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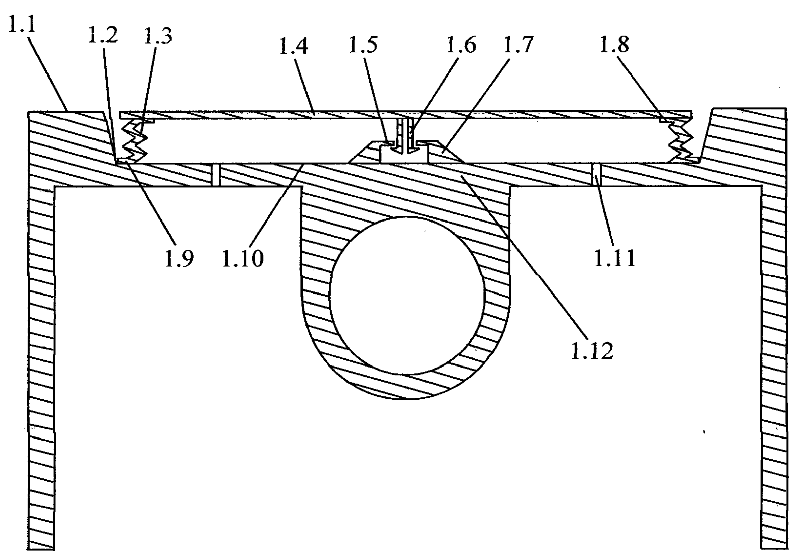
(54) PISTON WITH FLAT MOVABLE UPPER SURFACE

(57) The present invention comprises the use of a flat member (1.4, 2.4) which connects to a flexible member (1.3, 2.3) which attaches both said flat member (1.4, 2.4) and the top surface (1.10, 2.10) of the surface of the piston head (1.12, 2.12) which is positioned lower than the edge surfaces (1.1, 2.1) of said piston head (1.12, 2.12), such that said flat member (1.4, 2.4) is mounted on the lower surface (1.10, 2.10) of the piston head (1.12, 2.12). The aim of this design is to eliminate the exhaust fumes remaining inside the clearance volume by eliminating said clearance volume when the piston head (1.12, 2.12) reaches the top dead centre in the exhaust stroke, while keeping the clearance volume cleared when the piston head (1.12, 2.12) reaches top dead centre at the compression stroke.

This designs therefore removes more than 90 % of the clearance volume when it is required at top dead centre at the end of the exhaust stroke, while leaving the clearance volume clear at the compression and ignition strokes in order for the compressed gases to be housed inside the cylinder as required, hence maximising the combustion efficiency of the internal combustion engine. Said design can be applied to both two-stroke and four-stroke internal combustion engine designs.

Figure 1:



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Description

Description of the invention:

[0001] The present invention comprises the use of a flat member (1.4, 2.4) which connects to a flexible member (1.3, 2.3) which attaches both said flat member (1.4, 2.4) and the top surface (1.10, 2.10) of the surface of the piston head (1.12, 2.12) which is positioned lower than the edge surfaces (1.1, 2.1) of said piston head (1.12, 2.12), such that said flat member (1.4, 2.4) is mounted on the lower surface (1.10, 2.10) of the piston head (1.12, 2.12). The aim of this design is to eliminate the exhaust fumes remaining inside the clearance volume by eliminating said clearance volume when the piston head (1.12, 2.12) reaches the top dead centre in the exhaust stroke, while keeping the clearance volume cleared when the piston head (1.12, 2.12) reaches top dead centre at the compression stroke.

[0002] This designs therefore removes more than 90 % of the clearance volume when it is required at top dead centre at the end of the exhaust stroke, while leaving the clearance volume clear at the compression and ignition strokes in order for the compressed gases to be housed inside the cylinder as required, hence maximising the combustion efficiency of the internal combustion engine. Said design can be applied to both two-stroke and four-stroke internal combustion engine designs.

Figure 1 comprises a cross-sectional view of the piston head (1.12) when the flat member (1.4) is positioned at its uppermost position possible.

Figure 2 comprises a cross-sectional view of the piston head (2.12) when the flat member (2.4) is positioned at its lowest position possible.

Figure 3 comprises a side cross-sectional view of said piston head, with an air evacuation conduit (3.8) which connects the bottom area of said piston head (1.12, 2.12) to the mid chamber, as well as comprising wider piston head positioning members (3.5) and layers of adhesive bonded foam or rubber on the contacting surfaces (3.1, 3.2, 3.3, 3.7).

Figure 4 comprises a side of a cross-sectional side view of said piston head (4.1), comprising a fastener (4.2), preferably a rivet (4.2), bolt (4.2) or nut (4.2), which projects perpendicularly to the direction of motion of said piston head (4.1), and so through the side of said piston head's (4.1) upper surface, and simultaneously through the sides of the attaching member (4.3) of said flat movable member (1.4, 2.4), to the inner side of said attaching member (4.3), such that said attaching member (4.3) remains positioned over said inner flat surface (4.4).

[0003] The system fully functions automatically without the need of any further components, apart from a set of arrow shaped metallic members (1.6, 2.6) which stop the flat member (1.4, 2.4) from moving higher than required due to inertial forces when reaching the top dead centre at the exhaust stroke. Two flat teethed members (1.5, 2.5) stop the arrow shaped members (1.6, 2.6) from moving away due to inertia. These teethed members (1.5, 2.5) are sustained by solid members (1.7, 2.7) which connect to the lower surface (1.10, 2.10) of the piston head (1.12, 2.12).

[0004] When the piston head reaches top dead centre at the compression stroke, the inertial forces move the flat member (1.4) to the highest position possible, at which the top surface of the member (1.4) is aligned with the lateral upper surfaces (1.1) of the piston head, which come nearly in contact with the cylinder head. The teethed members (1.5) stop the flat member (1.4) from moving higher than required by the means of its arrow shaped members (1.6), which are connected to the flat member (1.4) and are stopped by said teethed members (1.5). When the piston head reaches top dead centre at the compression stroke, the pressure of the fluid inside the cylinder moves the flat member (2.4) as downwards as possible, which reaches a lower position which is just optimised for the compressed fluid to be compressed at the required compression ratio. The top surfaces (2.5) teethed members (2.7) stop said flat member (2.4) from being moved further downwards by the pressure of the fluid, as well as the material of the flexible material (2.3) which connect said flat member (2.4) to said upper surface (2.10) of the lower part of the piston head (2.12).

[0005] The fluid positioned at the top of the flat member (1.4, 2.4) is fully isolated from the fluids positioned below the piston head (1.12, 2.12), such as oil. The fluid positioned under said flat member (2.4) is vented downwards via a set of hollow cavities (1.11, 2.11) when said flat member (1.4,2.4) is moved downwards by the pressure of the compression and igniting fluid situated inside the cylinder. When the flat member (1.4) moves upwards due to the inertial forces of said flat member (1.4) and the elastic force of the flexible material (1.3) which connects it (1.4) to the piston head (1.10), the fluid can reach the chamber which is positioned between said flat ember (1.4) and the top surface (1.10) of the lower part of the piston head (1.12) by the means of the same hollow cavities (1.11) comprised into the piston head's (1.12) material. Said cavities (1.11) connect the upper (1.10) and lower surfaces of the middle section of the piston head (1.12) together.

[0006] Said flexible member (1.3, 2.3) which connects said flat member (1.4, 2.4) to the upper position head surface (1.10) fully seal the upper volume positioned on top of the piston head, from the chamber positioned under said flat member (1.4,2.4). This is because said flexible member (1.3, 2.3) is made of a metallic flexible material such as aluminium alloy, which can resist to high temperatures without changing its shape, as well as offer high strengths to stresses. This member (1.3, 2.3) comprises a spring-like cross-sectional geometry, but which is fully closed, and hence sealed along the sides of said member (1.3, 2.3).

[0007] During the manufacturing process, the flat member (1.4, 2.4) is attached to the flexible member (1.3, 2.3) by welding, adhesive bonding, or both. Then, said two-member part is attached to the lower piston head surface (1.10, 2.10) by adhesive bonding and/or welding the lateral edge (1.9, 2.9) of the flexible member (1.3, 2.3) to the upper surface (1.10, 2.10) of the lower member of the piston head (1.12). The welding should preferably be a laser welding process, as dimensional detail is required for this welding operation.

[0008] The flexible member (1.3,2.3) is attached to the flat member (1.4, 2.4) by laying adhesive on an inner edge surface (1.8, 2.8) comprised on the flexible member and on the bottom edge of the flat member (1.4, 2.4). A welding process can be applied in place of the adhesive bonding process concerned, or in addition to the adhesive bonding operation concerned.

[0009] The resulting design removes the clearance volume automatically when required, and leaves it automatically when required. The inertial forces of the flat member (1.4, 2.4) and the inertial forces of the flexible member (1.3,2.3) when reaching top dead centre at the ned of the compression stroke will by far by overpowered by the high stresses offered by the compressing fluid inside the cylinder, hence moving the flat member (1.4, 2.4) downwards as required. The unstressed position of the flexible member is when said flat member (1.4, 2.4) is positioned at its highest position possible (1.4), meeting the highest of the lateral edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

[0010] The arrow shaped members (1.6, 2.6) can be connected to the flat member (1.4, 2.4) either by adhesive bonding, welding, or both. The retaining members (1.7, 2.70 which are attached to the upper surface of the piston head (1.10, 2.10) can be either welded, adhesive bonded, or both. Said members (1.7, 2.7) can also be part of the piston head as a one piece cast or forged member.

[0011] The piston head (1.12, 2.12) can also comprise an upper surface (1.1, 2.1, 1.10, 2.10) which is fully flat, hence comprising the middle section (1.10, 2.10) being positioned at exactly the same height as the lateral edge surfaces (1.1, 2.1), hence being equally as high in relation to each (1.1, 2.1, 1.10, 2.10) other. In that case, the diameter of the flat member (1.4, 2.4) is equal to the diameter of the piston head (1.12, 2.12). This design will ensure that said flat member (1.4, 2.4) will remove as much of the clearance volume as possible when the piston head will reach top dead centre at the end of the exhaust stroke, hence maximising the removal of the exhaust gases, and hence maximising the combustion efficiency of the engine.

[0012] In the case of this design, the flexible member (1.3, 2.3) will attach to the outer upper edge surface (1.1, 2.1) of the piston head in order to occupy as much of the clearance volume as possible during the exhaust stroke. Said design will hence remove more than 90 % of the clearance volume at top dead centre at the end of the exhaust stroke. The flexible arrow shaped members (1.6, 2.6) and the teethed retaining members (1.7, 2.7) will stay positioned on the same place for the design concerned, as said teethed member (1.7, 2.7) will just need to stay attached to the top surface (1.10, 2.10) of the middle section of the piston head (1.12, 2.12), but which will just be at the same height level (1.10, 2.10) as the outer edge top surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

[0013] In the case of all piton head designs, the arrow shaped members (1.6, 2.6) which are attached to the flat member (1.4, 2.4) will be flexible enough to be pushed inside into the teeth (1.5, 2.5) of the teethed members (1.7, 2.7) during the assembly process of the piston head (1.12, 2.12). Said flexible arrow shaped members (1.6, 2.6) will both be deflected inwards when said flat member (1.4, 2.4) is being pushed onto the piston head's mid surface (1.10, 2.10) due to the arrow shaped geometries of said members (1.6, 2.6).

[0014] In the case of all piston head designs, the flat member (1.4, 2.4) will be positioned over exactly the same planar orientation as the top surfaces (1.1, 2.1, 1.10, 2.10) of the piston head's geometry (1.12, 2.12). The length of said flexible arrow shaped members (1.6, 2.6) does not vary during the compression or exhaust strokes, and hence does not vary whether said flat member (1.4, 2.4) is pushed downwards by the pressure of the top positioned fluids on top of the piston head (1.12, 2.12), or left pushed upwards by the elastic forces of the flexible member (1.3, 2.3) and the inertial forces of said flat member (1.4, 2.4).

[0015] In the case of the piston head designs (1.12, 2.12) in which the outer edge top surfaces (1.1, 2.12) are positioned higher than the middle section's top surfaces (1.10,2.10), the flat member (1.4, 2.4) which is attached to the lower top surface (1.10, 2.10) of the piston head (1.12, 2.12). Therefore, the diameter of the flat member (1.4, 2.4) should always be slightly lower than the dimeter of the lower top surface (1.10, 2.10) of the piston head (1.12, 2.12). With a slightly lower diameter than that of the middle surface (1.10, 2.10) on which it (1.4, 2.4) connects to, the flat member (1.4, 2.4) will move freely up and down freely as required, hence maximising the engine's combustion efficiency, and hence maximising the overall efficiency of the engine.

[0016] In the case of all internal combustion engine designs, the teethed members (1.7, 2.7) stop the flat member (1.4, 2.4) from being driven higher than required by the means of its internal teethed geometries (1.5, 2.5), thus stopping said flat member (1.4, 2.4) from entering into contact with the intake or exhaust valves positioned along the cylinder head, as well as the cylinder head itself.

[0017] The flat member (1.4, 2.4) is always positioned such that its (1.4, 2.4) top and bottom surfaces are positioned exactly parallel to the top surfaces (1.1, 2.1, 1.10, 2.10) of the piston head's design (1.12, 2.12), hence maximising geometrical equality along the upper surfaces (1.1, 2.1, 1.4, 2.4) of the entire piston head design (1.12, 2.12).

[0018] Said piston head can also comprise wider positioning members (3.5) for the flat member (1.4, 2.4) in order to distribute the load more evenly when said flat member (1.4, 2.4) enters into contact with said piston positioning member (3.5). Rubber or foam layers can be adhesive bonded to the surfaces (3.1, 3.2, 3.3, 3.7) of contact, such that the flat member (1.4, 2.4) will be decelerated at a much slower declaration rate, hence maximising the life of said flat member (1.4, 2.4). This operation should be performed before sticking and adhesive bonding said flat member (1.4, 2.4) over the top surface of the piston head (1.12, 2.12). This design will also minimise material fatigue of said flat member (1.4, 2.4). Said sustaining member (3.5) also maximises the life of said flat member (1.4, 2.4) by distributing the contacting load between said flat member (1.4, 2.4) and said positioning members (3.5) as evenly as possible along the piston head.

[0019] Air evacuation conduits (3.8) provide and air transfer path form the central chamber to the lower piston head area in case that said chamber is comprised with said positioning members (3.5) being geometrised in a full round 360 degree circumference profile. So, said air will find an escape route, and the force required to push said flat member (1.4, 2.4) downwards will be minimised, hence minimising the energy required, and maximising the system's efficiency.

[0020] More contacting members (3.6) can also be comprised, e.g. along the edges of said system. This distributes the load more evenly. This design will hence minimise the stresses comprised on said contacting members (3.4, 3.6).

[0021] The bottom flat members (1.9, 2.9) of the flexible members, can be pressed into positon over the piston head by a press, for the adhesive bonding to take place. Simultaneously, a laser welding process can be driven all around the piston head to make sure that said flat member (1.4, 2.4) is being inserted into its exact and required position. Alternatively, said laser welding process can be performed on a later manufacturing step.

[0022] Said flat member (1.4, 2.4) can also be riveted to said piston head (4.1), such that no laser welding process would be required. So, said piston head (4.1) can comprise a plurality of fasteners (4.2), preferably rivets (4.2), bolts (4.2) or nuts (4.2), which project perpendicularly to the direction of motion of said piston head (4.1), and so through the side of said piston head's (4.1) upper surface. Simultaneously, said fasteners (4.2) project through the sides of the attaching member (4.3) of said flat movable member (1.4, 2.4), to the inner side of said attaching member (4.3). So, said attaching member (4.3) remains positioned over said inner flat surface (4.4) of said piston head member (4.1), hence minimising design difficulties. So, said attaching member (4.3) is always comprised over said flat surfaced member (4.4), and hence under said flat movable member (1.4, 2.4).

[0023] Said lower flat attaching members (4.3) of said flat movable member (1.4, 2.4), is attached to the main body of the piston head (4.1) by a plurality of rivets (4.2), nuts (4.2) or bolts (4.2), such that said fasteners (4.2) attach perpendicularly to the direction of the forces of the injection's engine's pressures, hence projecting perpendicularly to the direction of motion of said piston head (4.1). Said fasteners (4.2) should preferably project horizontally sidewise from the outer side of said piston head (4.1) to the inner side of said flat attaching members (4.3). A plurality of fasteners should always be used, as said fasteners (4.2) should maintain the movable member (1.4, 2.4) at the required position constantly, and hence, a plurality of fasteners (4.2) are required for the system's structural stability. Said fasteners can be made of steel, titanium or aluminium, or any other metallic alloy.

[0024] Said fasteners (4.2) should be comprised in sets of at least two or four, and preferably in sets of at least six or eight, with said fasteners (4.2) being comprised one projecting in front of another (4.2). So, said fastener (4.2) would each project in front of another fastener (4.2) which is comprised projecting through the other side of said lateral piston head material area (4.1). This design would minimise stresses, and maximise stability of said movable member (1.4, 2.4), not only by distributing stresses unevenly, but also by guaranteeing the stability of said movable member (1.4, 2.4) by guaranteeing a stiff sustaining position at each fastener simultaneously. Said fasteners (4.2) should be pressed through the sides of said side surface of said piston head (4.1), hence being pushed perpendicularly to said lateral surface (4.1), hence guaranteeing functional stability, and simultaneous attaching to the sustaining member (4.3) of the movable flat member (1.4, 2.4).

[0025] Each of said fasteners would project simultaneously through said side area of said piston head (4.1) and said sustaining member (4.3) of said movable flat member (1.4, 2.4), hence maximising stability and maximising an even stress distribution model. Said fasteners (4.2) would be positioned through cavities comprised inside said side areas (4.1) of said piston head (4.1) and simultaneously through cavities comprised through said sustaining member (4.3). Each fastener (4.2) would be pushed into position from the outer side surface of the piston head (4.1). Hammering presses or electric hammers might be used to accomplish said job, as said cavities would comprise a certain degree of friction, in order to keep said fasteners (4.2) tight and stiff after being pushed into position.

[0026] Said cavities should be comprised in front of each other simultaneously through both piston head side area (4.1) and sustaining member (4.3) of said movable flat member (1.4, 2.4). Said cavities can be of rectangular or circular cross-section, but should preferably be of circular cross-section, as this design would distribute stresses as evenly as possible with maximum structural stability.

[0027] The material of the flat member should be a resistant material which offers very high strengths and withstands high temperatures, preferably steel, titanium or aluminium, and should preferably be stainless steels or titanium alloys. The flexible member should be made of a strong and highly resistant material which should withstand high temperatures but should also be much more flexible. Materials of the flexible member would be aluminium alloys or titanium alloys, preferably aluminium or titanium alloys.

[0028] The flat member (1.4, 2.4) can be compression forged, cast, or laser cut from a sheet of material and then further treated for finishing operations. The flexible member (1.3, 2.3) can be cold formed and the welded such that it is fully sealed at the sides. Alternatively, said flexible member (1.3, 2.3) can be produced with the injection moulding or casting process. High pressure forging is also an option for the production of said flexible member (1.3, 2.3).

[0029] The applications for this system comprise all types of four stroke and two-stroke internal combustion engines. However, four stroke engines would see a simpler and more essential application for this system.

[0030] Applications for this system include road vehicles, motorcycles, scooters, racing vehicles, racing cars, cars, trucks, lorries, tractors, excavators, marine vehicles, ships, boats, submarines, yachts, industrial systems, power systems, power generation systems, aircraft, light aircraft, helicopters, light helicopters, model aircraft, model helicopters, gas compressors, air compressors, compressors, railway vehicles, locomotives, maintenance railway vehicles, diesel multiple units, agricultural machinery, construction machinery, gardening equipment, gardening machines, powered saws, two stroke engines, four stroke engines, motorcycle engines, car engines, bus engines, truck engines, submarine engines, marine engines, generator engines, compressor internal combustion engines, aircraft piston engines, helicopter piston engines, reciprocating machines, and reciprocating combustion engines.

[0031] So, the present invention comprises an internal combustion engine which comprises a flat member (1.4, 2.4) in which the top and bottom surfaces of said member (1.4, 2.4) are positioned exactly in parallel to the upper surfaces of the piston head (1.1, 2.1, 1.10, 2.10), such that said flat member (1.4, 2.4) attaches to the lower surface (1.10, 2.10) of the piston head's (1.12, 2.12) top geometry by the means of a flexible member (1.3, 2.3) which is fully sealed along the sides, such that said member attaches to both the lower surface of said flat member (1.4, 2.4) and to the piston head's mid surface (1.10, 2.10), such that said flexible member (1.3, 2.3) seals the volume over said flat member (1.4, 2.4) from the volume under said flat member (1.4, 2.4), and can be pushed downwards by fluid pressures situated over said flat member (1.4, 2.4) by constantly comprising a spring like cross-sectional geometric profile.

[0032] An internal combustion engine according to the above in which said flexible member (1.3, 2.3) is in its unstressed position when said flat member (1.4, 2.4) is positioned as high as possible, such that the top surface of said flat member (1.4, 2.4) is exactly aligned in height with the top edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

[0033] An internal combustion engine according to the above in which said flat member (1.4, 2.4) is positioned such that its top surface (1.4, 2.4) cannot move higher than that of the upper edge surface (1.1, 2.1) of the piston head (1.12, 2.12).

[0034] An internal combustion engine according to the above in which a set of teethed members (1.7, 2.7) are attached to the mid surface (1.10, 2.10) of the piston head (1.12, 2.12), such that said teethed surfaces (1.7, 2.7) stop the excessively high movement of a set of arrow shaped members (1.6, 2.6) which are restrained by teethed geometric profiles (1.5, 2.5) which make part of said teethed members (1.7, 2.7), such that said arrow shaped members (1.6, 2.6) are attached to the lower surface of the flat member (1.4, 2.4), therefore impeding the top surface (1.4, 2.4) of said flat member (1.4, 2.4) from moving higher than the edge surface (1.1, 2.1) heights of the piston head (1.12, 2.12).

[0035] An internal combustion engine according to the above in which said flat member (1.4, 2.4) comprises a slightly lower dimeter than the dimeter of the flat surface (1.10, 2.10) onto which it (1.4, 2.4) is attached to from beneath it (1.4, 2.4).

[0036] An internal combustion engine according to the above in which said flexible member (1.3, 2.3) comprises an inward horizontal surfaced member (1.8, 2.8) along its upper surface, while simultaneously comprising an outward horizontal surfaced member (1.9, 2.9) along its lower surface, such that said flexible member (1.3, 2.3) is designed to be attached to both the flat member's bottom surface (1.4, 2.4) on top of it (1.3, 2.3), and to the middle top surface (1.10, 2.10) of the piston head (1.12, 2.12) beneath it (1.3, 2.3), hence forming a well attached set of components (1.4, 1.3, 1.10, 2.4, 2.3, 2.10) which seals the top volume over the flat member (1.4, 2.4) from that which is between said flat member (1.4, 2.4) and the mid upper surface (1.10, 2.10) of said piston head (1.12, 2.12).

[0037] An internal combustion engine according to the above in which a set of at least two hollow cavities (1.11, 2.11) is comprised through the member (1.12, 2.12) which separates the top middle surface (1.10, 2.10) of said piston head (1.12, 2.12) form the volume situated below said piston head (1.12, 2.12), hence offering a venting path for air or oil to be vented in or out of the chamber situated between said flat member (1.4, 2.4) and said upper mid surface (1.10, 2.10) of the piston head (1.12, 2.12), such that said cavities (1.11, 2.11) should preferably be comprised around the centre but not at said centre of the piston head's middle surface (1.10, 2.10).

[0038] An internal combustion engine according to the above in which said flat member (1.4, 2.4) comprises the same outer diameter as the outer diameter of the entire upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12), such that said piston head comprises a flat surface in which the middle surface (1.10, 2.10) should preferably be exactly as high as the outer edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12), such that said flexible member (1.3, 2.3) will attach said flat member (1.4, 2.4) to the outer edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

[0039] An internal combustion engine according to the above in which said flat member (1.4, 2.4) comprises the same outer diameter as the outer dimeter of the piston head's (1.12, 2.12) upper surfaces (1.1, 2.1) such that said flat member is positioned over the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12).

[0040] An internal combustion engine according to the above which comprises adhesive bonded layers of coatings or flexible material coatings such as foam or rubber being comprised over the surfaces (3.1, 3.2, 3.3, 3.7) of the members (3.5, 3.6) which can enter into contact with each other when said upper movable plate member (1.4, 2.4) is moved up and down passively by the pressure over the piston head (1.12, 2.12), such that said system can also comprise an air evacuation conduit (3.8) which connects the bottom chamber under said piston head (1.12, 2.12) to the chamber(s) of the connecting members (3.4, 3.5, 3.6) if said piston head sustaining member (3.5) is geometrised into a closed loop profiled geometry.

[0041] An internal combustion engine according to the above, in which said lower flat attaching members (4.3) of said flat movable member (1.4, 2.4), is attached to the main body of the piston head (4.1) by a plurality of rivets (4.2), nuts (4.2) or bolts (4.2), such that said fasteners (4.2) attach perpendicularly to the direction of the forces of the injection's engine's pressures, hence projecting perpendicularly to the direction of motion of said piston head (4.1), hence preferably horizontally sidewise from the outer side of said piston head (4.1) to the inner side of said flat attaching members (4.3).

[0042] An internal combustion engine according to the above in which the members comprised are to be manufactured by injection moulding, casting, die casting, high pressure die casting, laser cutting, high pressure forging processes or high pressure moulding processes, such that said flat member (1.4, 2.4) is to be attached to said flexible member (1.3) by adhesive bonding on the upper inner surface (1.8, 2.8) of the flexible member (1.3, 2.3) and the outer bottom surface of the flat member (1.4, 2.4), while the lower outer bottom surface (1.9, 2.9) of the flexible member (1.3, 2.3) is to be adhesive bonded to the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head.

[0043] An internal combustion engine according to the above in which the flat member (1.4, 2.4) is welded to the flexible member (1.3, 2.3) by welding said inner upper member (1.8, 2.8) to said flat member (1.4, 2.4), followed by the welding of the outer bottom surface (1.9, 2.9) of the flexible member (1.3, 2.3) to the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12), preferably by welding said outer member (1.9, 2.9) of the flexible member (1.3, 2.3) to the lower part of the inner wall (1.2, 2.2) of the piston head's (1.12, 2.12) upper volume.

[0044] An internal combustion engine according to the above in which the materials of which the parts concerned in this invention are made, are comprised of highly stress resistant materials such as aluminium alloys, titanium alloys, and/or steels, as well as high temperature resistant materials such as titanium alloys, aluminium alloys, and/or steels, such that said materials should preferably be stainless steels, aluminium alloys and/or titanium alloys.

[0045] An internal combustion engine according to the above in which said system design is applied in applications including road vehicles, motorcycles, scooters, racing vehicles, racing cars, cars, trucks, lorries, tractors, excavators, marine vehicles, ships, boats, submarines, yachts, industrial systems, power systems, power generation systems, aircraft, light aircraft, helicopters, light helicopters, model aircraft, model helicopters, gas compressors, air compressors, compressors, railway vehicles, locomotives, maintenance railway vehicles, diesel multiple units, agricultural machinery, construction machinery, gardening equipment, gardening machines, powered saws, two stroke engines, four stroke engines, motorcycle engines, car engines, bus engines, truck engines, submarine engines, marine engines, generator engines, compressor internal combustion engines, aircraft piston engines, helicopter piston engines, locomotive engines, racing engines, racing marine engines, reciprocating machines, and reciprocating combustion engines.

Claims

1. An internal combustion engine which comprises a flat member (1.4, 2.4) in which the top and bottom surfaces of said member (1.4, 2.4) are positioned exactly in parallel to the upper surfaces of the piston head (1.1, 2.1, 1.10, 2.10), such that said flat member (1.4, 2.4) attaches to the lower surface (1.1.0, 2.10) of the piston head's (1.12, 2.12) top geometry by the means of a flexible member (1.3, 2.3) which is fully sealed along the sides, such that said member attaches to both the lower surface of said flat member (1.4, 2.4) and to the piston head's mid surface (1.10, 2.10), such that said flexible member (1.3, 2.3) seals the volume over said flat member (1.4, 2.4) from the volume under said flat member (1.4, 2.4), and can be pushed downwards by fluid pressures situated over said flat member (1.4, 2.4) by constantly comprising a spring like cross-sectional geometric profile.

2. An internal combustion engine according to claim 1 in which said flexible member (1.3, 2.3) is in its un-

stressed position when said flat member (1.4, 2.4) is positioned as high as possible, such that the top surface of said flat member (1.4, 2.4) is exactly aligned in height with the top edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

3. An internal combustion engine according to claims 1 to 2 in which said flat member (1.4, 2.4) is positioned such that its top surface (1.4, 2.4) cannot move higher than that of the upper edge surface (1.1, 2.1) of the piston head (1.12, 2.12).

4. An internal combustion engine according to claims 1 to 3 in which a set of teethed members (1.7, 2.7) are attached to the mid surface (1.10, 2.10) of the piston head (1.12, 2.12), such that said teethed surfaces (1.7, 2.7) stop the excessively high movement of a set of arrow shaped members (1.6, 2.6) which are restrained by teethed geometric profiles (1.5, 2.5) which make part of said teethed members (1.7, 2.7), such that said arrow shaped members (1.6, 2.6) are attached to the lower surface of the flat member (1.4, 2.4), therefore impeding the top surface (1.4, 2.4) of said flat member (1.4, 2.4) from moving higher than the edge surface (1.1, 2.1) heights of the piston head (1.12, 2.12).

5. An internal combustion engine according to claims 1 to 4 in which said flat member (1.4, 2.4) comprises a slightly lower dimeter than the dimeter of the flat surface (1.10, 2.10) onto which it (1.4, 2.4) is attached to from beneath it (1.4, 2.4).

6. An internal combustion engine according to claims 1 to 5 in which said flexible member (1.3, 2.3) comprises an inward horizontal surfaced member (1.8, 2.8) along its upper surface, while simultaneously comprising an outward horizontal surfaced member (1.9, 2.9) along its lower surface, such that said flexible member (1.3, 2.3) is designed to be attached to both the flat member's bottom surface (1.4, 2.4) on top of it (1.3, 2.3), and to the middle top surface (1.10, 2.10) of the piston head (1.12, 2.12) beneath it (1.3, 2.3), hence forming a well attached set of components (1.4, 1.3, 1.10, 2.4, 2.3, 2.10) which seals the top volume over the flat member (1.4, 2.4) from that which is between said flat member (1.4, 2.4) and the mid upper surface (1.10, 2.10) of said piston head (1.12, 2.12).

7. An internal combustion engine according to claims 1 to 6 in which a set of at least two hollow cavities (1.11, 2.11) is comprised through the member (1.12, 2.12) which separates the top middle surface (1.10, 2.10) of said piston head (1.12, 2.12) form the volume situated below said piston head (1.12, 2.12), hence offering a venting path for air or oil to be vented in or out of the chamber situated between said flat member (1.4, 2.4) and said upper mid surface (1.10, 2.10) of the piston head (1.12, 2.12), such that said cavities (1.11, 2.11) should preferably be comprised around the centre but not at said centre of the piston head's middle surface (1.10, 2.10).

8. An internal combustion engine according to claims 1 to 7 in which said flat member (1.4, 2.4) comprises the same outer diameter as the outer diameter of the entire upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12), such that said piston head comprises a flat surface in which the middle surface (1.10, 2.10) should preferably be exactly as high as the outer edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12), such that said flexible member (1.3, 2.3) will attach said flat member (1.4, 2.4) to the outer edge surfaces (1.1, 2.1) of the piston head (1.12, 2.12).

9. An internal combustion engine according to claims 1 to 8 in which said flat member (1.4, 2.4) comprises the same outer diameter as the outer dimeter of the piston head's (1.12, 2.12) upper surfaces (1.1, 2.1) such that said flat member is positioned over the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12).

10. An internal combustion engine according to claims 1 to 9 which comprises adhesive bonded layers of coatings or flexible material coatings such as foam or rubber being comprised over the surfaces (3.1, 3.2, 3.3, 3.7) of the members (3.5, 3.6) which can enter into contact with each other when said upper movable plate member (1.4, 2.4) is moved up and down passively by the pressure over the piston head (1.12, 2.12), such that said system can also comprise an air evacuation conduit (3.8) which connects the bottom chamber under said piston head (1.12, 2.12) to the chamber(s) of the connecting members (3.4, 3.5, 3.6) if said piston head sustaining member (3.5) is geometrised into a closed loop profiled geometry.

11. An internal combustion engine according to claims 1 to 10, in which said lower flat attaching members (4.3) of said flat movable member (1.4, 2.4), is attached to the main body of the piston head (4.1) by a plurality of rivets (4.2), nuts (4.2) or bolts (4.2), such that said fasteners (4.2) attach perpendicularly to the direction of the forces of the injection's engine's pressures, hence projecting perpendicularly to the direction of motion of said piston head (4.1), hence preferably horizontally sidewise from the outer side of said piston head (4.1) to the inner side of said flat attaching members (4.3).

12. An internal combustion engine according to claims 1 to 11 in which the members comprised are to be manufactured by injection moulding, casting, die

casting, high pressure die casting, laser cutting, high pressure forging processes or high pressure moulding processes, such that said flat member (1.4, 2.4) is to be attached to said flexible member (1.3) by adhesive bonding on the upper inner surface (1.8, 2.8) of the flexible member (1.3, 2.3) and the outer bottom surface of the flat member (1.4, 2.4), while the lower outer bottom surface (1.9, 2.9) of the flexible member (1.3, 2.3) is to be adhesive bonded to the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head.

13. An internal combustion engine according to claims 1 to 12 in which the flat member (1.4, 2.4) is welded to the flexible member (1.3, 2.3) by welding said inner upper member (1.8, 2.8) to said flat member (1.4, 2.4), followed by the welding of the outer bottom surface (1.9, 2.9) of the flexible member (1.3, 2.3) to the upper surface (1.1, 2.1, 1.10, 2.10) of the piston head (1.12, 2.12), preferably by welding said outer member (1.9, 2.9) of the flexible member (1.3, 2.3) to the lower part of the inner wall (1.2, 2.2) of the piston head's (1.12, 2.12) upper volume.

14. An internal combustion engine according to claims 1 to 13 in which the materials of which the parts concerned in this invention are made, are comprised of highly stress resistant materials such as aluminium alloys, titanium alloys, and/or steels, as well as high temperature resistant materials such as titanium alloys, aluminium alloys, and/or steels, such that said materials should preferably be stainless steels, aluminium alloys and/or titanium alloys.

15. An internal combustion engine according to claims 1 to 14 in which said system design is applied in applications including road vehicles, motorcycles, scooters, racing vehicles, racing cars, cars, trucks, lorries, tractors, excavators, marine vehicles, ships, boats, submarines, yachts, industrial systems, power systems, power generation systems, aircraft, light aircraft, helicopters, light helicopters, model aircraft, model helicopters, gas compressors, air compressors, compressors, railway vehicles, locomotives, maintenance railway vehicles, diesel multiple units, agricultural machinery, construction machinery, gardening equipment, gardening machines, powered saws, two stroke engines, four stroke engines, motorcycle engines, car engines, bus engines, truck engines, submarine engines, marine engines, generator engines, compressor internal combustion engines, aircraft piston engines, helicopter piston engines, locomotive engines, racing engines, racing marine engines, reciprocating machines, and reciprocating combustion engines.

Figure 1:

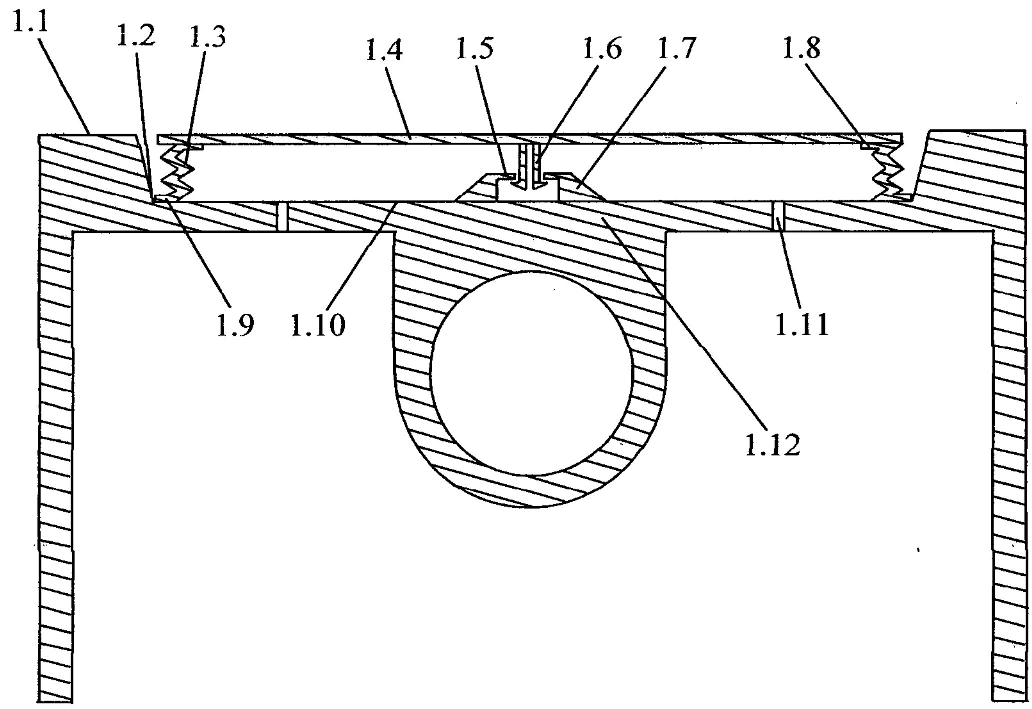


Figure 2:

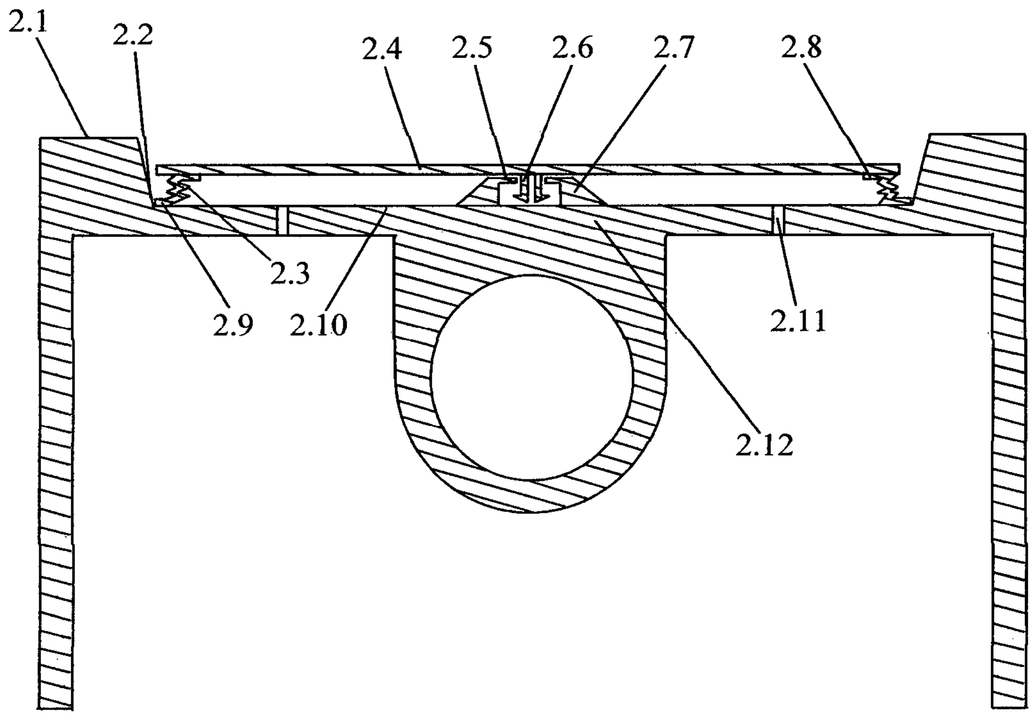


Figure 3:

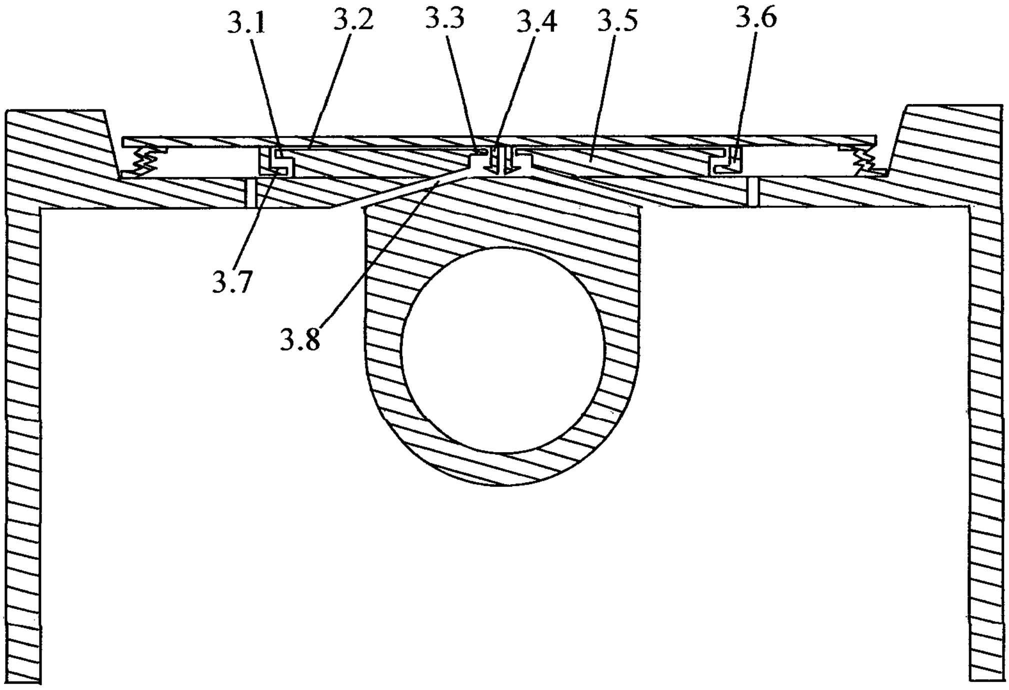
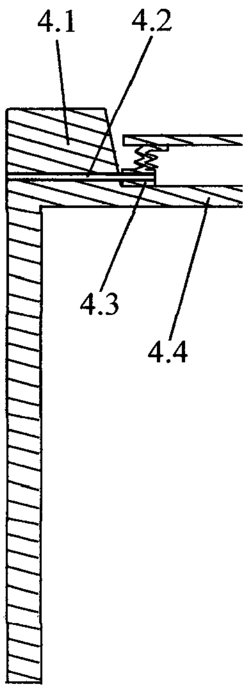


Figure 4:



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EUROPEAN SEARCH REPORT

Application Number
EP 17 00 1454

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2002 371912 A (MITSUBISHI HEAVY IND LTD) 26 December 2002 (2002-12-26) * the whole document * -----	1-15	INV. F02B41/00 F02B75/04
A	US 2 376 214 A (WEBSTER PHILIP S) 15 May 1945 (1945-05-15) * the whole document * -----	1-15	
A	US 2012/227705 A1 (ASHIZAWA TAKESHI [JP]) 13 September 2012 (2012-09-13) * the whole document * -----	1-15	
A	GB 2 526 336 A (LEEUW JON OTEGUI VAN [DE]) 25 November 2015 (2015-11-25) * the whole document * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F02B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 November 2017	Paulson, Bo

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23-11-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002371912 A	26-12-2002	JP 4395272 B2	06-01-2010
		JP 2002371912 A	26-12-2002
US 2376214 A	15-05-1945	NONE	
US 2012227705 A1	13-09-2012	CN 102782285 A	14-11-2012
		EP 2543849 A1	09-01-2013
		JP 5273290 B2	28-08-2013
		JP WO2011108120 A1	20-06-2013
		US 2012227705 A1	13-09-2012
		WO 2011108120 A1	09-09-2011
GB 2526336 A	25-11-2015	NONE	

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