Experimental Study on the Tribological Characteristics including of Oil Leakage in Valve Stem

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The purpose of this paper is to investigate the leakage characteristics of the valve stem in the gasoline engines. Especially, three factors affecting oil leakage are the power cylinder, engine head system, and the positive crankcase ventilation system. Which is the most variables, analysis difficulty is the valve stem seal characteristics. The testing system is used with oil motoring system. The leakage of an engine is analyzed for the cylinder temperature, atmosphere pressure, positive pressure, negative pressure, revolution of the camshaft and the surface roughness of the valve stem.

Keywords : leakage, seal, temperature, pressure, roughness

1. INTRODUCTION

The oil leakage in valve stem may produce the lubricant loss, clogging of the intake system, and carbon deposits on the surface of a piston. The engine failure caused by the oil leakage leads to the severe wear of the piston rings and skirt zone. The contact surface against the cylinder experiences the full range of lubrication regimes, which are from the boundary lubrication to full lubrication.

In this paper, the oil leakage through the valve stem seal has been measured for various operating conditions. The stem seal is already used and compared to the new valve stem seal.

2. EXPERIMENTALS

2.1 Mechanism of the valve stem seal

The seal lip model as shown in Fig. 1 has been used in this leakage test. The important design parameters of the stem seal are the offset, ε the angle, α of oil side, the angle, β of air, and the contact point radius, R. These parameters are strongly related to the contact zone of the stem seal.

2.2 Experimental apparatus

For the experimental results, the simple testing apparatus is built. This tester measures the leakage of an oil, which is leaked along the diameter of the valve. The leaked engine oil is collected and measured with a precision balance.

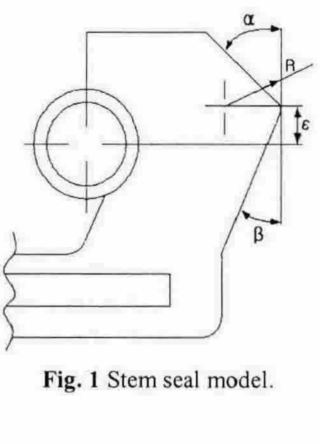

Fig. 1 Stem seal model.

3. RESULTS

3.1 Leakage of leakage varying with oil temperature

Fig. 2 shows the leakage of engine oil. For the increased temperature of oil, the leakage is increased for various speed of an engine. As the speed of an engine increases, the low range of the speed up to 100rpm is supposed to converge to a certain value.

3.2 Leakage due to an intake pressure

3.2.1 Positive pressure

When an intake pressure is positive, the leakage of oil is showed in Fig. 3. As the intake pressure is increased, the leakage of engine oil is slightly increased. This means that the intake pressure is not an influential factor.

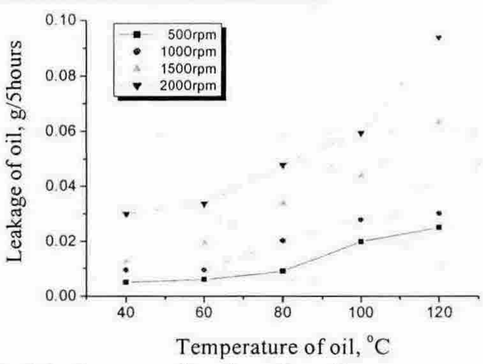

Fig. 2 Leakage as a function of an oil temperature.

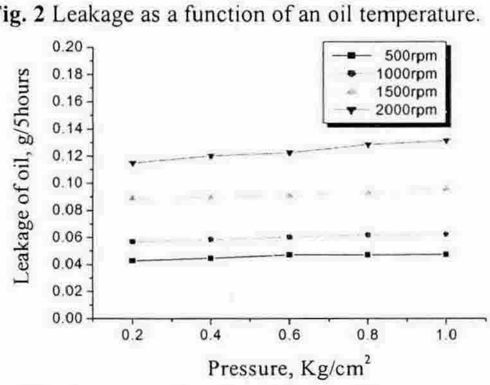

Fig. 3 Leakage as a function of the positive pressure.

3.2.2 Negative pressure

Fig. 4 shows that the increased negative pressure decreases the oil leakage. The increased speed of the engine cuts the oil leakage rapidly.

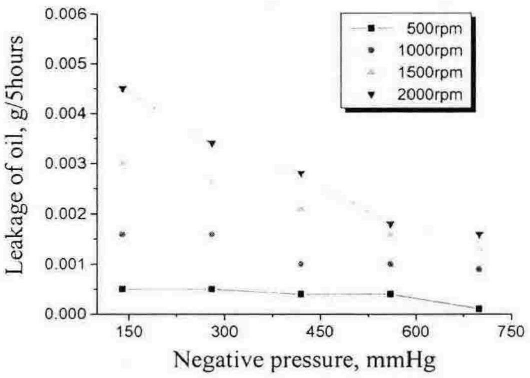

Fig. 4 Leakage as a function of the negative pressure.

3.3 Oil leakage by a camshaft revolution

Fig. 5 shows an oil leakage as a function of the camshaft revolution. As the speed of the shaft increases up to 2,000rpm, the oil leakage is moderately increased for 4 cylinders.

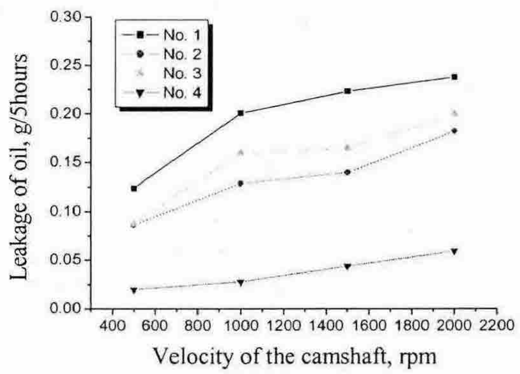

Fig. 5 Leakage as a function of the camshaft revolution.

3.4 Amount of oil leakage variation varying with surface roughness of valve stem

Test samples have been operated for 5 hours. After 5 hours' test of the valve, the measured surface roughness is 0.4598 μ m, 0.5109 μ m, 0.6206 μ m and 0.9273 μ m for 4 valves. after 125 hours' running, the measured surface roughness is 0.3727 μ m, 0.4278 μ m, 0.5325 μ m and 0.0.8469 μ m.

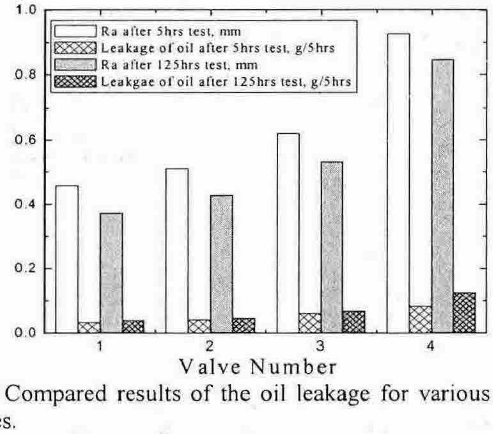

Fig. 6 Compared results of the oil leakage for various valve samples.

The leaked oil for the increased running speed is increasing due to wear. The surface roughness is very important parameters as shown in Fig. 6.

The increased surface roughness may be useful for minimizing surface wear of seal lip and controlling oil leakage[3]. And, the surface treatment technique must develop preserving minimum oil leakage with oil film without sticking between valve stem seal and valve stem.

4. DISCUSSIONS

1) As the oil temperature is rises, oil film decrease with down viscosity. But, the amount of oil leakage increase if oil flow fast.
2) As the positive pressure increases, the oil leakage is increases.
3) As the negative pressure increases, the oil leakage decreases.
4) For the camshaft revolution increases, more amount of oil leakage increases proportioning cylinder reciprocation moving.
5) The surface roughness is a extent about 0.35-0.55 μ m(Ra).

5. REFERENCES

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