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SMALL STRATIFIED-SCAVENGING TWO-STROKE INTERNAL COMBUSTION ENGINE

To meet the efficiency and environmental requirements for small two-stroke engines, the authors propose using of stratified scavenging [1]. The working process of such an engine involves the use of air instead of the air/fuel mixture to clean the combustion chamber from exhaust gases. This addresses the main problem of two-stroke engines – the formation of a significant amounts of toxic combustion products, primarily burned hydrocarbons that enter the exhaust channel in the form of gasoline vapors. Engine efficiency also improves.

Stratified scavenging has been implemented in the design of mass-produced single-cylinder two-stroke engines by engineers from Husqvarna (Figure 1) and Stihl. A crankcase scavenged two-stroke engine (1) comprises a cylinder (15) including scavenging ports (31) and at least one exhaust port, a piston (13), a

connecting rod (17), a crankshaft (18) and a generally sealed crankcase (16). The crankcase inducts a fuel/air mixture and is connected to the scavenging ports (31) through transfer ducts (3) which, as the piston (13) moves from a lower position towards a higher position, are inducting pure air let in from connecting ports (8) near the scavenging ports (31) in the cylinder (15). The transfer duct (3) volume is less than 20% of a volume swept by the piston (13) during an entire revolution of the crankshaft (18). Recesses (10) are formed in an outer periphery of the piston (13), said recesses (10) co-operating with the connecting ports (8) in the cylinder wall for controlling the filling of the transfer ducts (3) with air. An inlet tube (22) in the cylinder wall supplies the air/fuel mixture, said inlet tube (22) being connected to the crankcase (16) and covered by the piston (13) as the piston (13) is in the lower position, and open to the crankcase (16) as the piston (13) is in the higher position [2].

In principle, such a system operates by first a portion of air enters the combustion chamber, followed by the fuel/air mixture. As a result, some of the fuel previously lost during scavenging is retained. In addition, this allows to increase the overlap angle, that is, increase the time allocated for cleaning the cylinder, and the quality of cleaning increases.

To assess the efficiency of two-stroke engines with the proposed stratified scavenging, the authors in [3] developed an algorithm for calculating the window cross-section per cycle and evaluated the performance of such systems.

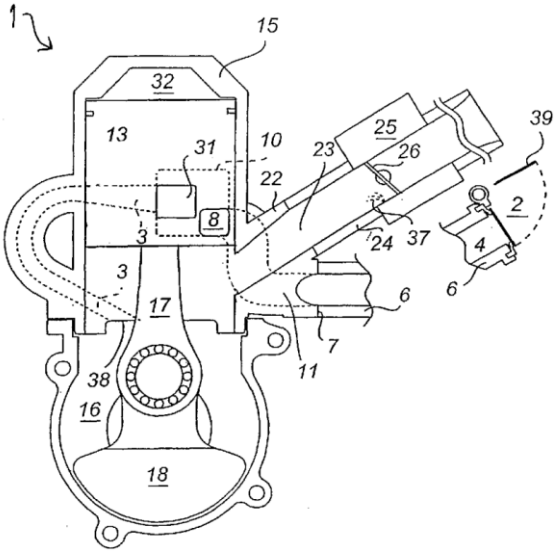

Figure 1 – Scheme of stratified-scavenging two-stroke engine [2]

The thermodynamic cycle of a carburetor engine of a traditional design and a modernized engine (with a stratified scavenging) was calculated. Key performance indicators were calculated: maximum cylinder pressure increased by 11%, engine power by 17%, and torque by 15%. The fuel economy of the modernized engine is 6% at nominal mode. The obtained data do not contradict the research [4].

Based on the comparative analysis of the obtained engine indicators, it can be assumed that the use of stratified scavenging of cylinders is effective for improving the characteristics of two-stroke engines.

However, there are some disadvantages, including increased design complexity, higher cost, and tuning difficulties. However, stratified scavenging opens up new possibilities for two-stroke engines.

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