

Internal combustion engine

The invention relates to an internal combustion engine having at least one piston cylinder.

In internal combustion engines, pollutants, such as for example nitrogen oxide (NO_x), carbon dioxide (CO_2), soot or dust particles, which put a strain on the environment, are produced due to the combustion of fossil, biological, solid or gaseous energy carriers in the combustion chamber of the cylinder.

The invention is aimed at avoiding this disadvantage and providing an internal combustion engine which facilitates as environmentally friendly as possible operation. The internal combustion engine of the invention is characterised in that it has a housing enclosing twin gas injectors and having two inlet openings for separate supply of hydrogen gas and oxygen gas to the combustion chamber of the piston cylinder, wherein the housing is provided with two pressure-controlled and time-controlled, electrical inlet valves and assigned nozzle needles, in that the combustion chamber has an outlet opening for ejection of the combustion product, and in that a thermolysis catalyst forms the combustion chamber covering, which thermolysis catalyst has two hollow cylinders arranged at a distance from one another and concentrically and surrounding an intermediate space, wherein the walls of the hollow cylinders defining the intermediate space are provided with a metal coating for release of the heat of combustion acting on the inner hollow cylinder, and wherein the outer hollow cylinder is provided with an inlet opening for the supply of water, an outlet opening for the release of oxyhydrogen gas and a temperature sensor for control of water supply.

The outlet opening of the combustion chamber can preferably be closed by a spring valve controlled by a double-acting camshaft.

According to a further inventive feature, the two inlet valves of the housing comprise in each case a coil, an anchor and a compression spring.

According to a further inventive feature, the spring valve is opened at about 160 degrees in the piston positions from the bottom dead centre to shortly before the upper dead centre.

The invention is illustrated in more detail below using an exemplary embodiment with reference to the drawings.

Figure 1 shows a schematic sectional representation of a part of the internal combustion engine of the invention having twin gas injectors and a thermolysis catalyst, Figure 2 shows schematically in detail the twin gas injectors and Figure 3 shows a schematic representation of a complete internal combustion engine.

According to Figures 1 and 2, the internal combustion engine of the invention has at least one piston cylinder 1 and a housing 3 enclosing twin gas injectors 2 and having two inlet openings 4 for the separate supply of the energy carriers hydrogen gas (H_2) and oxygen gas (O_2) in the ratio 2:1 to the combustion chamber 5, wherein two pressure-controlled and time-controlled, electrical inlet valves 6 control the supply to the energy carriers via two nozzle needles 7 arranged in the housing 3 at a distance precisely according to the operating requirements. The two inlet valves 6 comprise in each case a coil 8, an anchor 9 and a compression spring 10.

The internal combustion engine of the invention does not have an air-inlet opening, since an air supply is not necessary for the reaction of the oxygen gas with the hydrogen gas.

Since during the start process there is no momentum, the crankshaft 11 shown in Figure 3 is driven via an electrical starter not shown, wherein at a piston position shortly before the upper dead centre, the twin gas injectors 2 introduce hydrogen gas and oxygen gas in the ms range into the combustion chamber 5 of the cylinder 1. In the cold-start phase, the hydrogen-oxygen gas mixture introduced in the ratio 2:1 (oxyhydrogen gas) is combusted by spark ignition, for example by an ignition spark or a spark plug. After reaching a constant combustion chamber temperature of about 700 degrees C, the spark ignition is switched off and the auto-ignition adapted to a predetermined piston position. In the subsequent working cycle, the gas mixture burns at a temperature up to 3,000 degrees C and produces water molecules, wherein the

resulting pressure increase and volume increase of the gas mixture moves the piston 12 to the bottom dead centre of the cylinder 1. The working load 13 associated with the crankshaft 11 guides the piston 12 to the upper dead centre, wherein at the piston positions from the bottom dead centre to shortly before the upper dead centre at about 160 degrees, an outlet opening 15 arranged in the cylinder head 14 is opened by means of a spring valve 17 controlled by a double-acting camshaft 16 and the water molecules are passed to an exhaust gas water tank 18. The water molecules collected in the exhaust gas water tank 18 are passed to a pure-water tank 19 and then supplied to a thermolysis catalyst 20 forming the combustion chamber covering of the internal combustion engine, which thermolysis catalyst 20 decomposes the water molecules thermally into hydrogen gas and oxygen gas. The gas mixture formed is passed to a cooling-water device 21, as a result of which water vapour which is present to a small extent condenses to form water. Then the pure hydrogen/oxygen gas mixture is supplied to a gas-separation device 22, which separates the hydrogen gas from the oxygen gas. Then the separated gases are compressed in a high-pressure compressor 23 and stored in storage devices 24 to be supplied again to the internal combustion engine as energy carriers.

The thermolysis catalyst 20 has two concentric hollow cylinders 25 and 26 arranged at a distance of preferably 1 to 2 mm, and which enclose an intermediate space 27 which is provided with a metal coating 28 of preferably platinum, palladium, iridium, osmium, rhodium or the like. The outer hollow cylinder 26 is provided with a radially extending inlet opening 29 close to its base surface for the supply of water and a radially extending outlet opening 30 close to its top surface for the release of oxyhydrogen gas to the cooling-water device 21. The heat produced due to the combustion of the energy carriers in the combustion chamber 5 of the inner hollow cylinder 25, in the case of a metal coating 28 formed from platinum of the inner hollow cylinder 25, heats the latter to a temperature of about 1,200°C and puts it into an ignition state. The water flowing via the inlet opening 29 into the intermediate space 27 is transferred by the strongly heated hollow cylinders 25 and 26 directly with formation of super-heated water vapour ($2\text{H}_2\text{O}$), wherein due to the interaction of the water vapour with the platinum coating 28, the super-heated water vapour molecules in the oxyhydrogen gas ($2\text{H}_2 + \text{O}_2$), a mixture of gaseous hydrogen (2H_2) and oxygen (O_2) in the volume ratio $\text{H}:\text{O} = 2:1$, are thermally decomposed. Due to a temperature

sensor 31 arranged in front of the outlet opening 30, the water supply is controlled such that the super-heated water vapour produced keeps the temperature of the glowing platinum coating 28 constant at an ideal temperature of about 1,200°C.

The internal combustion engine of the invention may be operated in four-stroke cycle and in two-stroke cycle, since a separate intake stroke and compression stroke are not necessary. The advance angle per cylinder may therefore be switched in running operation from 720 degrees to 360 degrees, as a result of which an increase in power of the internal combustion engine without delay is possible.

The advantage of the invention is that no pollutants are produced, such as for example nitrogen oxide (NO_x), carbon dioxide (CO_2), soot or dust particles, hence the environment is not strained.

It goes without saying that the embodiment described may be modified several times within the framework of the general inventive concept. For example a rotary piston engine may be provided as the internal combustion engine.

Patent claims:

1. Internal combustion engine having at least one piston cylinder, characterised in that it has a housing (3) enclosing twin gas injectors (2) and having two inlet openings (4) for separate supply of hydrogen gas and oxygen gas to the combustion chamber (5) of the piston cylinder (1), wherein the housing (3) is provided with two pressure-controlled and time-controlled, electrical inlet valves (6) and assigned nozzle needles (7), in that the combustion chamber (5) has an outlet opening (15) for ejection of the combustion product, and in that a thermolysis catalyst (20) forms the combustion chamber covering, which thermolysis catalyst (20) has two hollow cylinders (25, 26) arranged at a distance from one another and concentrically and surrounding an intermediate space (27), wherein the walls of the hollow cylinders (25, 26) defining the intermediate space (27) are provided with a metal coating (28) for release of the heat of combustion acting on the inner hollow cylinder (25), and wherein the outer hollow cylinder (26) is provided with an inlet opening (29) for the supply of water, an outlet opening (30) for the release of oxyhydrogen gas and a temperature sensor (31) for control of water supply.
2. Internal combustion engine according to claim 1, characterised in that the outlet opening (15) of the combustion chamber can be closed by a spring valve (17) controlled by a double-acting camshaft (16).
3. Internal combustion engine according to claim 1 and 2, characterised in that the inlet valves (6) of the housing (3) have in each case a coil (8), an anchor (9) and a compression spring (10).
4. Internal combustion engine according to one of claims 1 to 3, characterised in that the spring valve (17) is opened at about 160 degrees in the piston positions from the bottom dead centre to shortly before the upper dead centre.
5. Internal combustion engine according to one of claims 1 to 4, characterised in that it is designed to be free of air-inlet openings.

6. Internal combustion engine according to one of claims 1 to 5, characterised in that it is designed for operation in four-stroke cycle or two-stroke cycle with an advance angle of 720 degrees or 320 degrees per cylinder.