



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
09.04.2014 Bulletin 2014/15

(51) Int Cl.:
B22F 3/24 (2006.01) **B22F 5/10** (2006.01)
F01C 1/14 (2006.01) **F04C 2/14** (2006.01)

(21) Application number: **12738385.9**

(86) International application number:
PCT/BR2012/000164

(22) Date of filing: **31.05.2012**

(87) International publication number:
WO 2012/162774 (06.12.2012 Gazette 2012/49)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

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(30) Priority: **31.05.2011 BR PI1102345**

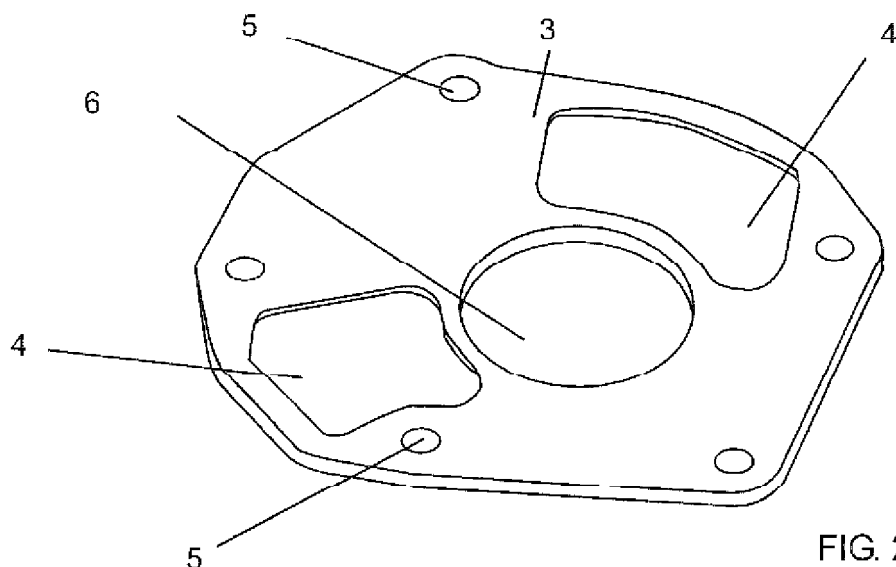
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(54) **A PROCESS FOR MANUFACTURING AN OIL-PUMP COVER AND A COVER**

(57) The present invention relates to an oil-pump cover (1) obtained by a process of sintering metallic powders, said cover having a chemical composition, granulometric distribution, sintering time and temperature that

enable a reduction of the level of the cover (1) weight of 8% - 16%, as well as a reduction of its final cost on the order of 10% to 20%.



Description

[0001] The present invention relates to an oil-pump cover, more specifically to a low-cost oil-pump cover, the reduction being made possible by a process of sintering metallic powders.

Description of the Prior Art

[0002] Internal combustion engines comprise essentially an engine block (provided with one or more cylinders and the crankshaft assembly), to which one or more heads (provided with valve gear) are associated, the crankshaft assembly being composed by pistons, rods and the crankshaft.

[0003] In order for an internal combustion engine to operate properly, the assembly of parts that compose the engine should be lubricated. Such function in the most modern engines is performed with the aid of an oil pump capable of removing the oil from the sump and sending it through the main lubrication gallery to the various engine parts, which is the so-called forced lubrication, capable of supplying oil to the high parts of the engine.

[0004] To achieve this, the oil pump is provided with gears or internal rotors whose rotation is fed by the engine itself (crankshaft, chain or belt), the rotation being capable of creating an oil sucking effect, which exerts the force required for the oil to be sent to the filter and reach, for instance, the valve gear.

[0005] Thus, one can say that the oil pump works exerting pressure onto the lubricating oil. In this regard, the oil pumps are provided with a cover that, in conjunction with the oil pump, guarantees the pressure required for the pump to operate. For this purpose, the oil-pump cover is provided with some characteristics that are intrinsic to the correct functioning of the lubricating system.

[0006] The cover of an oil pump of an internal combustion engine should have correct planicity, capable of reducing to a possible minimum the internal reflow of oil, which will guarantee that the oil will be correctly sent to the engine, minimizing leakage through the clearance of the cover/oil pump interface. This maintains a sufficient clearance with the rotors, so as to prevent pump locking.

[0007] Therefore, there are various characteristics that should be fulfilled in order to guarantee the tightness of the union of the cover with the oil pump. For this purpose, any oil pump should have an adequate shape (such as recesses capable of directing the flow properly) and should be sized so as to bear the work pressure, undergoing minimum alterations. It should have fatigue strength so as to prevent early change of the oil cover, and should have plasticity of up to 60 micrometers, among other fundamental characteristics to guarantee the useful life of the oil-pump assembly.

[0008] As a function of the characteristics which one wishes to achieve in a cover of oil pump for internal combustion engines, the prior art foresees a cover obtained with a steel plate that undergoes a number of mechanical

shaping steps. More specifically, the obtainment of an oil-cover pump of the prior art involves five steps, namely:

- i) stamping a plate for cutting and shaping recesses, when these are required;
- ii) removing the material displaced by recess shaping, when these are required, by a trimming operation;
- iii) machining to achieve an adequate planicity value;
- iv) boring the cover for inserting screws; and
- v) anti-oxidizing treatment of the cover.

[0009] It should be noted that any automotive part or component undergoes a careful development, which seeks to achieve a balance between the production cost, the final properties of the part, the raw material and the production/transformation technologies available. With regard to the oil-pump covers of the prior art, the model of such an equation finds solution in a steel cover that undergoes a process of transforming a steel plate in five steps, whereby one achieves a cover with density on the order of 7.85g/cm³.

[0010] It should be also noted that, as it is known, any decrease of one step in an industrial process brings about scale saving, thus bringing directly a financial benefit that is transported to the final cost of the part.

[0011] Parallel with this, analyzing the five steps mentioned above and meeting the shape and the raw material employed (steel plate), it is unfeasible to reduce one of the steps employed in the process, at least from the technical and economical point of view.

[0012] Additionally, the use of steel has a few limitations with regard to the stamping, since carbon contents higher than 0.2% make it difficult to carry out this process.

[0013] Thus, the cost/benefit factor for a new oil-pump cover should not meet only the manner in which a metal plate is processed, but it should go further, seeking to integrate a solution that will make use of other techniques that have not yet been employed on these components.

[0014] The Chinese prior-art document CN1827263 presents an interesting solution to an oil-pump body. According to this document, the oil-pump body is obtained by means of a process of sintering metallic powders containing iron, noble alloy elements and magnesium disulfide with a view to reduce friction and wear of the pump.

[0015] Just as in the preceding document, there are other documents that seek alternative solutions for producing parts by sintering metallic powders, as indicated in the Japanese document JP08074747, the objective of which is achieved by sintering a rotor of an oil pump in order to improve the functional properties at low and high working temperatures.

[0016] As a rule, such developments indicated by the prior art aim at the production of a part with specific characteristics as far as performance is concerned. Observing from this point of view, the sintering is a productive process that proves to be advantageous by virtue of the fact that it enables one to add determined chemical com-

pounds in contents that would not have solubility in steels in the form of steel plates. For this purpose, the prior-art documents disclose an interesting chemical composition only for the purpose for which the parts produced are intended. From the point of view of production of an oil-pump cover, such chemical compositions would not be interesting, because they would make the raise the final cost of the part, without any benefit for the application thereof.

[0017] In this regard, one has not yet found a solution that could provide a metallic oil-pump cover with a lower cost than the existing ones. On one hand, even if there are covers with a low cost of raw material, (steel plate), the subsequent steps of transforming make the final product expensive. On the other hand, an alternative sintering process, in spite of being less expensive in productive terms, does not yet have a composition applicable to an oil-pump cover that could enable a reduced final cost with the guarantee of performance required from the part.

Objectives of the Invention

[0018] An objective of the present invention is to provide an oil-pump cover of reduced cost, obtained by sintering metallic powders.

[0019] Another objective of the present invention is to provide a process for producing an oil-pump cover that will enable one to reduce the number of production steps by sintering a chemical composition of metallic powders compatible for this purpose.

Brief Description of the Invention

[0020] The objectives of the present invention are achieved by means of a process of manufacturing an oil-pump cover for use on internal combustion engines of an automotive vehicle, the process comprising a step i) of compacting, in metallic molds, an alloy of metallic powder, forming a green compacted material; a step ii) of sintering the green compacted material obtained in step i) at a temperature ranging from 1000°C to 1200°C during a time interval ranging from 10 to 60 minutes; a step iii) of calibrating the sintered material obtained in step ii) in a metallic mold; and a step iv) of anti-oxidizing treatment of the sintered material obtained in step iii).

[0021] The objectives of the present invention are also achieved by means of a cover obtained by the process described above.

[0022] The objectives of the present invention are further achieved by means of an oil-pump cover for use on an internal combustion engine of an automotive vehicle, the cover comprising an inner surface provided with one or more recesses, an outer surface, a plurality of orifices arranged in a peripheral portion, each being capable of receiving a screw for association of the cover with the oil pump and a through bore arranged in a substantially central region, wherein the cover is produced by sintering

metallic powder, the cover being having a density ranging from 6.g/cm³ to 7.3g/cm³.

[0023] The characteristics mentioned above, in addition to other features of the present invention, will be well understood through the examples and the detailed description of the figures hereafter.

Detailed Description of the Drawings

[0024] The present invention will now be described in greater detail with reference to an example of embodiment represented in the drawings. The figures show:

- Figure 1 is a perspective view of the outer surface of an oil-pump cover of the present invention;
- Figure 2 is a perspective view of the inner surface of an oil-pump cover of the present invention;
- Figure 3 is a front view of the outer surface of an oil-pump cover of the present invention;
- Figure 4 is a cross-sectional view of an oil-pump cover of the present invention;
- Figure 5 is a front view of the inner surface of an oil-pump cover of the present invention;
- Figure 6 is a front view of the outer surface of another possible embodiment of the oil-pump cover of the present invention.

Detailed Description of the Figures

[0025] Vehicles provided with an internal combustion engine need lubrication of the internal components of the engine and, as a rule, the lubrication function is provided by an oil pump. In turn, oil pumps are provided with a number of functional elements, among which the cover 1 of the oil pump.

[0026] An oil-pump cover 1 may have any configuration that conforms to the tightness of the oil circulating inside the respective oil pump to which it will be associated. In this regard, the cover 1 and the oil pump are developed with a view to achieving a reduction in the cost of the product, and this reduction may occur through the shape and the geometry of the cover 1, as well as through the material and the respective process of manufacturing.

[0027] The focus of the present invention is on the cover 1 and the manufacture thereof, seeking to provide a cover 1 the reduction of cost of which should result from the set of variables that interact in the process of obtaining the cover 1.

[0028] As will be clear hereinafter, the present invention may be applied to any geometry of the cover 1, as well as to any type of engine that makes use of an oil pump, namely those fed with fuel based on gasoline, ethanol and Diesel.

[0029] Before going into the details of the invention, one should note that, as a rule, a cover 1 comprises a flat surface constituted by two opposite and parallel faces (see figures 1 to 6).

[0030] Like an oil-pump cover of the prior art, the cover

1 of the present invention comprises an inner surface 3, which will be associated by pressure to the pump wall, to guarantee adequate tightness of the circulating oil of the oil pump. The tightness is typically carried out by the substantially permeable region of the cover 1, wherein the remaining portion of the inner surface 3 will keep contact with the oil circulating inside the oil pump. It should be further noted that the inner surface 3 of the cover 1 may be provided with at least one recess 4, either textured or not, to direct the flow of oil properly.

[0031] In opposition to the inner surface 3, there is an outer surface 2, which comprises a plurality of through bores arranged in a substantially peripheral portion. Each orifice 5 is capable of receiving a screw for association by pressure of the cover 1 with the oil-pump body. It should be noted that the orifices 5 are provided with such a geometry that they will be capable of housing the screw head inside the cover 1 (see figure 1), so that, after the cover 1 is mounted on the oil pump, the top of the screw head will be flush with the outer surface 2 of the cover 1.

[0032] Finally, still with regard to the constructive characteristics, the cover 1 is provided with a through bore 6 arranged in a substantially central region, the function of which is to allow entry of the element that will introduce rotation and torque that will cause the gears of the pump oil to move.

[0033] As said before, all these geometric characteristics are obtained by the prior art in a succession of at least five steps, which are absolutely different from those of the present invention, as defined below.

[0034] With a view to achieve a reduction of the final cost of the product, the cover 1 of the present invention makes use of a process of sintering metallic powders, instead of stamping, cutting and melting as in the prior art.

[0035] In greater detail, the present invention starts from the obtainment of ferrous powders that can be obtained through different processes such as: water spraying, air spraying, gas spraying, reduction, grinding etc. the powders may have a granulometric distribution ranging from 0% to 2% with the size smaller than 0.068mm, ranging from 7% to 11 % with size ranging from 0.068 mm to 0.112 mm and from 20% to 30% with size ranging from 0.112 mm to 0.354 mm, wherein the remainder has size bigger than 0.354 mm. Such ferrous powders and additives may be mixed and delivered ready by the supplier. Thus, the present invention starts from a metallic powder alloy as described above and comprises the following steps:

- Step i): compacting, in metallic molds, the alloy, forming a compacted green material;
- Step ii): sintering the compacted green material obtained in step i) at a temperature ranging from 1000° to 1200°C during a time interval ranging from 10 to 60 minutes;
- Step iii): calibrating the sintered material obtained in step ii) in a metallic mold;
- Step iv) anti-oxidizing treatment of the sintered ma-

terial obtained in step iii).

[0036] As said before, the selection of a chemical composition that will enable a competitive cost and that will enable one to produce a cover 1 by the above-mentioned process is a crucial factor for the success of the present invention. In this regard, step i) comprises a chemical composition of powders that will enable one to obtain a cover of step iv), comprising at least 0.3% to 0.9% by weight of carbon, a maximum of 3.0% by weight of copper, a maximum of 2.0% of at least one of the elements chosen from nickel, chrome, silicon, molybdenum, by weight, the balance of the chemical composition being iron.

[0037] The great advantage of a sintering process is that the work piece, after step iii), will be already in its final constructive configuration, without the need to carry out machining operations, as is the case with covers processed in the prior art, in two steps.

[0038] An evident example of this is the formation of the recesses 4, which, after compaction, are already in their final shape, without the need for subsequent removal of the material on the opposed face, or even from the orifices 5. The cover 1, when it is in the state of green compacted material, will automatically exhibit such a shape that will comprise the orifices 5 without the need to make bores subsequently. The present invention provides a cover 1 the orifices 5 of which will have such geometry that it will be able to house the head of the mold screw, so that, after the cover 1 has been mounted on the oil pump, the top of the screw head will be flush with the outer surface 2. It should be noted that, in order to achieve this geometric form, the prior art would need two bores of different diameter, which places the present invention in outstanding advantage over the old oil-pump cover.

[0039] It should be noted that, unlike what happens in stamping of steel plates of the prior art, wherein the limit of carbon contents is 0.2%, the present invention comprises carbon contents that may reach 0.9%, a significantly higher value, which naturally results in greater fatigue resistance.

[0040] Thus, the present invention, in proposing a sintered oil-pump cover 1, has greater flexibility in the choice of the final properties of the cover, by virtue of the fact that the sintering process enables greater amplitude in the chemical composition of the alloy.

[0041] Therefore, it is evident that the present invention comprises one step less in the process of production an oil-pump cover than the prior-art process (four steps instead of five), which provides a reduction in the cost on the order of 10% to 20%.

[0042] One should note that such reduction referring to the cost is not achieved only by decreasing one step in the process of manufacturing the cover 1, since various factors contribute to this achievement. In other words, even if the sintering technique is widely known, it is natural that one has never proposed an oil-pump cover 1 by

sintering metallic powders, since the mere alteration of a plastic shaping process is not enough for achieving the results of the present invention.

[0043] In a preferred embodiment, the cover 1 of the present invention is provided with specific technical and functional characteristics such as ultimate tensile stress - UTS) of a minimum of 200 Mega Pascal (MPa), an elasticity limit (Yield strength - YS) of at least 150 MPa, a minimum lengthening of 0.5% and fatigue resistance higher than 100 MPa.

[0044] For this purpose, it is necessary not only to select the correct chemical composition, but also to combine it with the various characteristics of the production process, namely granulometric distribution, sintering time and temperature.

[0045] It should be further noted that, in addition to a reduction in the final cost, the cover 1 of the present invention has achieved also a surprising reduction in the weight, which markedly leads to an intrinsic advantage of the cover/oil-pump assembly. Such a reduction in weight is achieved by reducing the density of the material that composes the cover 1, exhibiting values between 6.6g/cm³ and 7.3g/cm³, instead of the 7.85g/cm³ of the prior art. In other words, the cover 1 of the present invention provides a reduction in weight around 8% to 16% as compared with the prior art. It should be noted that the reduction in weight of the oil-pump cover 1 enables a reduction of weight of the vehicle and a consequent decrease in the consumption of fuel and emission of polluting gases, an objective which any assembling company pursues.

[0046] In summary, the oil-pump cover 1 of the present invention achieves, at the same time, two advantages, since it provides both a reduction in the final cost of a finished part and a reduction in the level of its weight.

[0047] A preferred embodiment having been described, one should understand that the scope of the present invention embraces other possible variations, being limited only by the accompanying claims, which embrace possible equivalents.

Claims

1. A process for manufacturing an oil-pump cover for use on internal combustion engine of an automotive vehicle, the process being **characterized by** comprising:

- Step i): compacting, in metallic molds, an alloy of metallic powders so as to form a green compacted material;
- Step ii): sintering the compacted material obtained in step i) at a temperature ranging from 1000°C to 1200°C during a time interval ranging from 10 to 60 minutes;
- Step iii): calibrating the sintered material obtained in step ii) in a metallic mold; and

- Step iv): anti-oxidizing treatment of the sintered material obtained in step iii).

2. A process according to claim 1, **characterized in that** the alloy of metallic powder is obtained by grinding at least two powders with granulometric distribution ranging from 0% to 2% with size lower than 0.068mm, from 7% to 11 % with size lower than 0.112mm, and from 20% to 30% with size higher than 0.354mm, wherein the remaining volume has size lower than 0.354 with respect to the total volume of the powders.
3. A process according to claims 1 and 2, **characterized in that** the product obtained in step iv) comprises at least 0.3% to 0.9% by weight of carbon, a maximum of 3.0% by weight of copper, a maximum of 2.0% of at least one of the elements nickel, chrome, silicon, molybdenum, by weight, the balance of the chemical composition being iron.
4. An oil-pump cover for use on an internal combustion engine of an automotive vehicle, **characterized by** being obtained by the process defined in claims 1 to 3.
5. An oil-pump cover for use on an internal combustion engine of an automotive vehicle, the cover (1) comprising:
 - an internal surface (3);
 - an external surface (2);
 - a plurality of orifices (5) arranged in a peripheral portion, each being capable of receiving a screw for association of the cover (1) with the oil pump;
 - a through bore (6) arranged in a substantially central region; the cover (1) being **characterized by** being produced by sintering metallic powder, the cover (1) being provided with a density ranging from 6.6g/cm³ to 7.3g/cm³.
6. A cover according to claim 5, **characterized in that** the metallic powder is provided with granulometric distribution ranging from 0% to 2% with size lower than 0.068mm, from 7% to 11% with size lower than 0.112mm, and from 20% to 30% with size higher than 0.354mm, wherein the remaining volume has size lower than 0.354 with respect to the total volume of the powders.
7. A cover according to claims 5 and 6, **characterized by** containing at least 0.3% to 0.9% by weight of carbon, a maximum of 3.0% by weight of copper, a maximum of 2.0% of at least one of the elements nickel, chrome, silicon, molybdenum, by weight, the balance of the chemical composition being iron.
8. A cover according to claims 5 to 7, **characterized**

in that it is sintered at a temperature ranging from 1000°C to 1200°C during a time interval ranging from 10 to 60 minutes.

9. A cover according to claims 5 to 8, **characterized** 5
by being sintered, and the internal surface (3) is provided by at least one recess (4).

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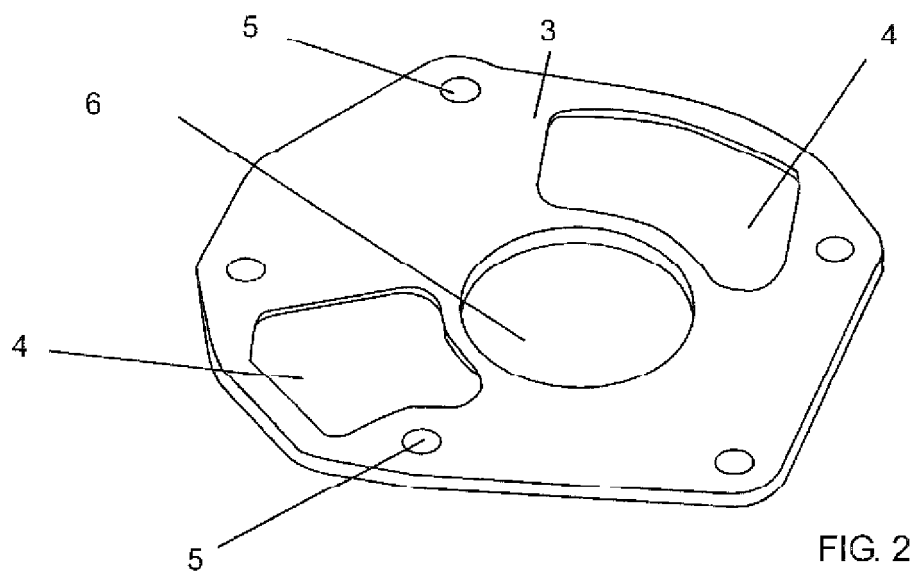
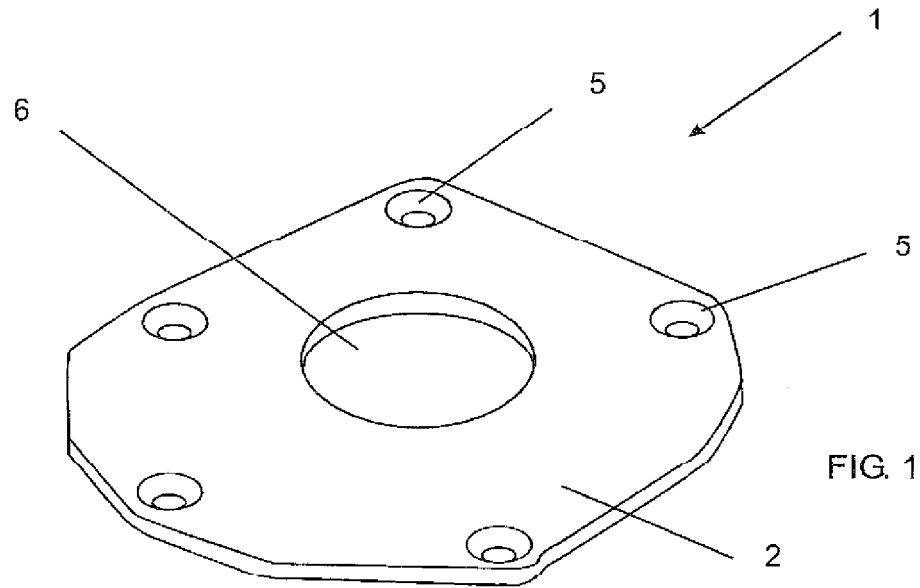
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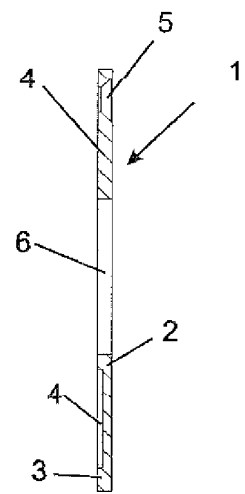
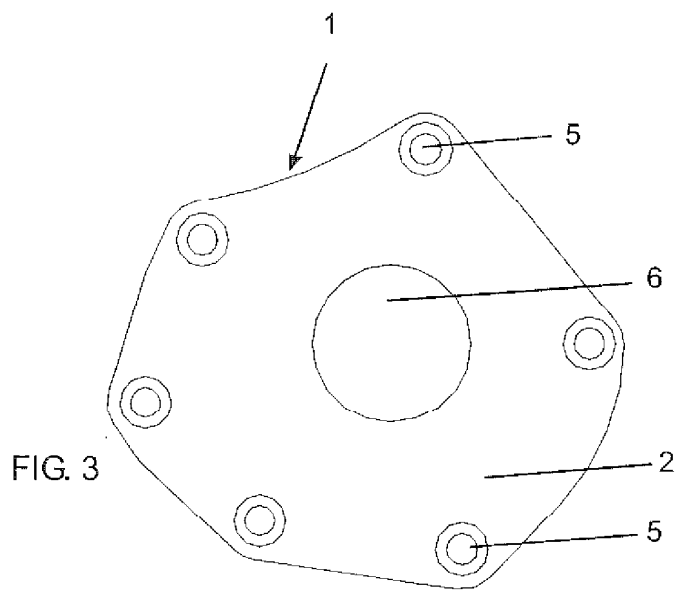


FIG. 4

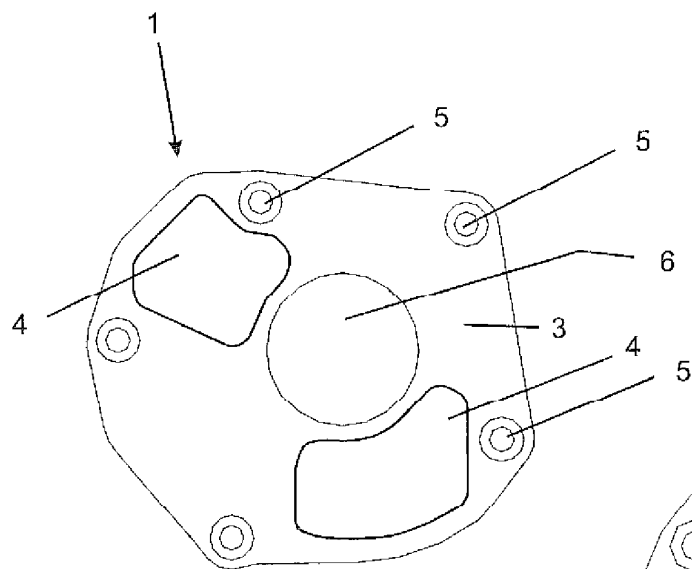


FIG. 5

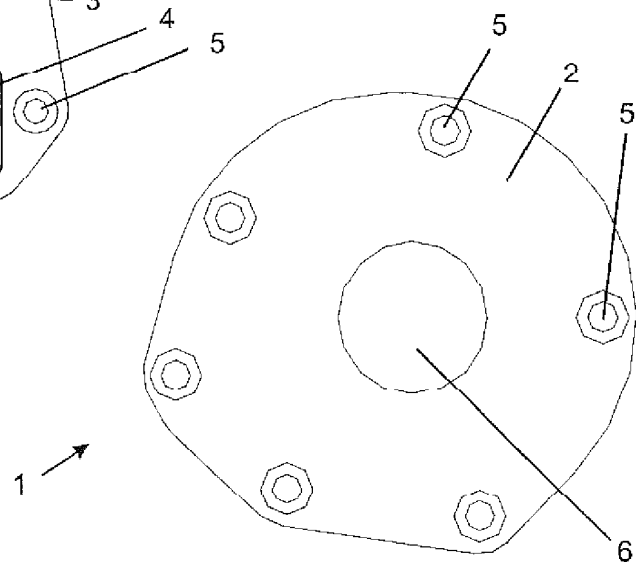


FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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