1. Introduction
A spark ignition and a compression ignition engine with uniflow valve scavenging of the cylinder and a transfer valve in the piston crown have been described.

A great disadvantage of two-stroke engines are ports which are made in the cylinder bearing surface. Under the heat which is realised during the combustion, the thermal extension of the range in proximity of the ports and other parts of the cylinder is different and so the distortion of the geometry of the cylinder liner surface force the designer to make the clearance between the piston and the cylinder liner bigger.

This fact is the reason why two-stroke engines their had mileage shorter. In the fig.1. there, as an example, has been shown the developed cylinder liner of a spark ignition engine with crankcase compression. This disadvantage has been the main reason that designs and production of two-stroke compression ignition engines, for about 30 or 40 years has been stopped; those engines at this time had not the mileage of four-stroke engines.

If one would consider two-stroke spark ignition engines with crankcase compression so also the combustion of the oil which lubricate the cylinder interior was and is a disadvantage. It could not been removed because of the bigger toxicity of the exhaust gases.

To withdraw the disadvantage of the deformation of the cylinder liner surface of compression ignition engines and keep the geometry of the surface as in four-stroke engines has been an idea developed in which in the piston crown has been a transfer valve installed. This valve can be formed as the combustion chamber of the engine.

This conception has been patended by Jan A. Wajand in Poland and the description of the patent has been published in the Bulletin of the Patent Office Polish on the 14th February 2000, under the numbers A1/21/327896, /22/ 1998 08 06 and 7/51/F01B1.
2. The spark ignition engine (SJ)
To proof the conception with the transfer valve in the piston crown has been a proofedina four-stroke SJ engine rebuild, which was the authors disposal. This engine had a power output of 3,3 kW at 3000 rev/min, the cylinder diameter is of 70 mm, and the stroke-60 mm. The swept volume is 230 cm$^3$. The engine is air cooled by means of its own ventilator.

The preparations of the engine to the planned experiment included:
- the rebuilding of the piston with the valve situated in the piston crown; there has been two solutions, one with a compressor plate valve - fig. 2. and the next, with a poppet valve - fig. 3, the crankcase has been filled with timber to reduce the clearance volume,
- on the crankshaft there has been mounted small masses also to reduce the clearance volume,
- on one of the walls of the crankcase there has been mounted valves to provide the crankcase with air-fuel-oil mixture,
- there has been designed a new cam to evacu ate properly the exhaust gases after the combustion, over poppet valves in the cylinder head,
- and new springs designed to conquer the acceleration of the exhaust valves,
- there has been changed the transmission of the camshaft so that the transmission to the crankshaft is 1:1.

The engine has been started on the 15 February 2000. The start of the engine was easy, the idle run was even and the accelaration of the engine has been satisfactory.

The second experiment with the poppet valve in the piston crown took place on the 16th of March 2000, and again the start was easy, the idle run was even and the accelaration of the engine has been satisfactory.

It should be underlined that both experiments were done only to proof the conception of the transfer valve in the piston crown; there has not been any tests to optimize the operational parameters of the engine.

3. The compression ignition engine (CJ)
The reason of the described experiments and deformations of the liner geometry which were the disadvantages of the compression ignition engine in the use of two stroke engines in trucks, buses, plant machines, fish cutters and so on. Again the conception leaded two a solution of an engine without ports in the cylinder liner valves in the cylinder head to keep the geometry of any distortion.

To carry out the planned experiments, a compression ignition engine which was at the disposal of the authors has been used. This engine has a direct injection chamber, had a power output of 7 kW at 3000 rev/min. The cylinder diameter is of 90 mm and the stroke -90 mm. The swept volume of the cylinder is 573 cm$^3$. The engine is air cooled by means of an own ventilator.

There has been designed a new piston which is shown in fig. 4. The upper part of the piston guides the piston rings. In the piston crown there is the transfer valve mounted.

The lower part of the piston is its skirt. Both parts of the piston are joint together by means of a sleeve which is in a way a "piston rod". Thanks to this solution some advantages has been gained:
- the piston crown and ring part of the piston with relativ high temperature are separated from the skirt, what causes a lower temperature; the clearance of the skirt can be smaller,
- the skirt can be designed of a different material as the ring part, so the expansion coefficient of it could be smaller; again the clearance could be smaller,
- both parts of the cylinder liner are separated, so they are not influenced by the higher temperature of the crown,
the piston crown is well cooled, because of the air which flows through the valve,
the sleeve /"piston rod"/ has no contact with the liner,
the piston rings have the possibility of unconstrained movement what enables a better grind in
with the liner.
This engine has been started on the 24 September 2002. The start was easy, the run was even and
the acceleration of the engine was satisfactory.
Also in this engine there has not been made any attempt to optimised any of the operational
parameters, the only sense of the experiments were to proof the conception of the valve situated
in the piston crown.

4. Conclusions
Both engines, which the authors had to their disposall, are not up to date in comparison with high
speed modern engines.
- In the compression ignition engine there is the possibility to divide the ring part from the
skirt; both parts could be build of different materials. This possibility could be also used in
the spark ignition engine, though in such a case, there could not be used the initial crankcase
compression.
- It is strongly emphasized, that there has not been made any experiments to optimize any of
the operational parameters of both engines; by both of them the only aim was to confirm the
conception of the transfer valve in the piston crown.
- Both engines could be started without any problems, both ran even and their acceleration has
been satisfactory.

5. Development directions of the conception
The main development directions of the presented conception are:
1) Design of a basic engine with the main assumption of a two-stroke solution with
optimization of the mass of the engine its overall dimensions and its main dimensions i.e.
the cylinder diameter and the piston stroke.
2) Design of a forced operation of the valve situated in the piston crown.
3) Shaping of the valve and its seat to obtain the best cylinder feeding with air and the swirl of
the air load in regard with the pressure of the feeding air and the inertia forces.
4) Optimizing of the sleeve /"piston rod"/ in the sense of its mass and dimensions. The main
assumption is, that the air velocity should be kept in reasonable limits.
5) Design of the exhaust cam to obtain a good exhaust scaveging of the cylinder over exhaust
valves with the possibility to use the Kadenacy effekt.
6) Optimization of the materials of both parts of the piston and both parts of the cylinder liners
to obtain a proper course of the engine.
7) It is once again ascertained, that the authors are aware that the development of both engines
would demand big financial costs.

The authors are ready to show the engines to anybody who would be interested to visit the test-
bed with the engines, after timing the visit.
Fig. 1. Developed view of typical two stroke engine cylinder liner

Fig. 2. Piston with a plate valve

Fig. 3. Piston with a poppet valve
Fig. 4. Cylinder and piston of the compression ignition engine: 1-piston ring part, 2-piston skirt, 3-sleeve (“piston rod”)