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"Cellular Solids Structure and Properties", pages 1 to 3, by Gibson and Ashby, Per-

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EP 0 516 356 B1

Description

This invention relates to an improvement of a head gasket for major use between a cylinder block and a cylinder head in an automobile engine.

A known existing head gasket of this type is in the form of a sheet element punched out from a soft steel plate or made by bonding asbestos joint sheets or expanded graphite sheets on opposite surfaces of a steel plate or an embossed aluminum base material.

Since a metal gasket punched out from a soft steel plate is not flexible because of a high modulus of elasticity, it often fails to maintain close contact with the opposed surface of a counterpart member at a portion between the cylinder block and the cylinder (a portion distant from clamping bolts) in which the surface pressure is relatively low when deformation is caused by thermal distortion or thermal vibration, and therefore invites fluid leakage (gas, oil or cooling water).

An asbestos joint sheet can maintain close contact with a counterpart member even at a portion with a low surface pressure. However, because of a number of voids present in the interior of the material itself, it is not sufficiently airtight when the contacting surface pressure is low. In addition, the use of an asbestos joint sheet is limited because of environmental contamination.

A gasket using expanded graphite sheets is expensive. Since a gasket such as a cylinder gasket has a large area, if it is entirely made of graphite, the gasket manufacturing cost is substantially increased. In addition, graphite is liable to be damaged and is therefore difficult to handle.

US-A-4 049 856 discloses a head gasket comprising a metal sheet and a layer which consists of asbestos, rubber and microspheres of fuel ash cenospheres.

It is therefore an object of the invention to provide a head gasket which ensures an excellent seal even in a portion having a low surface pressure, prevents leakage through the material because of a low surface pressure in the interior of the material, and contributes to a reduction in the manufacturing cost.

In order to attain the above object, the invention provides a structure in which a cellular rubber layer defining discrete cells therein is bonded to one or both of the opposite surfaces of a metal plate.

Since the head gasket includes layers of cellular rubber defining discrete cells in the interior and bonded to the metal plate, a large amount of compression is obtained even with a small clamping pressure. Therefore, close contact with a counterpart member is improved, and sufficient sealing effect is ensured at a portion in which the surface

pressure is low because of long intervals among bolts, in particular, in paths for cooling water, oil and so forth. In addition, since cells in the cellular rubber layers are discrete and do not communicate with each other, fluid leakage through the material never occurs in a low surface pressure portion of the gasket.

In the drawings:

Fig. 1 is a cross-sectional view of a head gasket material taken as an embodiment of the invention.

Fig. 2 is a plan view of the head gasket material.

Fig. 3 is a plan view of a finished head gasket.

Fig. 4 is an enlarged cross-sectional view of the part of a cylinder bore grommet in a head gasket forming a further embodiment of the invention.

Fig. 5 is an enlarged cross-sectional view of the part of a cylinder bore in a head gasket forming another embodiment of the invention.

Fig. 6 is an enlarged cross-sectional view of the part of a cylinder bore in a head gasket forming yet another embodiment of the invention.

Fig. 7 is an enlarged cross-sectional view of the part of a cylinder bore grommet in a head gasket forming yet a further embodiment of the invention.

Fig. 8 is an enlarged cross-sectional view of the part of a cylinder bore grommet in a head gasket forming yet another embodiment of the invention.

The drawings show embodiments of the invention. Fig. 1 is a cross-sectional view of a gasket material, Fig. 2 is a plan view of the same, and Fig. 3 is a plan view of a finished head gasket.

In the drawings, letter A denotes a sheet gasket element, 1 designates a metal plate, and 2 indicates a cellular rubber layer including discrete cells therein and bonded to each surface of the metal plate. Although the illustrated embodiment includes two cellular rubber layers 2 on opposite surfaces of the metal plate, the cellular rubber layer 2 may be provided on only one surface of the metal plate.

A stainless steel plate (SUS), a cold-rolled steel plate (SPCC) or an aluminum plate may be used to prepare the metal plate of the head gasket element A. The metal plate, however, is not limited to these materials.

Proposed rubber materials for the cellular rubber layer including discrete cells are nitrile rubber, acrylic rubber and fluororubber. Also other rubber materials may be used as desired.

The preferred thickness of the metal plate is of the order of 0.10 to 3.00 mm for the metal plate, and that of the cellular rubber layer is of the order of 200 to 1000 μ .

Specific Examples

Opposite surfaces of a cold-rolled steel plate, 0.25 mm thick, underwent degreasing treatment using an alkali degreasing agent, surface roughening treatment, and activation treatment using phosphoric acid. Thereafter, primer prepared by using phenolic resin as a basic material and modified by NBR rubber compound was applied to these surfaces. After a drying process, rubber compound liquid including foaming agent, etc. was applied on the primer up to a predetermined thickness. After a drying process, non-adhesive layers were further applied thereon, and vulcanization treatment was executed for 10 to 20 minutes to cause foaming simultaneously with vulcanization. Thus, a sheet gasket element that has discrete-cellular rubber layers, each being 350 μ thick, was obtained.

By punching the sheet gasket element A in the form of a desired cylinder head gasket and by mounting U-shaped grommets 3 of stainless steel to the circumferential edges of cylinder bores, a head gasket was obtained.

Figs. 4 to 8 show various embodiments of grommet attaching processing and bead processing for the cylinder bore of the head gasket.

Fig. 4 shows an embodiment in which the cellular rubber layer 2 is partly removed around the bore, and a grommet 4 is mounted onto the exposed margin of the metal plate 1.

Fig. 5 shows an embodiment in which spring steel is used as a material of the metal plate 1, and a bead 5 is formed by the entire thickness of the structure around the bore.

Fig. 6 shows an embodiment in which the cellular rubber layer 2 is partly removed around the bore, and a bead 6 is formed on the exposed margin of the metal plate 1.

Fig. 7 shows a combination of the arrangements of Figs. 4 and 6.

Fig. 8 shows an embodiment in which a metal ring 7 is incorporated into the arrangement of Fig. 4.

The invention described above gives the following effects:

(a) Since opposite surfaces of the metal plate are covered by cellular rubber layers having a large degree of compression, the gasket closely contacts a counterpart member even in a portion where the surface pressure is low because of long intervals between bolts. Therefore, the sealing surface follows deformation caused by heat and vibration, and reliably prevents leakage of gas, oil and cooling water.

b) Since the cellular rubber layer reliably maintains close contact with a counterpart surface, lateral movement of the counterpart member caused by thermal deformation or vibration is

absorbed in the interior of the cellular rubber layer, and prevents leakage caused by abrasion of the gasket surfaces.

c) Since the cellular rubber layer defines discrete or independent cells, its degree of airtightness is excellent even in a portion having a low surface pressure. Therefore, leakage of gas, oil and cooling water through the material never occurs.

d) Since the gasket is produced in a streamline manufacturing process from formation of the cellular rubber layer to bonding thereof to the metal base element, the manufacturing cost is reduced significantly.

e) Since a reliable seal is ensured even in a portion where surface pressure given by clamping force is not large, it is possible to decrease the weight of the cylinder head and the number of bolts.

f) With an existing head gasket prepared by bonding a millboard and a graphite sheet to opposite surfaces of a metal plate having cut-out claws upstanding therefrom and by attaching grommets to the cylinder bores, both a surface pressure larger than 300 to 1500 kgf/cm² on the grommet and a surface pressure larger than 100 kgf/cm² on the sheet are necessary to seal all of the combustion gas, water and oil.

Recently, however, thinner bolts have been used to decrease the weight of an engine. Therefore, even if the surface pressure on the grommet is large enough for a sufficient gas seal, the surface pressure on the sheet is often small for a sufficient seal of water and oil, and vice versa. This is the reason why high skill is required in designing a head gasket. That is, it depends on a balanced distribution of clamping pressure by using a limited number of bolts.

In an experiment to compare the sealing effect of the above-mentioned existing arrangement and that of the product by the present invention, it was confirmed that surface pressure required to seal gas of 5 kgf/cm² was 100 kgs/cm² in the former and 10 kgf/cm² in the latter. That is, the invention ensures reliable seal of water and oil with a lower surface pressure than with the existing gasket. Therefore, a sufficient surface pressure can be applied to a cylinder bore grommet, and the design of the gasket is much easier.

Claims

1. A head gasket comprising:
 - a metal plate (1); and
 - a cellular rubber layer (2) bonded to at least one of the opposite surfaces of said metal plate and defining discrete cells therein.

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|--|------------------------------|--|
| <p>2. A head gasket as claimed in claim 1 wherein said metal plate is a stainless steel plate, a cold-rolled steel plate or an aluminum plate.</p> <p>3. A head gasket as claimed in claim 1 or claim 2 wherein said rubber layer is made of nitrile rubber, acrylic rubber or fluororubber.</p> <p>4. A head gasket as claimed in any one of the preceding claims wherein said metal plate is 0.1 to 3 mm thick, and said rubber layer is 200 to 1000 μ thick.</p> <p>5. Use of a head gasket as claimed in any one of the preceding claims in an automobile engine.</p> | <p>5</p> <p>10</p> <p>15</p> | <p>3. Joint de culasse selon la revendication 1 ou la revendication 2, dans lequel ladite couche de caoutchouc est formée de caoutchouc nitrile, de caoutchouc acrylique ou de caoutchouc fluoré.</p> <p>4. Joint de culasse selon l'une quelconque des revendications précédentes, dans lequel ladite plaque métallique a une épaisseur de 0,1 à 3 mm, et ladite couche de caoutchouc a une épaisseur de 200 à 1000 μm.</p> <p>5. Utilisation d'un joint de culasse selon l'une quelconque des revendications précédentes dans un moteur d'automobile.</p> |
|--|------------------------------|--|

Patentansprüche

- | | |
|---|---|
| <p>1. Kopfdichtung, umfassend: eine Metallplatte (1) und eine Schicht (2) aus zelligem Gummi, die mit wenigstens einer der beiden gegenüberliegenden Oberflächen der Metallplatte verbunden ist und in der diskrete Zellen gebildet sind.</p> <p>2. Kopfdichtung nach Anspruch 1, wobei die Metallplatte eine Platte aus nichtrostendem Stahl, eine kaltgewalzte Stahlplatte oder eine Aluminiumplatte ist.</p> <p>3. Kopfdichtung nach Anspruch 1 oder 2, wobei die Gummischicht aus Nitrilkautschuk, Acrylkautschuk oder Fluorkautschuk hergestellt ist.</p> <p>4. Kopfdichtung nach einem der vorangehenden Ansprüche, wobei die Metallplatte 0,1 bis 3 mm dick ist und die Gummischicht 200 bis 1000 μ dick ist.</p> <p>5. Verwendung einer Kopfdichtung nach einem der vorangehenden Ansprüche in einem Automotormotor.</p> | <p>20</p> <p>25</p> <p>30</p> <p>35</p> <p>40</p> |
|---|---|

Revendications

- | | |
|---|-------------------------------|
| <p>1. Joint de culasse comportant :
 une plaque métallique (1) ; et
 une couche (2) de caoutchouc cellulaire liée à au moins l'une des surfaces opposées de ladite plaque métallique et à l'intérieur de laquelle sont définies des cellules physiquement distinctes.</p> <p>2. Joint de culasse selon la revendication 1, dans lequel ladite plaque métallique est une plaque d'acier inoxydable, une plaque d'acier laminé à froid ou une plaque d'aluminium.</p> | <p>45</p> <p>50</p> <p>55</p> |
|---|-------------------------------|

FIG.1



FIG.2

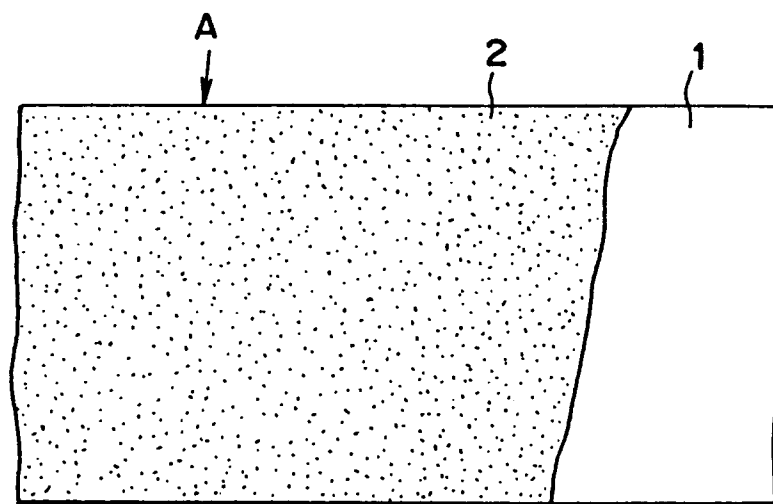


FIG.3

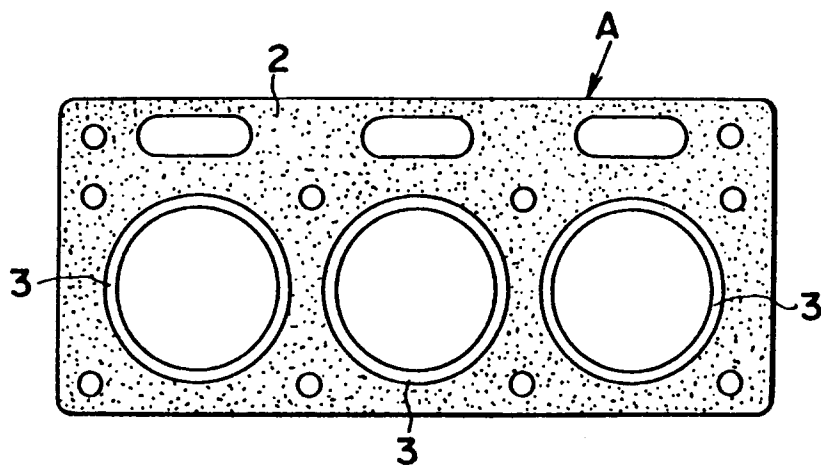


FIG. 4

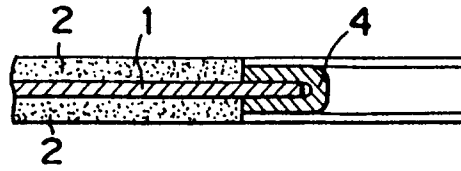


FIG. 5

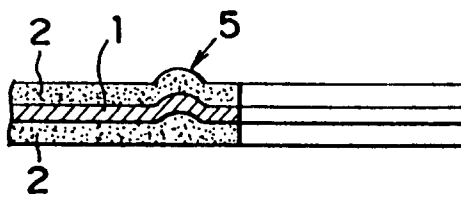


FIG. 6

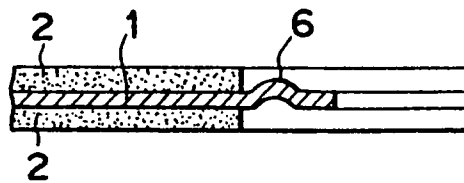


FIG. 7

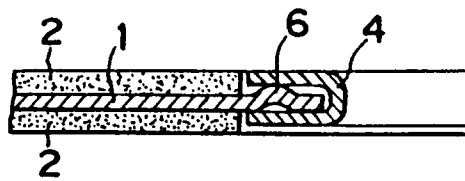


FIG. 8

