flank of the oil ring groove was measured. Oil film was measured by Laser Induced Fluorescence Method. Two optical fibers were embedded in the outer and inner side of lower flank of the oil ring groove as shown in figure 1. The force acting on the lower rail was estimated from calculated friction force, calculated inertial force, measured oil pressure under the oil ring and the measured third land pressure.

The oil film thickness for the barrel faced oil ring measured under 2000 rpm engine speed and Pmax=4.5 MPa condition is shown in figure 2 compared with the estimated force. It was found that the oil film thickness measured at the outer side showed a good agreement with the force. In the expansion stroke, the oil film thickness was thinner than that of the intake stroke because the force in the expansion stroke was smaller than that in the intake stroke because of the third land pressure. On the other hand, the oil film thickness for the inner side showed constantly quite small value, and it suggested that oil was well sealed under this operating condition.

The left graph in figure 3 shows the oil film thickness for the taper faced lower rail measured under 1500 rpm and Pmax=4.5 MPa condition. The right graph shows that for the barrel faced oil ring measured under the same condition for the taper faced. It was found that friction force apparently affected oil film thickness stronger in the case of the taper faced oil ring.

Findings showed that estimating force acting on the lower rail of oil ring was required for estimating the oil film thickness under the lower rail, and the shape of sliding surface affected the oil film thickness.

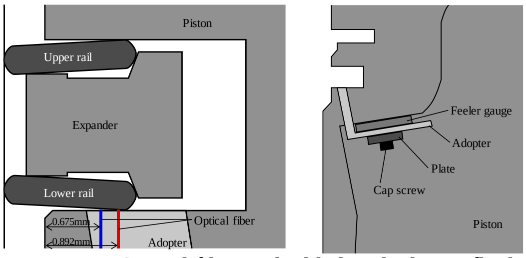

Fig. 1 Optical fiber embedded in the lower flank of oil ring groove

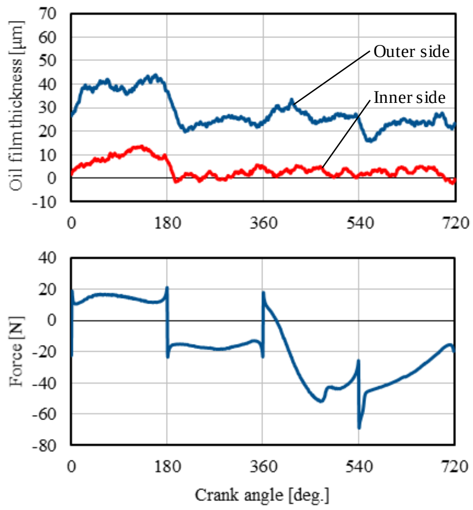

Fig. 2 Oil film thickness compared with force acting on lower rail of oil ring (2000 rpm, Pmax = 4.5 MPa)

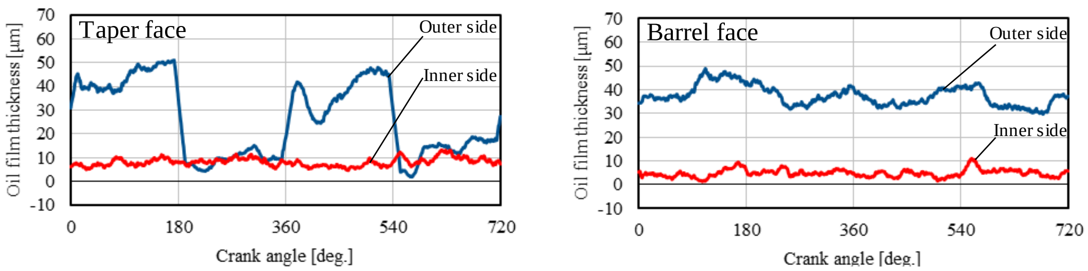

Fig. 3 Effect of shape of sliding surface of lower rail on oil film thickness (1500 rpm, Pmax = 4.5 MPa)