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(54) **MULTI-PIECE CYLINDER HEAD**

MEHRTEILIGER ZYLINDERKOPF

CULASSE À PIÈCES MULTIPLES

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Description

Field of the Invention

[0001] The present invention relates to a multi-piece cylinder head; wherein inserts are mounted to the regions where the valve bridges, at which compressive stress is intense, are located; and compressive stress is reduced.

Background of the Invention

[0002] Cylinder head is one of the most essential engine parts which forms the combustion chambers by covering the upper part of the combustion chamber and provides bearing to some outer parts. The surface of the cylinder head facing the combustion chamber forms the wall of the combustion chamber together with the engine block liner and the upper surface of the piston. The cylinder head has a quite complicated structure and accommodates a plurality of integrated or mounted parts.

[0003] Some parts provided in the engine cylinder block and the cylinder head and the functions of these parts are as follows:

- Flame deck is the surface of the cylinder head facing the combustion chamber and forms the roof of the combustion chamber.
- Water jacket is a channel-shaped groove within the cylinder head and the coolant passes therethrough.
- Oil gallery is comprised of channels which are located within the cylinder head and through which pressurized oil passes.

Intake and exhaust valve seat inserts are ring shaped metal snap-fit inserts which provide leaning surface to the valves.

Intake and exhaust valve seats are the contact surfaces of the cylinder head facing the valve inserts.

[0004] Intake and exhaust valves are metal parts which, by moving up and down, open and close the holes of the intake and exhaust valves opening to the combustion chamber.

- Intake and exhaust ports are the channels provided in the cylinder head, which carry the intake and exhaust gases to the cylinder or moves them away from the cylinder. Intake and exhaust ports connect the combustion chamber with the intake and exhaust manifolds.
- Valve guides are cylindrical metal inserts which function as guides during upward and downward movement of the valves and which can be mounted to the cylinder head by snap fit connection.
- Spark plug, injector, glow plug slots and abutment surfaces where parts similar to plugs, injectors are mounted.
- Valve train is a complex mechanical system which is mounted to the uppermost surface of the cylinder

head and enables the valves to be opened and closed when desired.

[0005] In internal combustion engines, generally the cylinder head covers the whole upper surface of the engine block. The cylinder head is the part which is directly exposed to the combustion loads during the combustion in the engine. Thus, the cylinder head is exposed to both thermal and high pressures at the same time. Since the cylinder head is exposed to high pressure and heat, thermal expansions occur at different levels on the cylinder head and these thermal expansions cause damage, cracks and even fractures on the cylinder head.

[0006] The cylinder head should be effectively cooled in order to minimize the strains occurring due to the expansion induced by thermal loads. In the modern engines used today, cooling is performed by means of a coolant which is a water-glycol mixture. The water jacket provided in the cylinder head is used for cooling. The cylinder head is cooled by passing coolant through the water jacket.

[0007] The cylinder head is a structure that also carries the valve systems. The exhaust and intake valves are mounted to the cylinder head. The region at the exhaust and intake ports between the circular openings to the combustion chamber are called valve bridges. Valve bridges are exposed to very high heats and strains. Protection of this region, which is named as valve bridge, against heat and expansion is very important. The invention of the present application is intended for enhancing thermomechanical resistance and strength of the region where the valve bridge is located.

[0008] In internal combustion engines, the average temperature in the cylinder exceeds 1000°C and this temperature value gradually increases in more efficient engine operations. In the currently used engines, the weakest parts of the cylinder head design are the valve bridges between the two valve openings. Valve bridges are usually the parts which are exposed to the highest temperature. Since the valve bridges, in addition to the explosion in the engine, are also exposed to the temperatures of the exhaust gas leaving the cylinder; the exhaust-exhaust valve bridge is a very critical region whose strength should be the highest. The valve bridges which are heated during operation of the engine undergo thermal expansion and tend to increase their sizes. However, since the regions which are distant from the combustion chamber are cooler, the exhaust gas surrounds the valve bridges and prevents unrestricted elongation of the bridges. The said situation causes the valve bridges to be subjected to compressive stress at high temperatures. The force of the said compressive stress is quite high and when it is applied to the valve bridge repeatedly, it causes the valve bridge regions to crack under thermomechanical fatigue. Each heating and cooling of the engine causes thermal cycle and the said fluctuating compressive stress.

[0009] Strength of an engine under compressive stress

varies from engine to engine, from driver to driver and according to the way of driving. However all engines are designed to exhibit resistance to a certain number of thermal cycles. The greater the resistance exhibited against thermal cycle, the more durable and clean the engine will be. This is because a crack occurring in the valve bridges gets larger by time and upon proceeding to the water jacket, it may cause engine damages, even hydraulic locking. The said engine failures are very expensive and undesired situations. The invention of the present patent application is developed for solving the problem of cracks occurring in cylinder head valve bridges. By means of the invention of the present application, strength of the valve bridge regions is enhanced and the pressure is allowed to reach higher values. Thus engine performance and fuel consumption are improved.

[0010] The cracks occurring in the valve bridges in the state of the art and elimination of the engine failures resulting due to advance of the cracks is an important technical problem. There are some applications in the state of the art in order to solve this technical problem. In a part of these applications, the distance of the cooling channels passing in between the ports to the combustion chamber is reduced in order to prevent thermomechanical cracks. Reducing the metal thickness between the water jacket and the combustion chamber enables the temperature of the valve bridges to decrease. Metal thickness is very important for the said improvement made in the valve bridge region. If the metal thickness is below a certain limit, it causes high-cycle fatigue under high pressures. In the said embodiment, it is very difficult to achieve the balance between the expansion-induced thermomechanical fatigue and combustion pressure, i.e. force induced high-cycle fatigue; and this balance cannot always be provided. The said situation causes decrease of the engine power or increase of the fuel consumption.

[0011] In another embodiment used for solving the technical problem encountered in the state of the art, thickness of the problematic bridge is reduced by milling. In this embodiment, temperature is aimed to be reduced by decreasing the thickness between the water jacket and the bridge. At the same time, rigidity of the said sections is decreased there by decreasing the stress. In this solution, a limited milling can be performed and thus a limited improvement can be achieved.

[0012] The following are the patent documents which relate to solutions which are applied on valve bridges and are intended for prevention of cracks occurring due to thermal expansion and compressive stress.

[0013] In the International patent document no. WO2012112084, an application in the state of the art, inserts are used in order to prevent formation of cracks in valve bridges. The inserts extend from the bridges to the water jackets. In the said patent document, a material with has higher heat conductance is used as the insert and thus temperature is aimed to be reduced. In the said solution, the form and place of mounting have no importance and temperature is aimed to be reduced by driving

inserts. In the patent document of the present application, a pre-strain is produced by using inserts and thus compressive force is aimed to be reduced. The shape, technical structure, place of use and purpose of use of the insert disclosed in the present patent application are completely different.

[0014] In the United States patent documents no. US8061030 and US2012103297, an application in the state of the art, use of inserts for reducing thermal deformation in the cylinder head is advised. The insert is placed on the surface of the cylinder head that faces the cylinders. In the said documents, slots are provided in between the cylinders and "T" shaped wedges are arranged into these slots. With the said patent, overall deformation of the cylinder head is aimed to be reduced. In the present patent application, the strain around the bridge or injector plug is aimed to be reduced and therefore the insert is arranged on the surface of the cylinder head facing the combustion chamber.

[0015] In the European patent document no. EP0392988, an application in the state of the art, inserts are used for increasing thermal resistance. Inserts are placed between the valve openings and injector/plug openings. The insert used in the said patent document is attached to the cylinder head via metallurgical adhesion. The insert is made of a material with low thermal expansion and prevents the material surrounding it from being subjected to thermal expansion. The insert of the present patent application has a completely different mechanical structure, and is not attached to the surface on which it is positioned via metallurgical adhesion.

[0016] Great Britain patent document no: GB2019758, an application in the state of the art, discloses about placing an insert into the cylinder head during casting, forming a metallic connection between the cylinder head and the insert, and about how this metallic connection will be strengthened. The insert of the present patent application has a completely different mechanical structure, and is not attached to the surface on which it is positioned via metallurgical adhesion.

[0017] In the European patent document no. EP0056107, an application in the state of the art, materials of the inserts are defined. There is no detailed information about the way the insert will be connected. It is stated that mechanical connection or weld connection can be performed. The said document relates to use of different materials which increases thermomechanical strength. In the patent document of the present application, a pre-strain is produced by using inserts and thus compressive force is aimed to be reduced. The shape, technical structure, place of use and purpose of use of the insert disclosed in the present patent application are completely different.

[0018] French patent document no. FR2606707, an application in the state of the art, disclose an insert made of aluminum-silicon material and states that the insert is fixed via welding. The said document relates to use of different materials which increases thermomechanical

strength. The insert of the present patent application has a completely different mechanical structure, and is applied in a different manner.

[0019] In the Great Britain patent document no. GB2021685, an application in the state of the art, a heat shield which will protect the valve bridge is applied between the valve openings. By producing a hollow between the said insert and the bridge, transmission of the explosion-induced thermal load is prevented, and the heat is aimed to be transmitted to the head through connection points only by heating the shield. In the present patent application, pre-strain is aimed to be produced by means of the insert, and mechanical structure of the insert is designed to produce pre-strain.

[0020] In the German patent document no. DE4025994, an application in the state of the art, an insert is applied at the valve bridge region between the valve openings. Subject matter of the said patent document is resistance of the insert. In the present patent application, pre-strain is aimed to be produced by means of the insert, and mechanical structure of the insert is designed to produce pre-strain.

[0021] In the French patent document no. FR2736968, an application in the state of the art, an insert serving as a heat shield is used and the side surfaces of the inserts are isolated from the valve bridge region. In the patent document of the present application, a pre-strain is produced by using inserts and thus compressive force is aimed to be reduced. The shape, technical structure, place of use and purpose of use of the insert disclosed in the present patent application are completely different.

[0022] German patent document no. DE3714229, an application in the state of the art, discloses use of inserts. In the aid document, it is aimed to form a hollow between the cylinder head and valve inserts. By means of the said hollow, it is intended to allow transverse expansion of the bridges. In the patent document of the present application, a pre-strain is produced by using inserts and thus compressive force is aimed to be reduced. The shape, technical structure, place of use and purpose of use of the insert disclosed in the present patent application are completely different.

[0023] European patent document no. EP0392988, an application in the state of the art, is intended for reducing thermomechanical fatigue on the flame deck of the cylinder head. The said patent document discloses about channels provided between the bridges and thus thickness of a problematic bridge is reduced by milling. The said patent document does not include any description about use of inserts and producing pre-strain by inserts. In the present patent application, the thermomechanical fatigue on the flame deck of the cylinder head is reduced by using a pre-strain insert.

[0024] United States patent document no. US2014048033, an application known in the state of the art, discloses about connecting a mating part with the cylinder head during casting. It is stated that the base of the cylinder head facing the combustion chamber is coat-

ed with a plate. The present patent application is very different in terms of the solution method, mechanical structure and producing pre-strain with the insert.

[0025] In the European patent document no. EP0525330, an application in the state of the art, a plate with a very high thermal resistance is connected with the cylinder head. There are differences between the said insert and the insert defined in the present patent application in terms of connection form, shape and structure.

[0026] European patent document no. EP2024116, an application in the state of the art, discloses a complicated support structure. There are major differences between the said structure and the invention of the present patent application in terms of mechanical structure, use and design.

[0027] United States patent document no. US2015020386, an application known in the state of the art, discloses about providing service to the injector plug by means of an insert. The said patent document does not include any description about preventing thermomechanical fatigue. The insert described in the present patent application differs in terms of shape, mounting place and mounting form.

[0028] The United States patent document no. US8485243, an application in the state of the art, aims to prevent thermomechanical fatigue. A disc-shaped hollow is provided within the cylinder head facing the combustion chamber and this hollow is filled with liquid metal. Thus use of different micro structure or material on the flame deck is allowed thereby increasing the fatigue resistance. In the present patent application, thermomechanical fatigue is reduced by using pre-strain insert.

[0029] In the European patent document no. EP0132505, an application in the state of the art, inserts are not used and certain sections on the surface are subjected to surface hardening process. Thermomechanical resistance is enhanced by the surface hardening process. In the present patent application, thermomechanical fatigue is reduced by using pre-strain insert.

[0030] In the German patent document no. DE102007053371, an application in the state of the art, the cylinder head wall is thick in the middle and the thickness gradually decreases towards the boundaries. Inserts are not used in the said document and the solution method is completely different.

[0031] United States patent document no. US4889080, an application known in the state of the art, relates to water jacket flow improvement and increasing cooling performance. Patent documents no. EP296320, US2011000216 and EP2273197 are also very different from the invention of the present application.

[0032] DE3728530 and JP S 61 114034 U disclose cylinder heads with an insert in the valve bridge region.

[0033] There are some applications in the state of the art for increasing engine life and performance by reducing thermomechanical fatigue occurring on the cylinder head. However, none of these applications include pro-

ducing pre-strain by placing inserts on the bridges between two valve openings and decreasing thermomechanical fatigue by tensile or compressive force.

Objectives of the Invention

[0034] An objective of the present invention is to provide a multi-piece cylinder head which, by increasing thermomechanical fatigue resistance in engine cylinder heads, enables repairing the cracks on the cylinder head flame deck in a shorter period of time and with lower maintenance costs.

[0035] Another objective of the present invention is to provide a multi-piece cylinder head which, by increasing the strength of the cylinder head, enables to obtain higher in-cylinder temperature and pressure values.

[0036] A further objective of the present invention is to provide a multi-piece cylinder head which enhances engine performance and life.

Summary of the Invention

[0037] The multi-piece cylinder head, which is defined in the first claim and the other claims dependent on the first claim, and which is developed to fulfill the objective of the present invention, provides a thermomechanical improvement at the region which is located between the intake and exhaust valve openings and in which the fatigue cracks are encountered most intensely. With the inserts driven to the valve bridges, a pre-strain is produced at the points where the cracks are observed the most, and the compressive force at these regions is reduced. The inserts are placed on the valve bridges that are located on the surface facing the combustion chamber, and the resulting deformation is corrected by machining the insert and the cylinder head together. Thus, a pre-strain is produced at the bridge regions before the cylinder cover is mounted on the engine block, and formation of cracks on the cylinder head is prevented.

Detailed Description of the Invention

[0038] The multi-piece cylinder head developed to fulfill the objective of the present invention is illustrated in the accompanying figures, in which

Figure 1 is a top view of the multi-piece cylinder head.

Figure 2 is a sectional view of the multi-piece cylinder head.

Figure 3 is a close sectional view of the multi-piece cylinder head.

Figure 4 is a front view of the insert with pre-strain and the mounting hole.

Figure 5 is a front view of the insert with pre-strain and the mounting hole.

[0039] The components shown in the figures are given

reference numbers as follows:

1. Multi-piece cylinder head
2. Body
3. Water jacket
4. Intake valve opening
5. Exhaust valve opening
6. Valve bridge
7. Seat

71. Seat recess

72. Protrusion

8. Insert

81. Insert body

82. Tab

Y: Surface of the cylinder head facing the combustion chamber

[0040] The multi-piece cylinder head (1); whose thermomechanical strength is increased by reducing the compressive stress at areas, wherein the compressive stress is intense, by means of the parts made of materials with different or same level of thermal conductivity; comprises

- at least one body (2),
- at least one intake valve opening (4) which is located on the body (2),
- at least one exhaust valve opening (5) which is located on the body (2),
- at least one valve bridge (6),
- at least one seat (7) which is provided on the valve bridge (6) and whose depth is the same or less than the wall thickness of the body (2),
- at least one insert (8), which is removable, and which, upon being fitted into the seat (7), produces pre-strain at the valve bridge (8) region in tensile direction.

[0041] The multi-piece cylinder head (1) of the present invention forms the combustion chambers by covering the engine cylinder block and carries thereon the intake and exhaust valves and plugs. The multi-piece cylinder head (1) is comprised of a body (2) which is designed and shaped according to the engine block. The multi-piece cylinder head (1) is under high temperature and pressure since it is directly exposed to the explosion loads. Preferably a water jacket (3) is used for cooling the multi-piece cylinder head (1). The water jacket (3) is preferably located in the multi-piece cylinder head (1), i. e. the body (2). The water jacket (3) is in the form of a hollow having different geometric forms within the body (2). The coolant passes through the water jacket (3) and thus the body (2) is cooled.

[0042] In one embodiment of the invention, an intake valve opening (4) and an exhaust valve opening (5) are

provided on the body (2) of the multi-piece cylinder head (1). An intake valve is mounted on the intake valve opening (4) and an exhaust valve is mounted on the exhaust valve opening (5). There is provided a valve bridge (6) between the intake valve opening (4) and the exhaust valve opening (5) on the surface (Y) of the multi-piece cylinder head (1) facing the combustion chamber, i.e. the surface (Y) of the body (2) facing the combustion chamber.

[0043] The valve bridge (6) is the region which is located between the intake valve openings (4) and/or exhaust valve openings (5) and/or the intake valve opening (4) and the exhaust valve opening (5). The valve bridge (6) is one of the regions which is exposed to the highest heat and strains in the multi-piece cylinder head (1). Particularly the valve bridge (6) region, which is situated between the two exhaust valve openings (5), is the region which is exposed to the highest temperature, and the most intense thermomechanical fatigue is observed at this valve bridge (6). Since the valve bridge (6) is exposed to more heat than the other regions on the body (2), compressive stress is applied on the valve bridge (6) from the surrounding regions. Thermal cycle takes place in the multi-piece cylinder head (1) at every heating and cooling of the engine, and especially the valve bridge (6) is the region which is affected the most by the said thermal cycle and which undergoes the most intense compressive stress.

[0044] The seat (7) and insert (8) are used in order to reduce the compressive stress occurring in the valve bridges (6). A pre-strain in tensile direction is achieved at the valve bridge (6) by means of the seat (7) provided on the valve bridge (6) and the insert (8) mounted to this seat (7). The pre-strain obtained by the insert (8) reduces the compressive stress applied on the valve bridge (6).

[0045] In the preferred embodiment of the invention, there is at least one seat (7) provided at the region(s) where the valve bridge (6) or valve bridges (6) is/are located. The seat (7) provides a hollow space towards inside of the body (2) at the region where the valve bridge (6) is located. The seat (7) may be of different geometries and sizes. The seat (7) preferably comprises at least one seat recess (71) and at least one protrusion (72). There is provided a seat recess (71), which is adjacent to the body (2) walls on both sides of the seat (7), and which starts from the body's (2) upper surface level and proceeds downwards. In the preferred embodiment of the invention, there are two seat recesses (71) in the seat (7) which preferably have the same form and are symmetrical to each other. The sides of the seat recess (71) are preferably flat (Figure 4).

[0046] In the preferred embodiment of the invention, there is at least one protrusion (72) in the seat (7) preferably between the seat recesses (71) and towards the body (2) upper surface. The protrusion (72) can be of different geometric forms and it is preferably flat. Width and height of the protrusion (72) vary depending on the body (2) wall thickness and the valve bridge (6).

[0047] In one embodiment of the invention, the seat recess (71) and the protrusion (72) are quadrangular. In the said embodiment, depth of the seat recess (71) is less than the body's (2) wall thickness, and height of the protrusion (72) is less than the body's (2) wall thickness (Figure 4).

[0048] In an alternative embodiment of the invention, the middle part of the protrusion (72) in the seat (7) is open. The hollow between the protrusions (72) continues along the whole body (2). Thus, a hollow is formed in the body (2) up to the water jacket (3). The insert (8) placed in the seat (7) contacts the coolant travelling within the water jacket (3) (Figure 5).

[0049] In the preferred embodiment of the invention, an insert (8) is mounted into the seat (7). The insert (8) is preferably made of a material whose thermal conductivity is higher than that of the seat (7) and the body (2). Thus thermal resistance of the insert (8) is further enhanced. The insert (8) preferably comprises at least one insert body (81) and at least one tab (82). In a preferred embodiment of the invention, the insert (8) comprises an insert body (81) and two tabs (82) which start from both sides of the insert body (81) and extend downwards. In this embodiment, the insert (8) is preferably "U" shaped (Figure 4).

[0050] In an alternative embodiment of the invention; the insert (8) comprises an insert body (81) and two tabs (82), which start from both sides of the insert body (81) and extend downwards; and a third tab (82) that is the middle tab (82), which is located in between the tabs (82) at the sides and which is longer and wider than the side tabs (82). In this embodiment, the insert (8) is preferably "T" shaped (Figure 5). The middle tab (82) provided in the middle part of the insert body (81) fits into the hollow between the seat (7) protrusions (72).

[0051] In the preferred embodiment of the invention, the insert (8) completely fits into the seat (7) and fills in the empty space within the seat (7) almost completely. The tabs (82) provided on both sides of the insert body (81) fit into the seat recess (71) within the seat (7). Size, width and shape of the seat recess (71) and the tabs (82) are the same. Thus the tabs (82) completely fit into the seat recess. The hollow remaining between the insert body (81) tabs fits over the protrusion (72) provided in the seat (7). Thus, the insert tabs (82) and the hollow remaining between the tabs (82) fit to the seat recess (71) and the protrusion (72) thereby enabling mounting of the insert (8) to the seat (7).

[0052] In the preferred embodiment of the invention, the distance between the insert (8) tabs (82) is shorter than the distance between the seat recesses (71). This distance difference between the tabs (82) and the seat recesses (71) causes the insert (8) to be fitted by applying a force to the seat (7). The insert (8) is mounted to the seat (7) upon applying a force on the upper surface of the insert (8). Since the distance between the insert (8) tabs (82) is smaller than the distance between the seat recesses (71) and a force is applied on the insert (8)

when it is being fitted, a pre-strain occurs on the tabs (82) in tensile direction. The inserts (8) are mounted on the body (2), i.e. on the multi-piece cylinder head (1), and the multi-piece cylinder head (1) is machined together with the inserts (8) so as to prevent the resulting deformations and tolerance-induced errors. Thus, a pre-strain is produced at the valve bridge (6) region before the multi-piece cylinder head (1) is mounted on the cylinder block.

[0053] In an alternative embodiment of the invention, the insert (8) is preferably "T" shaped. In this embodiment, there are tabs (82) on two sides and in the middle of the insert body (81). The tab (82) located in the middle is much wider and larger than the tabs (82) on the sides (Figure 5). In this embodiment, the seat (7) has the same "T" form like the insert (8). There is a hollow in the middle of the seat (7) between the protrusions (72) and the middle tab (82) fits into this hollow. The insert (8) side tabs (82) fit into the seat recesses (7). The insert (8) middle tab moves up to the water jacket (3) and contacts the coolant. Thus direct cooling is provided for the insert (8). A force is applied to the insert (8) from the top for the insert (8) side tabs (82) to fit into the seat recesses (7). Hence during fitting of the tabs (82), a pre-strain occurs on the tabs (82) in tensile direction. Intensity of the pre-strain force is controlled by changing the distance between the insert (8) tabs (82) or the distance between the seat recesses (71).

[0054] By means of the multi-piece cylinder head (1) of the present invention, the resistance against thermomechanical fatigue at the valve bridge (6) on the surface (Y) of the body (2) facing the combustion chamber is increased.

[0055] The hollow located between the intake and exhaust valve openings (4, 5) provided on the body (2) of the multi-piece cylinder head (1) of the present invention is named as valve bridge (6), and it is the region where fatigue is observed the most. In the multi-piece cylinder head (1); seats (7) are provided at the valve bridges (6) located on the surface (Y) of the body (2) facing the combustion chamber, and inserts (8), which provide pre-strain in tensile direction, are arranged in the said seats (7). When the insert (8) tabs (82) are being fitted into the seat recesses (71), they produce a tensile force on the seat recesses (71), and this force causes pre-strain. The pre-strain enabled by the insert (8) reduces the compressive stress applied on the valve bridge (6) region and enhances thermomechanical resistance. Thus, formation of cracks at the valve bridge (6) region is substantially prevented.

[0056] By means of the pre-strain provided by the insert (8), the compressive force applied on the valve bridges (6) and the stress occurring in these regions are reduced. When the thermomechanical fatigue in the multi-piece cylinder head (1) increases too much and causes damages/losses, a crack / fracture occurs in the insert (8). In such a case, only the insert (8) is replaced. The entire cylinder head is not required to be replaced.

Claims

1. A multi-piece cylinder head (1), whose thermomechanical strength is increased by reducing the compressive stress at areas, wherein the compressive stress is intense, basically **comprising**
 - at least one body (2),
 - at least one intake valve opening (4) which is located on the body (2),
 - at least one exhaust valve opening (5) which is located on the body (2),
 - at least one valve bridge (6); and wherein
 - at least one seat (7), which comprises seat recesses (71) and at least one protrusion (72), which is located on the valve bridge (6) on the surface (Y) facing the combustion chamber, and whose depth is the same or less than the wall thickness of the body (2), and **characterized by**
 - at least one insert (8), which comprises at least one insert body (81) and tabs (82), which is removable, and which, upon being fitted into the seat (7), produces pre-strain at the valve bridge (6) region in tensile direction, wherein, since the distance between the tabs (82) thereof is shorter than the distance between the seat recesses (71) and a force is applied thereon when being mounted into the seat (7), a pre-strain occurs on the tabs (82) thereof in tensile direction, and which reduces the compressive force applied to the valve bridge (6) by means of the pre-strain it provides.
2. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the valve bridge (6) which is located between the intake valve opening (4) and exhaust valve opening (5) on the surface (Y) of the body (2) facing the combustion chamber.
3. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the valve bridge (6) which is located between the intake valve openings (4) and/or exhaust valve openings (5) and/or intake valve opening (4) and the exhaust valve opening (5).
4. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the seat (7), which is located at the region where the valve bridge (6) is located, and forms an empty space towards inside of the body (2).
5. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the seat recess (71) which forms a hollow adjacent to the body (2) walls on both sides of the seat (7) starting from the body's (2) upper surface level and proceeding downwards.
6. A multi-piece cylinder head (1) according to Claim 1, **characterized by** two seat recesses (71) within

the seat (7) preferably having the same shape and being symmetrical to each other.

7. A multi-piece cylinder head (1) according to Claim 1, **characterized by** at least one protrusion (72), which is located within the seat (7) preferably between the seat recesses (71), which extends towards the upper surface of the body (2), and whose middle part is open and extends along the body (2). 5
8. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the seat recess (71), which is preferably quadrangular and whose depth is less than the wall thickness of the body (2), and the protrusion (72), whose height is less than the wall thickness of the body (2). 10
9. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the insert (8) which is made of a different material whose thermal conductivity is preferably higher than the seat (7) and the body (2). 15
10. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the insert (8), which comprises an insert body (81) and two tabs (82) starting from both sides of the insert body (81) and extending downwards, and which is preferably "U" shaped. 20
11. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the insert (8) comprising two tabs (82) starting from both sides of the insert body (81) and extending downwards, and a middle tab (82), which is located in between the tabs (82) at the sides and which is longer and wider than the side tabs (82); and which is preferably "T" shaped. 25
12. A multi-piece cylinder head (1) according to Claim 11, **characterized by** the middle tab (82) which is provided in the middle of the insert body (81) and fits into the hollow between the seat (7) protrusions (72). 30
13. A multi-piece cylinder head (1) according to Claim 10, **characterized by** the tabs (82) which are provided on both sides of the insert body (81) and fit into the seat recess (71) within the seat (7). 35
14. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the seat recess (71) and tabs (82) whose sizes, widths and shapes are almost the same. 40
15. A multi-piece cylinder head (1) according to Claim 1, **characterized by** the insert (8), which is placed in the seat (7) that is provided in the valve bridges (6) located on the surface (Y) of the body (2) facing the combustion chamber, and which provides pre-strain in tensile direction in the seat (7). 45

Patentansprüche

1. Mehrteiliger Zylinderkopf (1), dessen thermomechanische Festigkeit durch Verringerung der Druckspannung in Bereichen erhöht wird, in denen die Druckspannung intensiv ist, im Wesentlichen **umfassend**
 - mindestens ein Körper (2),
 - mindestens eine Einlassventilöffnung (4), die sich auf dem Körper (2) befindet,
 - mindestens eine Auslassventilöffnung (5), die sich auf dem Körper (2) befindet,
 - mindestens eine Ventilbrücke (6); und wobei
 - mindestens einen Sitz (7), umfassend Sitzausnehmungen (71) und mindestens einen Vorsprung (72), der sich auf der Ventilbrücke (6) auf der der Brennkammer zugewandten Fläche (Y) befindet und dessen Tiefe gleich oder kleiner als die Wanddicke des Körpers (2) ist, und **gekennzeichnet durch**
 - mindestens einen Einsatz (8), der mindestens einen Einsatzkörper (81) und Laschen (82) aufweist, der herausnehmbar ist und der beim Einsetzen in den Sitz (7) eine Vorspannung im Bereich der Ventilbrücke (6) in Zugrichtung erzeugt, wobei da der Abstand zwischen ihren Laschen (82) kürzer ist als der Abstand zwischen den Sitzausnehmungen (71) und auf diese beim Einbau in den Sitz (7) eine Kraft ausgeübt wird, tritt auf ihre Laschen (82) eine Vorspannung in Zugrichtung ein, die die auf die Ventilbrücke (6) ausgeübte Druckkraft durch die von ihr bewirkte Vorspannung reduziert.
2. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** die Ventilbrücke (6), die zwischen der Einlassventilöffnung (4) und der Auslassventilöffnung (5) auf der dem Brennraum zugewandten Oberfläche (Y) des Körpers (2) angeordnet ist.
3. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** die Ventilbrücke (6), die zwischen den Einlassventilöffnungen (4) und/oder den Auslassventilöffnungen (5) und/oder der Einlassventilöffnung (4) und der Auslassventilöffnung (5) angeordnet ist.
4. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** den Sitz (7), der sich im Bereich der Ventilbrücke (6) befindet und zum Inneren des Körpers (2) hin einen Freiraum bildet.
5. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** die Sitzausnehmung (71), die einen an die Wände des Körpers (2) angrenzenden Hohlraum auf beiden Seiten des Sitzes (7) bildet, der vom Niveau der oberen Oberfläche des Körpers

(2) abfällt und nach unten verläuft.

6. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** zwei Sitzausnehmungen (71) innerhalb des Sitzes (7), die vorzugsweise die gleiche Form haben und symmetrisch zueinander sind. 5
7. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** mindestens einen Vorsprung (72), der sich innerhalb des Sitzes (7) vorzugsweise zwischen den Sitzausnehmungen (71) befindet, der sich zur Oberseite des Körpers (2) hin erstreckt, und dessen Mittelteil offen ist und sich entlang des Körpers (2) erstreckt. 10
8. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** die Sitzausnehmung (71), die vorzugsweise viereckig ist und deren Tiefe geringer ist als die Wandstärke des Körpers (2), und den Vorsprung (72), dessen Höhe geringer ist als die Wandstärke des Körpers (2). 20
9. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** den Einsatz (8), der aus einem anderen Material hergestellt ist, dessen Wärmeleitfähigkeit vorzugsweise höher ist als die des Sitzes (7) und des Körpers (2). 25
10. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** den Einsatz (8), der einen Einsatzkörper (81) und zwei Laschen (82) aufweist, die von beiden Seiten des Einsatzkörpers (81) ausgehen und sich nach unten erstrecken, und der vorzugsweise "U"-förmig ist. 30
11. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch**, dass der Einsatz (8) zwei Laschen (82), die von beiden Seiten des Einsatzkörpers (81) ausgehen und sich nach unten erstrecken, und eine mittlere Lasche (82) umfasst, die sich zwischen den Laschen (82) an den Seiten befindet und die länger und breiter als die Seitenlaschen (82) ist; und die vorzugsweise "T"-förmig ist. 35 40
12. Mehrteiliger Zylinderkopf (1) nach Anspruch 11, **gekennzeichnet durch** die mittlere Lasche (82), die in der Mitte des Einsatzkörpers (81) vorgesehen ist und in den Hohlraum zwischen den Vorsprüngen (72) des Sitzes (7) passt. 45
13. Mehrteiliger Zylinderkopf (1) nach Anspruch 10, **gekennzeichnet durch** die Laschen (82), die auf beiden Seiten des Einsatzkörpers (81) vorgesehen sind und in die Sitzausnehmung (71) innerhalb des Sitzes (7) passen. 50
14. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** die Sitzausnehmung (71) und

Laschen (82), deren Größen, Breiten und Formen nahezu gleich sind,

15. Mehrteiliger Zylinderkopf (1) nach Anspruch 1, **gekennzeichnet durch** den Einsatz (8), der in den Sitz (7) eingesetzt ist, der in den Ventilbrücken (6) vorgesehen ist, die sich auf der der Brennkammer zugewandten Oberfläche (Y) des Körpers (2) befinden, und der eine Vorspannung in Zugrichtung im Sitz (7) bewirkt. 10

Revendications

1. Culasse en plusieurs parties (1), dont la résistance thermomécanique est augmentée en réduisant la contrainte de compression par endroits, dans laquelle la contrainte de compression est intense, **comportant** essentiellement
 - au moins un corps (2),
 - au moins une ouverture de soupape d'admission (4) qui est située sur le corps (2),
 - au moins une ouverture de soupape d'échappement (5) qui est située sur le corps (2),
 - au moins un coupleur de soupapes (6) ; et dans lequel
 - au moins un siège (7), qui comporte des évidements de siège (71) et au moins une saillie (72), qui est située sur le coupleur de soupapes (6) sur la surface (Y) tournée vers la chambre de combustion, et dont la profondeur est égale ou inférieure à l'épaisseur de la paroi du corps (2), et **caractérisé par**
 - au moins un insert (8), qui comprend au moins un corps d'insert (81) et des languettes (82), qui est amovible et qui, lors de son montage dans le siège (7), produit une précontrainte dans la zone du coupleur de soupapes (6) dans le sens de la traction, dans lequel, étant donné que la distance entre ses languettes (82) est inférieure à la distance entre les évidements du siège (71), une force est appliquée sur celui-ci lorsqu'il est monté dans le siège (7), une précontrainte se produit sur ses languettes (82) dans le sens de la traction, et qui réduit la force de compression appliquée au coupleur de soupapes (6) grâce à la précontrainte qu'il fournit. 35 40 45
2. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** le coupleur de soupapes (6) qui est situé entre l'ouverture de la soupape d'admission (4) et l'ouverture de la soupape d'échappement (5) sur la surface (Y) du corps (2) faisant face à la chambre de combustion. 50 55
3. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** le coupleur de soupapes (6)

qui est situé entre les ouvertures des soupapes d'admission (4) et/ou d'échappement (5) et/ou l'ouverture des soupapes d'admission (4) et l'ouverture des soupapes d'échappement (5).

4. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** le siège (7), qui est situé dans la région où se trouve le coupleur de soupapes (6), et qui forme un espace vide vers l'intérieur du corps (2). 5 10
5. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'évidement du siège (71) qui forme un creux adjacent aux parois du corps (2) des deux côtés du siège (7) décrochant du niveau de la surface supérieure du corps (2) et allant vers le bas. 15
6. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** deux évidements de siège (71) dans le siège (7) ayant de préférence la même forme et étant symétriques l'un par rapport à l'autre. 20
7. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** au moins une saillie (72), qui est située à l'intérieur du siège (7), de préférence entre les évidements du siège (71), qui s'étend vers la surface supérieure du corps (2), et dont la partie médiane est ouverte et s'étend le long du corps (2). 25
8. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'évidement du siège (71), qui est de préférence quadrangulaire et dont la profondeur est inférieure à l'épaisseur de la paroi du corps (2), et la saillie (72), dont la hauteur est inférieure à l'épaisseur de la paroi du corps (2). 30 35
9. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'insert (8) qui est fait d'un matériau différent dont la conductivité thermique est de préférence supérieure à celle du siège (7) et du corps (2). 40
10. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'insert (8), qui comprend un corps d'insert (81) et deux languettes (82) partant des deux côtés du corps d'insert (81) et s'étendant vers le bas, et qui est de préférence en forme de "U". 45
11. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'insert (8) comprenant deux languettes (82) partant des deux côtés du corps d'insert (81) et s'étendant vers le bas, et une languette centrale (82), qui est située entre les languettes (82) sur les côtés et qui est plus longue et plus large que les languettes latérales (82) ; et qui est de préférence en forme de "T". 50 55
12. Culasse en plusieurs parties (1) selon la revendica-

tion 11, **caractérisé par** la languette centrale (82) qui est prévue au milieu du corps d'insert (81) et s'insère dans le creux entre les saillies (72) du siège (7).

13. Culasse en plusieurs parties (1) selon la revendication 10, **caractérisé par** les languettes (82) qui sont prévues des deux côtés du corps d'insert (81) et s'insèrent dans l'évidement du siège (71) à l'intérieur du siège (7).
14. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'évidement du siège (71) et les languettes (82) dont les dimensions, les largeurs et les formes sont presque identiques.
15. Culasse en plusieurs parties (1) selon la revendication 1, **caractérisé par** l'insert (8), qui est placé dans le siège (7) qui est prévu dans les coupleurs de soupapes (6) situés sur la surface (Y) du corps (2) faisant face à la chambre de combustion, et qui assure la précontrainte dans le sens de la traction dans le siège (7).

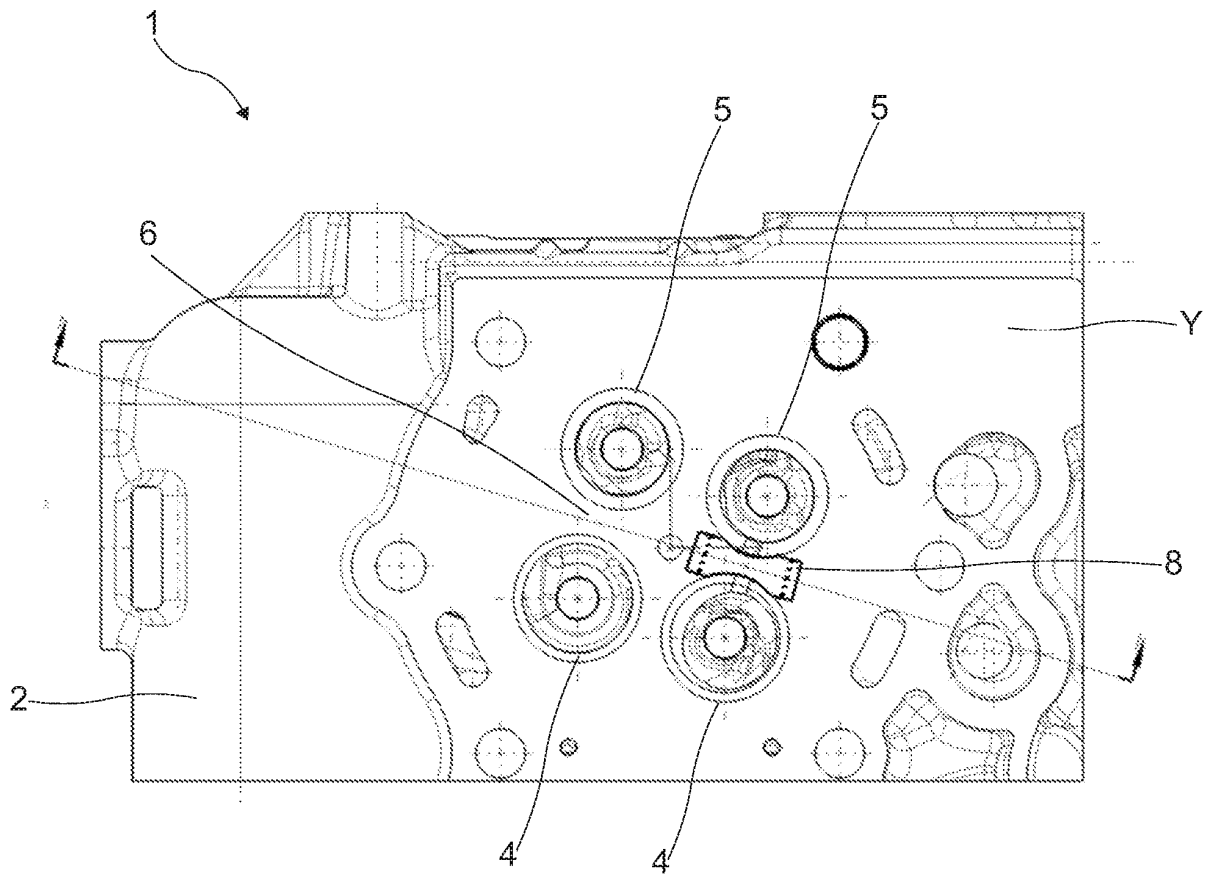


Figure 1

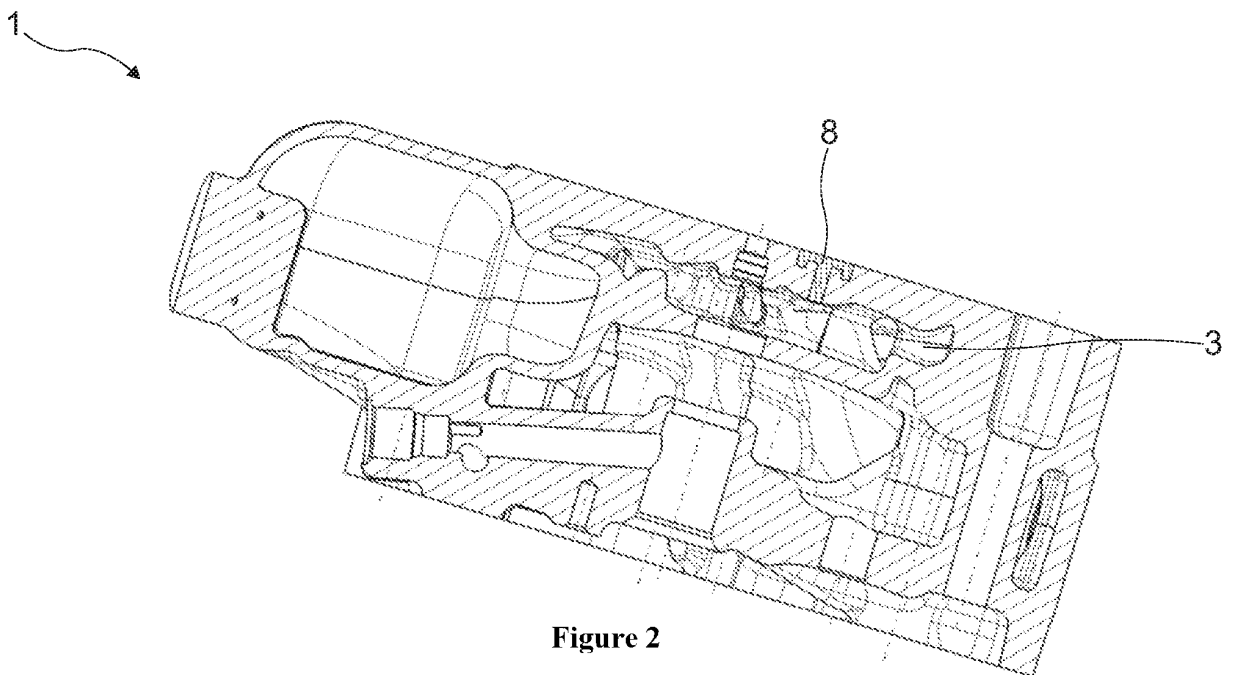


Figure 2

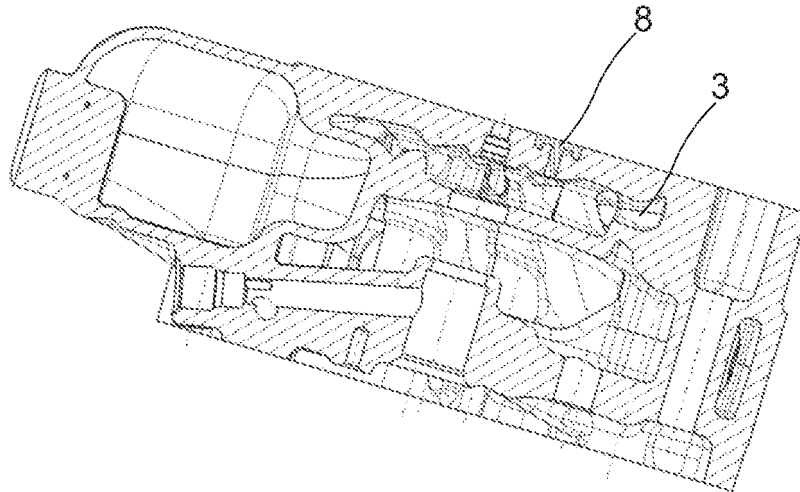


Figure 3

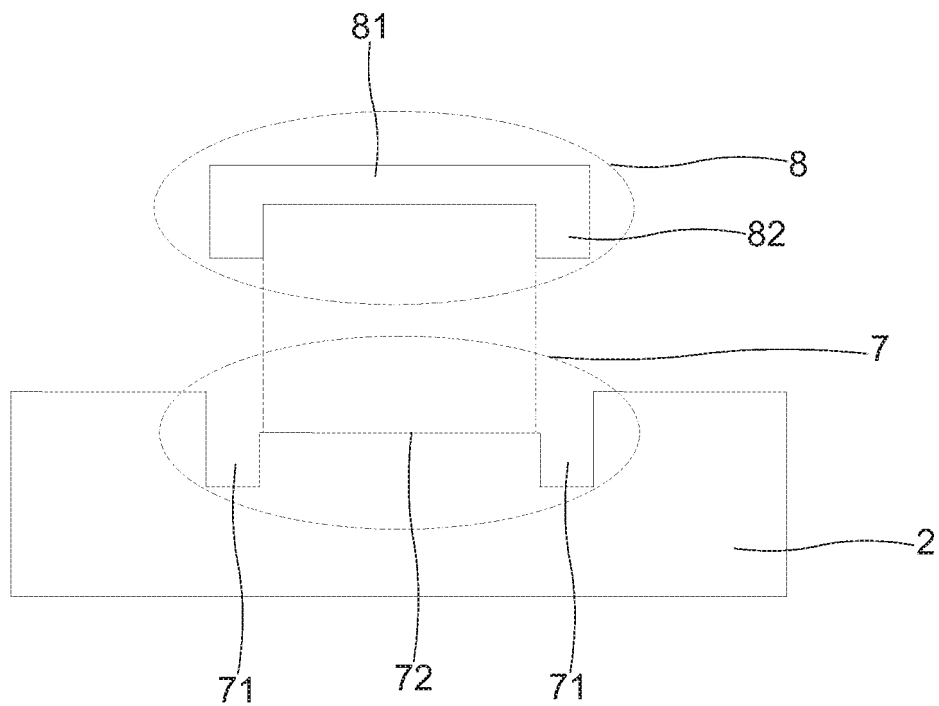


Figure 4

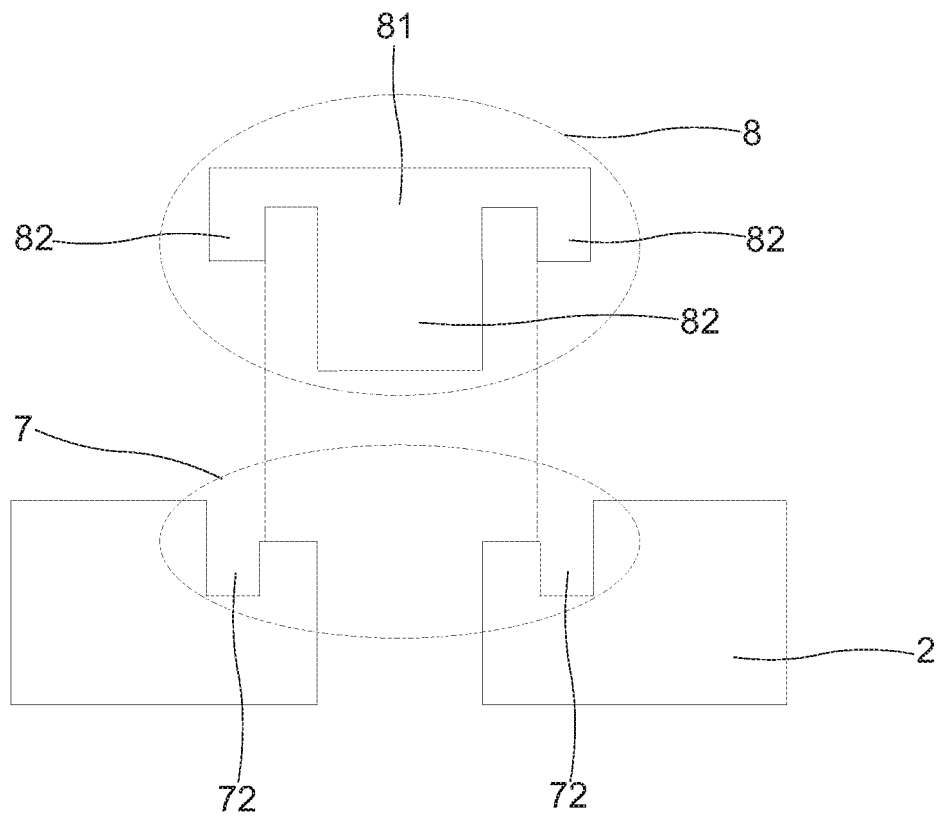


Figure 5

REFERENCES CITED IN THE DESCRIPTION

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