Moving Inlet Ports Concept for Optimization of 2-Stroke UNI-Flow engines

Nowadays, the fixed size and position of the inlet ports on 2-stroke engines is one of the most limiting factors for improving thermal efficiency. In fact, only a symmetrical shape of the effective port area can be realized. A compromise needs to be found between sufficient expansion piston work and the duration of the scavenging process. This is especially the case for dual-fuel (DF) engines, where the scavenging process plays a crucial role. Due to the cylinder shape of the cylinder liners and the large number of inlet ports (about 30 per cylinder liner), it is difficult to find a simple mechanical solution which allows a flexible control of the inlet ports area.

A solution has been developed to allow asymmetric inlet port opening and closing without compromising the movement of the piston or the high pressure phase of the combustion cycle. In fact only the lower part of the cylinder liner is movable, while the upper part is fixed in the engine frame as for a standard liner. This means that during combustion no pressure losses are expected. During the expansion stroke, when the piston has passed the connection between the upper and the lower liner parts, the lower part is lowered allowing a longer expansion stroke and so more piston work. When the piston has reached bottom death centre, the lower liner part is than shifted upwards increasing the inlet port area rapidly. The scavenging process can be so synchronized optimally with the exhaust valve timing and a larger effective area is obtained. The lower part must then be in “closed” position when the piston passes connection again during the compression stroke in order to avoid piston rigs damages.

Summary

The proposed solution allows the control and therefor optimization of the effective opening area of inlet ports on 2-stroke UNI-flow engines. This gives the possibility to fully optimize the scavenging process targeting longer expansion work, longer duration and/or increased in-cylinder swirl (depending on the control strategy). Thanks to this solution it is possible to increase the load capability of DF engines and in general to improve thermal efficiency. The cylinder liners are composed of two parts: the upper part, which is fitted in the engine frame as a common cylinder liner, and the lower part, where the inlet ports are machined, which can be moved vertically. The movement of the lower part is made possible by pneumatic (or hydraulic) pistons and is fully independent from the piston movement.

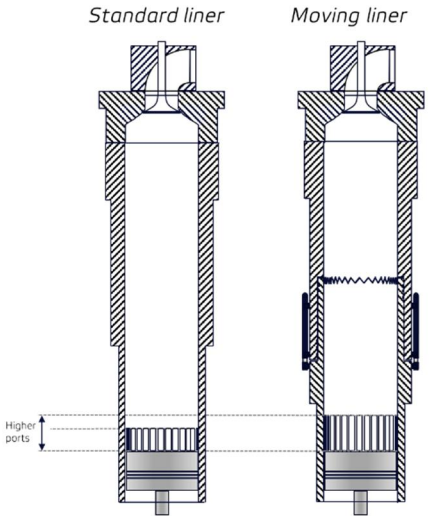

Figure 1: Comparison of a standard liner (left) and a liner with Moving Inlet Ports (right).

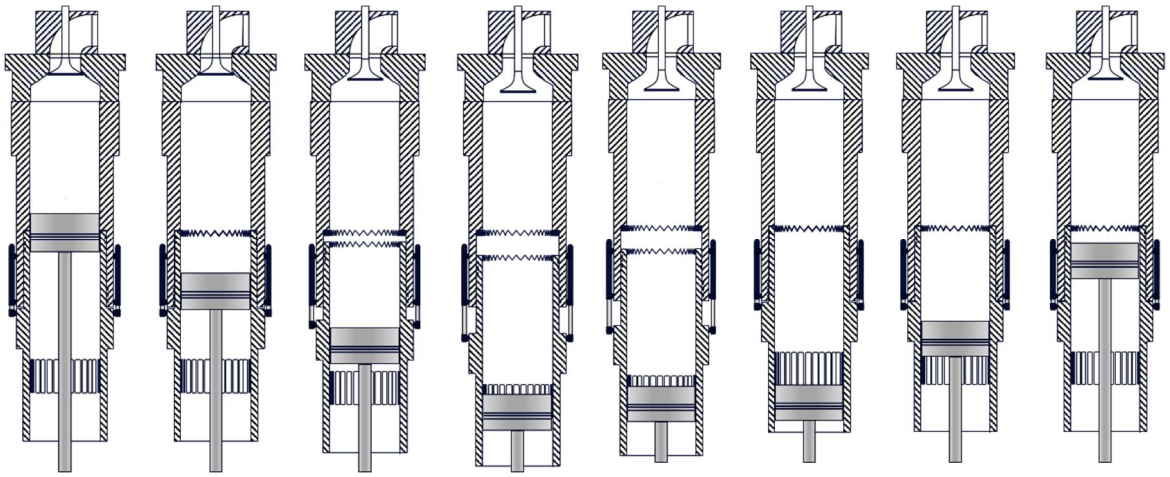

Figure 2: Moving Inlet Ports concept.

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