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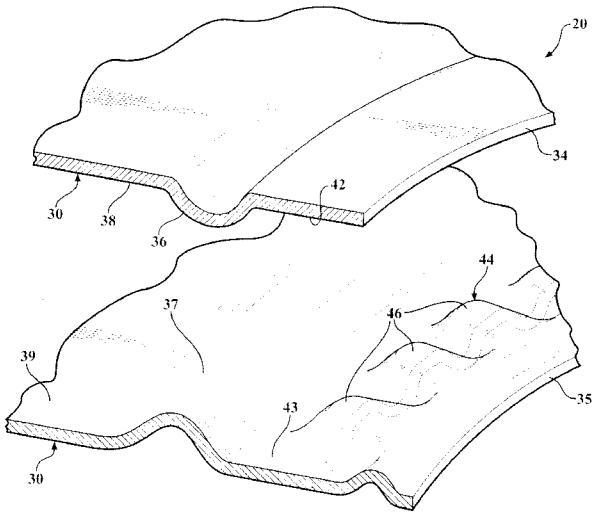
(54) Title: GASKET WITH A COMPRESSION LIMITER

FIG. 4



(57) Abstract: A multi-layer gasket including first and second functional layers, each having an opening. Each of the functional layers includes a compression bead, and the compression beads contact and seal against one another when the gasket is compressed between a cylinder head and an engine block. At least one of the functional layers includes a stopper disposed between the compression bead and the opening. The stopper has a gear-like shape including a plurality of circumferentially spaced teeth. Each tooth extends upwardly from a plane by a distance which is less than the combined height of the compression beads. When the gasket is compressed between the cylinder head and engine block, the stopper ensures that the compression beads remain elastically biased against one another and maintain a gas-tight seal.

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GASKET WITH A COMPRESSION LIMITER

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to static gaskets of the type used to establish a gas-tight seal between two members to be clamped together, and more particularly to multi-layer gaskets such as cylinder head gaskets.

2. Related Art

[0002] In establishing a gas-tight seal between two members to be clamped together, such as a cylinder head and an engine block, it is common to use a static cylinder head gasket having multiple layers. Generally, at least one of the layers of the multi-layer gasket, sometimes referred to as a functional layer, has a compression bead to establish the fluid tight seal. Another of the layers, sometimes referred to as a distance layer, is configured to abut the functional layer in an effort to establish the gas-tight seal by compressing the compression bead of the functional layer. Unfortunately, while fastening the cylinder head to the engine block, the compression bead can be over-compressed and substantially flattened. If the compression bead is over-compressed, in addition to losing its ability to maintain a gas-tight seal, fatigue cracks can form in the area of the compression bead during the initial clamping or while in use. If formed, fatigue cracks ultimately reduce the ability of the static gasket to maintain a gas-tight seal, thereby diminishing the life and performance of the engine.

[0003] Some gasket manufacturers have begun producing multi-layer gaskets including compression limiters for preventing flattening of the compression bead when the gasket is compressed between the cylinder head and the engine block. These compression

limiters are typically additional components and may either be costly to produce or may fully prevent flattening of the compression bead.

SUMMARY OF THE INVENTION

[0004] According to one aspect of the invention, a multi-layer gasket for establishing a fluid-tight seal between a first member and a second member is provided which includes a compression limiter in the form of a stopper for preventing full flattening of a compression bead when the gasket is compressed between the first member, e.g. an engine block, and the second member, e.g. a cylinder head. The gasket has one or more layers, and the stopper has a gear-like shape and is integrally formed with one of the layers through an embossing process. Each tooth of the gear-shaped stopper extends upwardly from a plane by a distance which is less than the height of the compression bead if the gasket has a single layer or the combined heights of the compression beads if the gasket has multiple layers. Accordingly, both of the compression beads extend upwardly from the plane and remain elastically biased against one another, even if the cylinder head is over-loaded onto the engine block. As such, the compression beads are assured of maintaining a generally constant, high sealing pressure against one another, thereby providing and maintaining the gas-tight seal about the circumference of the cylinder bore. In addition to maintaining the desired gas-tight seal about the cylinder bore, the compression beads, by not being over-compressed and completely flattened, remain free from the formation of premature fatigue cracks both during assembly and while in use. Thus, for very little additional cost, the gasket is protected from full flattening of the compression bead, even if the cylinder head is over-loaded onto the engine block.

[0005] According to another aspect of the invention, the heights, radial lengths, widths, circumferential spacing and/or the directions of the teeth are varied around

the opening. By varying any combination of these parameters, a non-uniform pressure distribution between the compression beads around the opening can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and other features and advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0007] Figure 1 is an exploded view of a known gasket positioned between a cylinder head and a gasket;

[0008] Figure 2 is a perspective fragmentary view of a known multi-layer gasket;

[0009] Figure 3 is an exploded and fragmentary view of an exemplary multi-layer gasket disposed adjacent an engine block;

[0010] Figure 4 is an exploded and fragmentary view of a first embodiment of the gasket;

[0011] Figure 5 is an exploded and fragmentary view of a second embodiment of the gasket;

[0012] Figure 6 is a top and fragmentary view of a second functional layer of a third embodiment of the gasket;

[0013] Figure 7 is a top and fragmentary view of the second functional layer of a fourth embodiment of the gasket;

[0014] Figure 8 is a top and fragmentary view of the second functional layer of a fifth embodiment of the gasket;

[0015] Figure 9 is a top and fragmentary view of the second functional layer of a sixth embodiment of the gasket;

[0016] Figure 10 is a cross-sectional view of a seventh embodiment of the gasket; and

[0017] Figure 11 is a cross-sectional view of an eighth embodiment of the gasket.

DETAILED DESCRIPTION OF THE ENABLING EMBODIMENTS

[0018] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a gasket **20** configured for establishing a seal between a cylinder head (not shown) and an engine block **22** is generally indicated in Figure 3. The exemplary gasket **20** includes a plurality of large, generally circular openings **24** which correspond with a plurality of cylinder bores **26** in the engine block **22**. The gasket **20** also includes a plurality of holes **28** for allowing bolts or fasteners to extend through the gasket or for allowing coolant to flow between the engine block **22** and the cylinder head, as will be understood by those of ordinary skill in the art. Although the exemplary gasket **20** is a cylinder head gasket for use in an internal combustion engine, it should be appreciated that the gasket **20** could be used to seal any desirable members, not just a cylinder head and an engine block **22**. Additionally, although each of the embodiments shown in the drawings and discussed below have two layers, it should be appreciated that the gasket could include any desirable number of layers including one layer.

[0019] A first embodiment of the gasket **20** is illustrated in Figure 4. The gasket **20** includes a first functional layer **30** and a second functional layer **32** overlying one another and secured to one another at their outermost peripheries through, for example, welding, brazing or rivets. Each of the functional layers **30, 32** also has an inner periphery

34, 35 defining one of the openings **24** discussed above, as will be understood by those of ordinary skill in the art.

[0020] Each of the functional layers **30, 32** also includes a compression bead **36, 37**, a main body portion **40, 41** and an inner periphery portion **42, 43**. The compression beads **36, 37** are spaced radially from and circumferentially surround the inner peripheries **34, 35**. Each of the main body portions **40, 41** extends along a plane **38, 39**, and the compression beads **36, 37** extend upwardly from the plane **38, 39**. The inner periphery portions **42, 43** extend between the inner peripheries **34, 35** and the compression beads **36, 37** and are generally planar with the main body portions **40, 41**. The functional layers **30, 32** are preferably constructed from a resilient material such as spring steel and can have any desirable thickness. The compression beads **36, 37** are preferably formed on the functional layers **36, 37** through an embossing process, as will be understood by those of skill in the art. As shown in Figure 4, the functional layers **30, 32** are arranged such that the aforementioned compression beads **36, 37** face one another. Thus, when the gasket **20** is compressed between the engine block **22** and the cylinder head, the compression beads **36, 37** engage one another to facilitate a gas-tight seal about the cylinder bore **24**, thereby preventing combustion fluids or gasses from escaping the cylinder bore **24** between the cylinder head and the engine block **22**.

[0021] In contrast to the first functional layer **30**, the second functional layer **32** also includes a stopper **44** located on the inner periphery portion **43** between the compression bead **37** and the inner periphery **35** for preventing the compression beads **36, 37** from being completely flattened between the cylinder head and engine block **22**, as will be discussed in further detail below. The stopper **44** circumferentially surrounds the opening **24** and has a generally gear-like shape and including a plurality of circumferentially spaced teeth **46** extending out of the plane **39** by a distance which is less than the combined heights of the

compression beads **36, 37**. Therefore, the compression beads **36, 37** are allowed to contact and seal against one another when the gasket **20** is compressed between the cylinder head and the engine block **22**.

[0022] The stopper **44** is an integral feature of the second functional layer **32** and is preferably formed through an embossing process, similar to the compression bead **36**. The shape and curvature of the teeth **46** provide them with great resistance to flattening, and therefore, when the gasket **20** is compressed between the cylinder head and the engine block **22**, the teeth **46** contact the inner periphery portion **42** of the first functional layer **30** and hold the two inner periphery portions **42** apart. Thus, neither of the compression beads **36, 37** can be completely flattened against the other. Accordingly, both of the compression beads **36, 37** extend upwardly from the plane **38** and remain elastically biased against one another, even if the cylinder head is over-loaded onto the engine block **22**. As such, the compression beads **36, 37** are assured of maintaining a generally constant, high sealing pressure against one another, thereby providing and maintaining the gas-tight seal about the circumference of the cylinder bore **26**. In addition to maintaining the desired gas-tight seal about the cylinder bore **26**, the compression beads **36, 37**, by not being over-compressed and completely flattened, remain free from the formation of premature fatigue cracks both during assembly and while in use. Moreover, the stopper **44** itself provides an extra layer of sealing, which further improves the gasket's **20** sealing ability, and also functions as a fire dam to limit the exposure of the compression beads **36, 37** to the combustion fires in the cylinder bore. All of these additional advantages are achieved at a minimal cost because no additional components are required and the stopper **44** can be cheaply and quickly added to the gasket **20** through the embossment process.

[0023] In the exemplary gasket **20** of Figure 4, the teeth **46** have a generally uniform circumferential spacing from one another and all rise above the plane **39** by a similar

height. Additionally, all of the teeth **46** extend radially toward the compression bead **37** by a similar distance. Such a stopper **44** might be preferred if a generally uniform sealing pressure is desired around the circumference of the cylinder bore **26**. However, as will be discussed in further detail below, if desired, each of these parameters could be varied to provide the gasket **20** with a non-uniform sealing pressure around the cylinder bore **26**. For example, it might be desirable to have a wider spacing between teeth **46** in areas where less sealing pressure is required and to have a smaller spacing between teeth **46** in areas where a greater sealing pressure is required.

[0024] Referring now to Figure 5, a gasket **120** constructed according to another embodiment is illustrated. Similar to the gasket **20** described above, this gasket **120** includes first and second functional layers **130, 132**, each having a compression bead **136, 137**. The second functional layer **132** also has a stopper **144** comprising a plurality of teeth **146** disposed in the inner periphery portion **143**. As shown in phantom lines, some of the other teeth **146** rise to different heights above the plane **139** than the tooth **146** through which the cross-section was taken. Teeth **146** having different heights will impact uniformity of the pressure exerted between the compression beads **136** around the opening **124**. Specifically, more pressure will be exerted between the compression beads **136, 137** if the teeth **146** are shorter, whereas less pressure will be exerted between the compression beads **136, 147** if the teeth **146** are larger.

[0025] Referring now to Figure 6, the second functional layer **232** of a gasket **220** constructed according to yet another embodiment is shown. Similar to the gaskets **20, 120** described above, the compression beads **237** extend circumferentially around each of the openings **224**, and the stoppers **244** are disposed on the inner periphery portions **242** between the inner peripheries **243** and the compression beads **237**. In this embodiment, the teeth **246**

of the stopper **244** have varying circumferential spacing, varying widths and they extend radially by different distances toward the compression beads **237**.

[0026] The second functional layer **332** of a gasket **320** constructed according to another embodiment is shown in Figure 7. In this gasket **320**, the teeth **346** of the stopper **344** are generally uniformly circumferentially spaced from one another but extend radially toward the compression beads **337** by different distances from one another. As discussed above, this could have an impact on the uniformity of the sealing pressure between the compression beads **337**.

[0027] The second functional layer **432** of a gasket **420** constructed according to yet another embodiment is generally shown in Figure 8. In contrast to the stoppers **44, 144, 244, 344** described above, the teeth **446** of this stopper **444** extend inwardly toward the opening **424** rather than toward the compression bead **437**. This is yet another example of how the stopper **444** can be modified while retaining its ability to prevent flattening of the compression beads **437**.

[0028] The second functional layer **532** of a gasket **520** constructed according to yet another embodiment is illustrated in Figure 9. This gasket **520** is distinguished from the gaskets **20, 120, 220, 320, 420** described above because the teeth **546** of the stopper **544** alternate between extending toward the opening **524** and extending toward the compression bead **537**. It should be appreciated that the teeth **546** could take any desirable pattern in order to create a gasket **520** with specific sealing characteristics. For example, it might be desirable to have two teeth **546** to extend toward the compression bead **537** for every tooth **546** extending toward the opening **524**.

[0029] Referring now to Figure 10, a gasket **620** constructed according to a further embodiment is illustrated in cross-section. This embodiment is distinguished from the gaskets **20, 120, 220, 320, 420, 520** described above because both the first and second

functional layers **630, 632** have a stopper **644, 645** disposed on their respective inner periphery portions **642, 643**. Such a gasket **620** could be advantageous because the functional layers **630, 632** have mirror profiles of one another. In this embodiment, the teeth **646, 647** have a combined height which is less than the combined height of the compression beads **636, 637** to allow the compression beads **636, 637** to contact and seal against one another when the gasket **620** is compressed between the cylinder head and the engine block.

[0030] Referring now to Figure 11, still another embodiment of the gasket **720** is illustrated. In this embodiment, the gear teeth **746, 747** of the functional layers **730, 732** are interleaved with one another, i.e. the gear teeth of the first functional layer **730** extend radially inwardly toward the opening **724**, and the gear teeth **747** of the second functional layer **732** extend radially outwardly toward the compression bead **736**. Because the teeth **746, 747** are interleaved with one another, each should have a height which is less than the combined height of the compression beads **736, 737**. Interleaving the teeth **746, 747** could have the effect of strengthening the stopper **744** and/or improving its ability to block combustion gasses from ever reaching the compression beads **736, 737**.

[0031] It should be appreciated that the gasket could take many forms other than those shown herein. For example, rather than having the compression beads facing toward one another, they could face in the same direction and sealed to one another in a nesting relationship. Additionally, the gasket could include any number of functional layers, and could also include one or more distance layers (not shown), if desired.

[0032] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A multi-layer gasket for establishing a fluid-tight seal between a first member and second member, comprising:

at least a first functional layer having at least one opening and at least one compression bead projecting out of a plane of said at least first functional layer by a predetermined distance and extending circumferentially about and spaced from said at least one opening;

at least a second layer overlying said at least said first functional layer and having at least one opening aligned with said at least one opening of said at least said first functional layer; and

wherein at least one of said at least first and second layers including a stopper surrounding said aligned openings having a plurality of circumferentially spaced teeth extending out of said plane by a distance less than said predetermined distance of said compression bead for limiting compression of said compression bead.

2. The multi-layer gasket as set forth in claim 1 wherein said teeth of said fire wall extend radially inwardly toward said aligned openings.

3. The multi-layer gasket as set forth in claim 1 wherein said teeth of said fire wall extend radially outwardly toward said compression bead.

4. The multi-layer gasket as set forth in claim 1 wherein a plurality of said teeth extend radially inwardly toward said aligned openings and wherein a plurality of said teeth extend radially outwardly toward said compression bead.

5. The multi-layer gasket as set forth in claim 1 wherein said teeth extend radially by variable distances from one another.

6. The multi-layer gasket as set forth in claim 1 wherein said teeth are spaced circumferentially from one another by variable distances.

7. The multi-layer gasket as set forth in claim 1 wherein said teeth have variable widths.

8. The multi-layer gasket as set forth in claim 1 wherein both of said layers include a fire wall circumferentially surrounding said opening and including a plurality of circumferentially spaced teeth extending out of said plane by a distance less than said predetermined distance of said compression bead for preventing said compression bead from being completely flattened between said first and second members.

9. The multi-layer gasket as set forth in claim 1 wherein said circumferentially spaced teeth are integrally connected to one another.

10. The multi-layer gasket as set forth in claim 1 wherein said compression bead is embossed onto said first functional layer.

11. The multi-layer gasket as set forth in claim 10 wherein said stopper is embossed onto said first functional layer.

12. The multi-layer gasket as set forth in claim 1 wherein both of said layers include a compression bead circumferentially surrounding said aligned openings.

13. The multi-layer gasket as set forth in claim 12 wherein each of said layers includes a stopper including a plurality of teeth

14. The multi-layer gasket as set forth in claim 13 wherein the combined height of said teeth of said first and second layers is less than the combined height of said compression beads of said first and second layers.

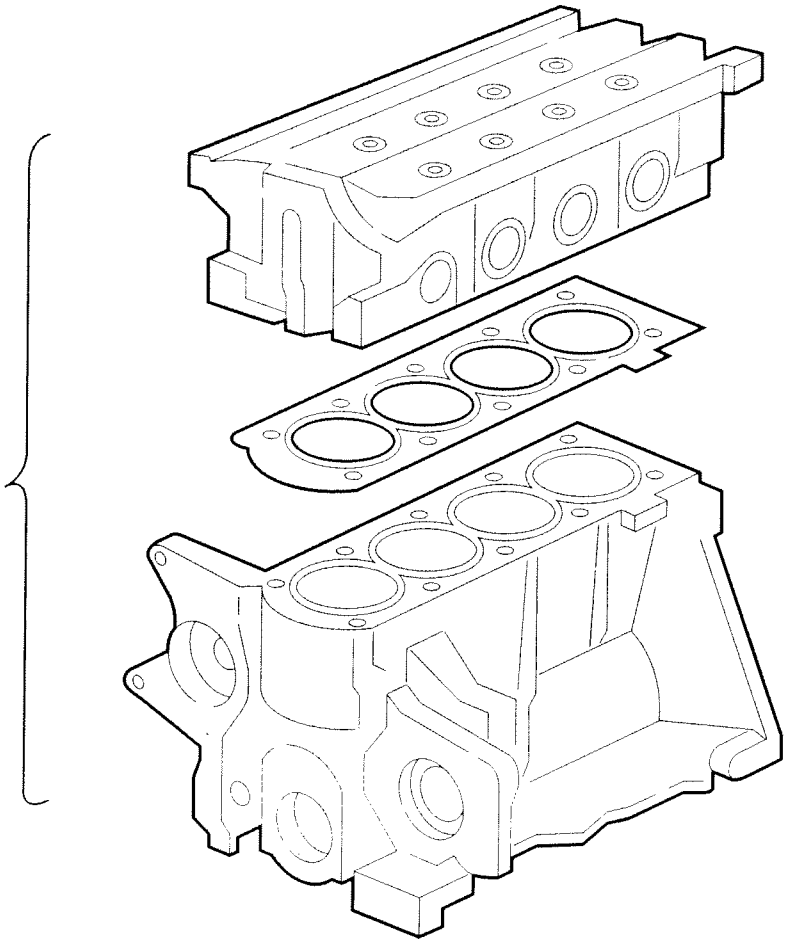


FIG. 1
PRIOR ART

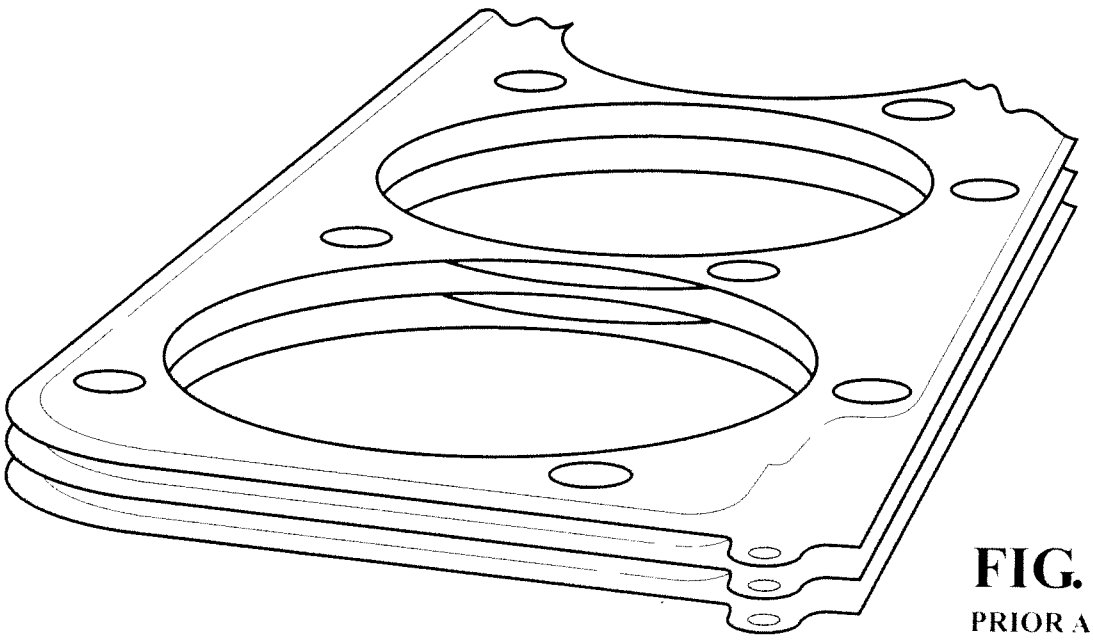


FIG. 2
PRIOR ART

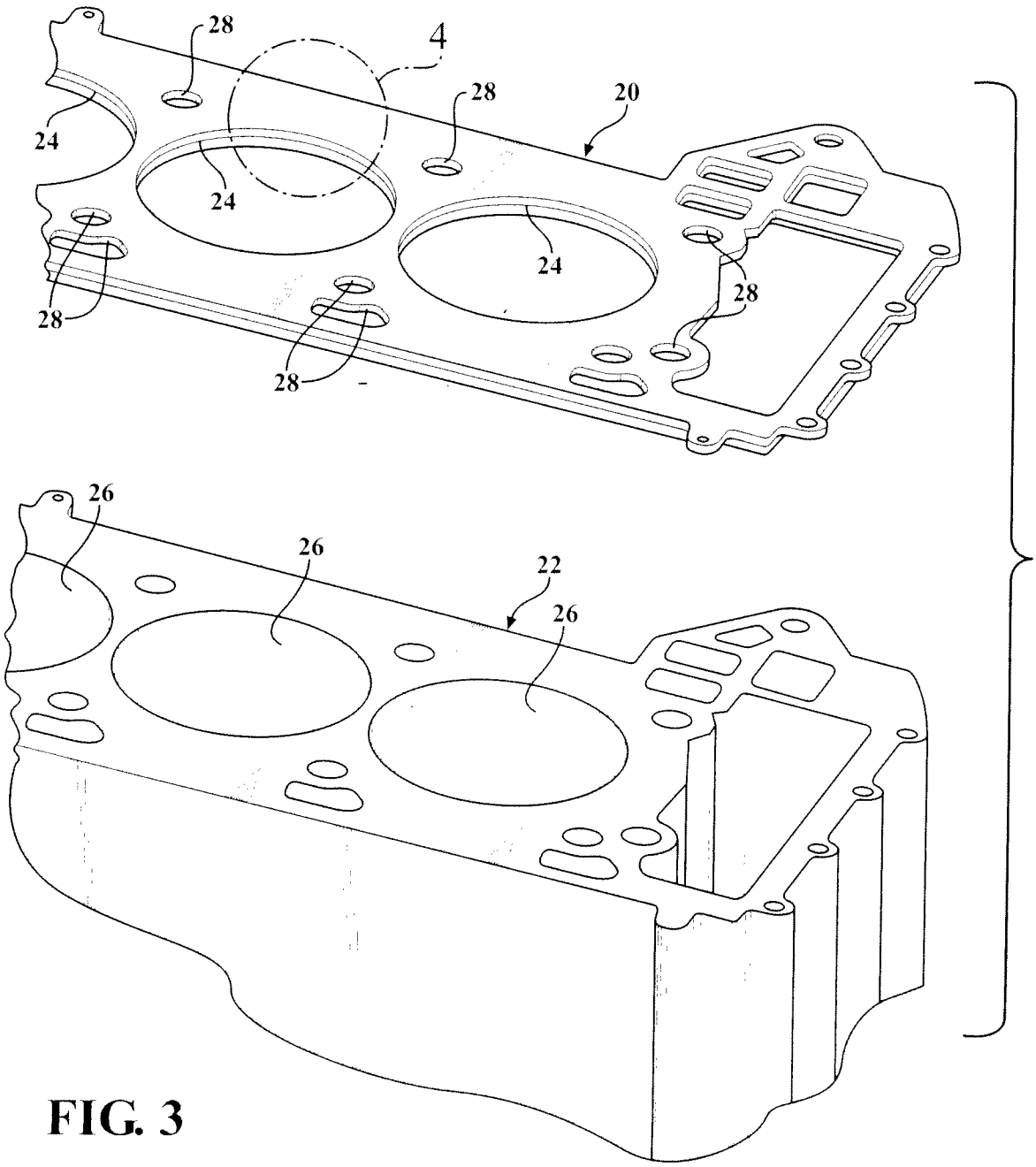


FIG. 3

FIG. 4

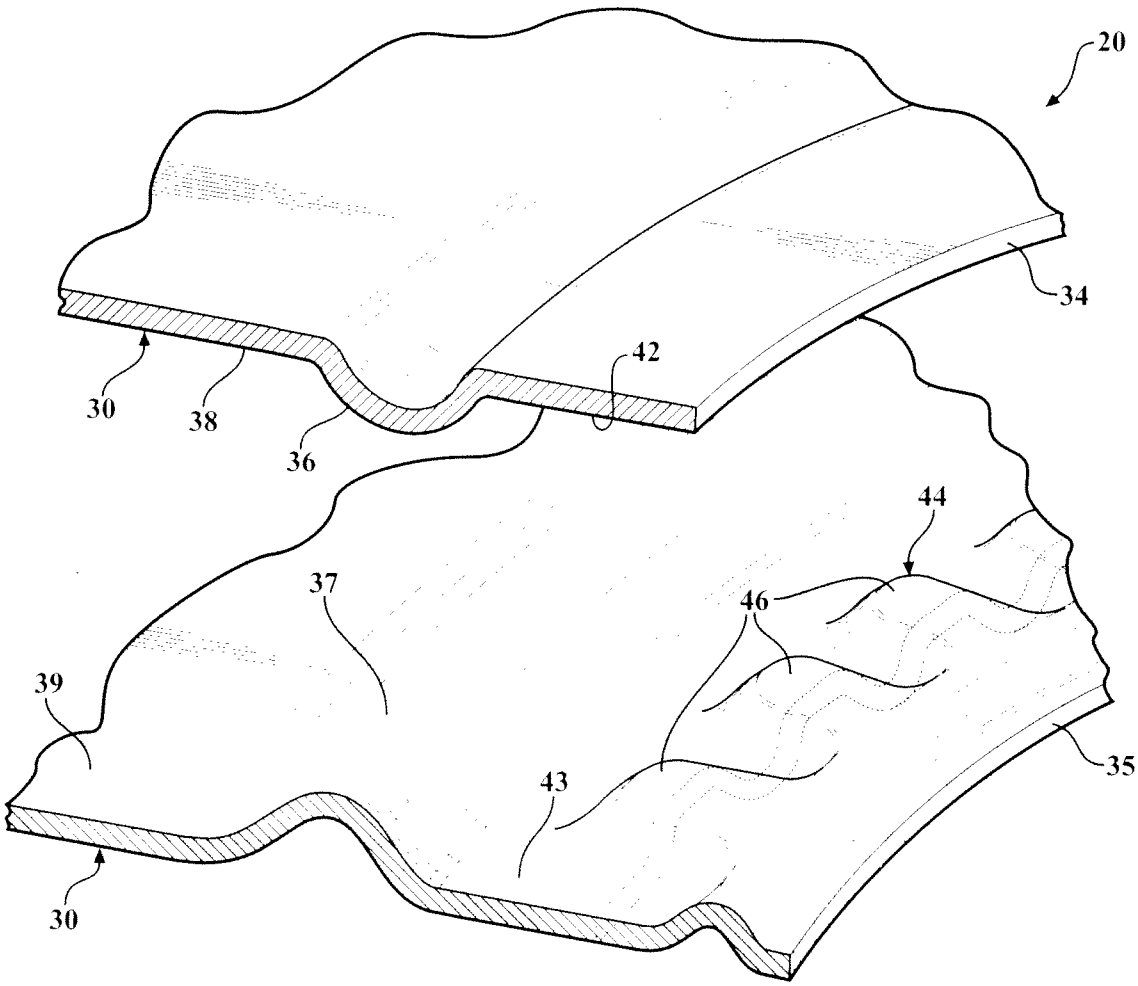
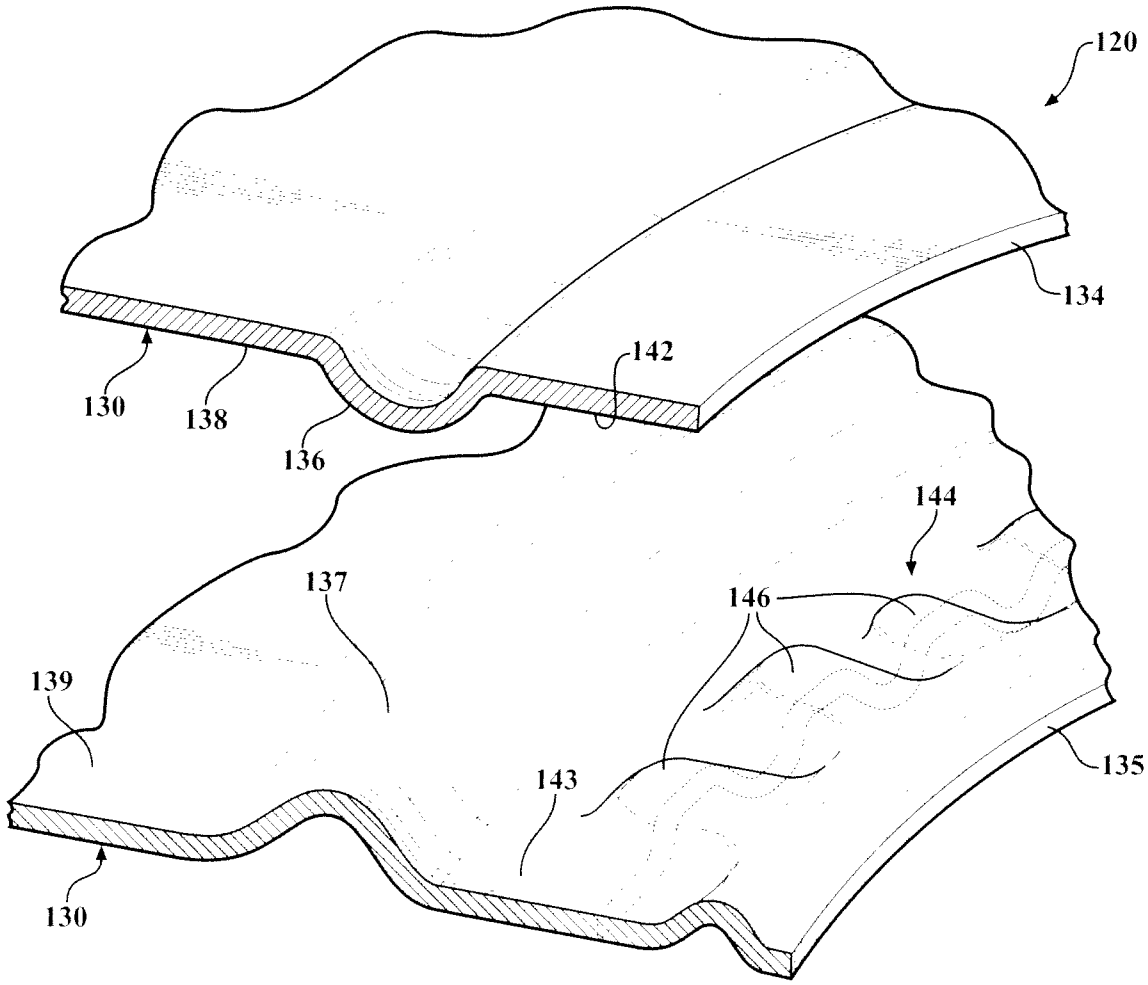


FIG. 5



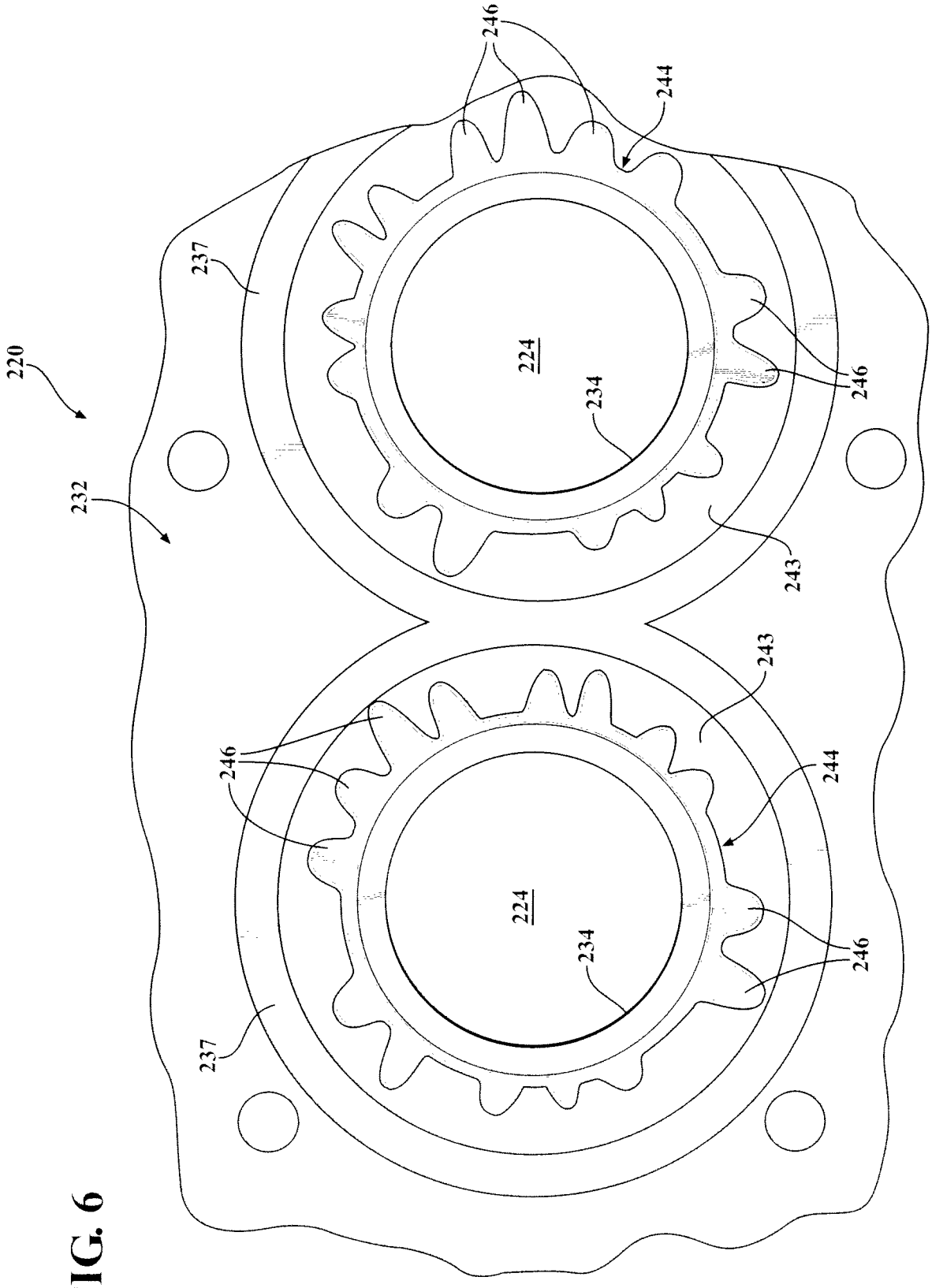


FIG. 6

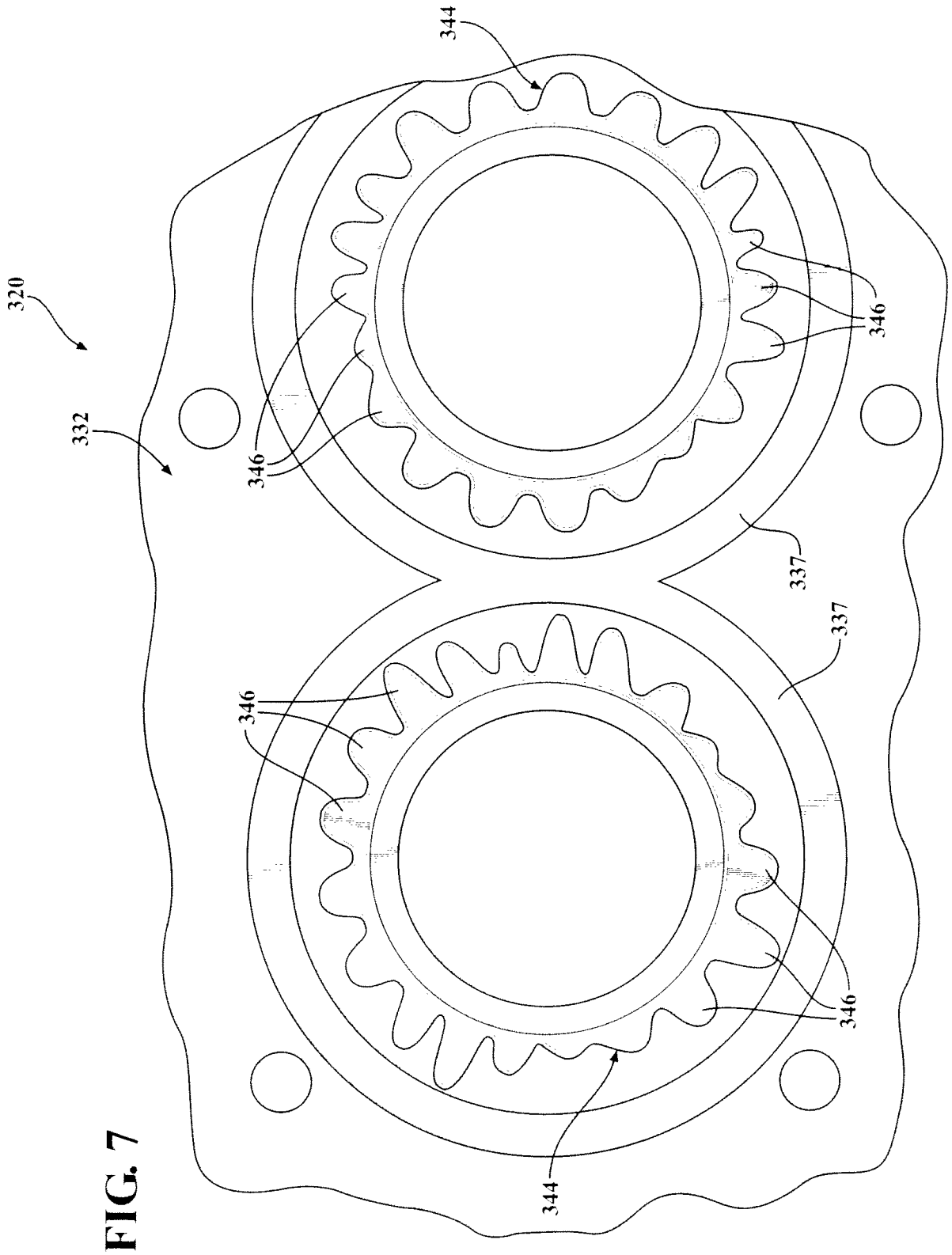


FIG. 7

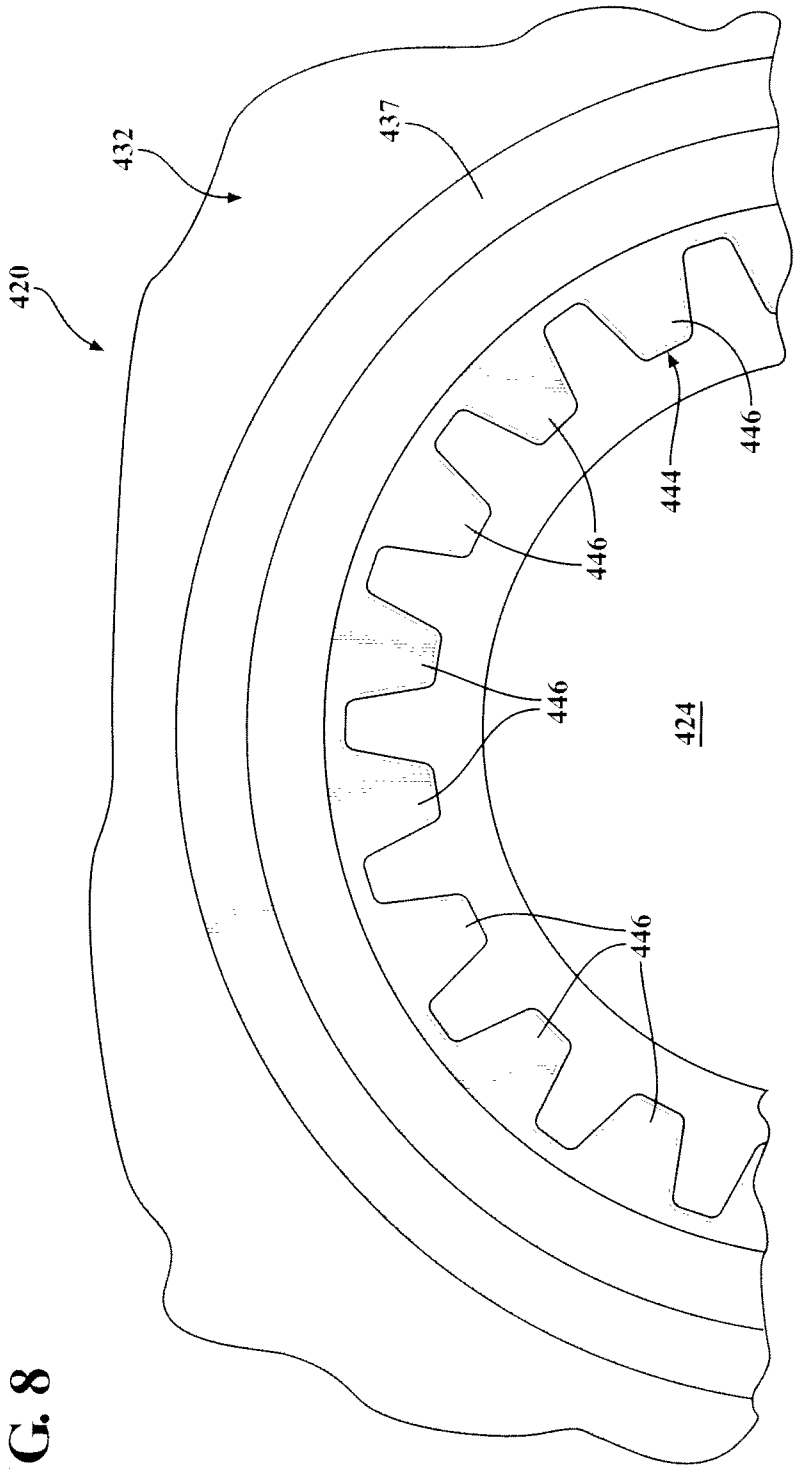


FIG. 8

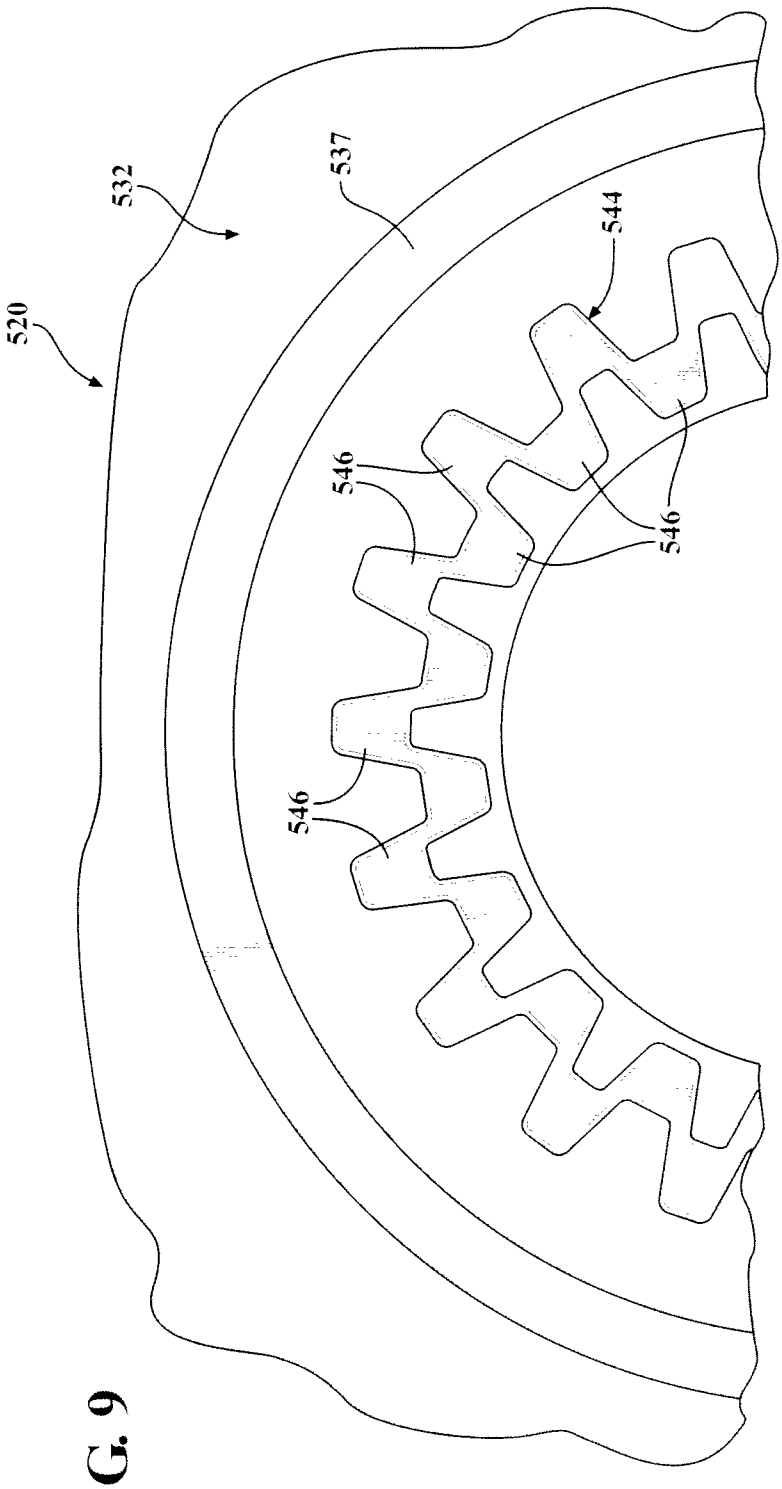

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FIG. 9

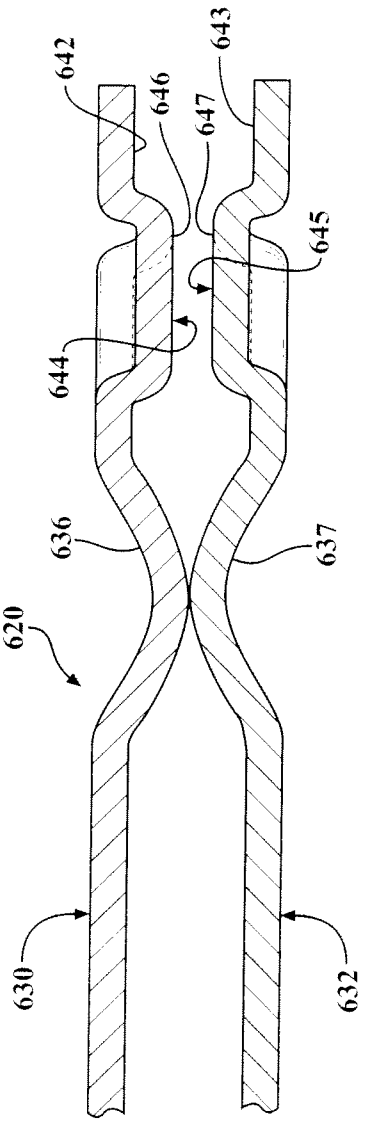
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FIG. 10

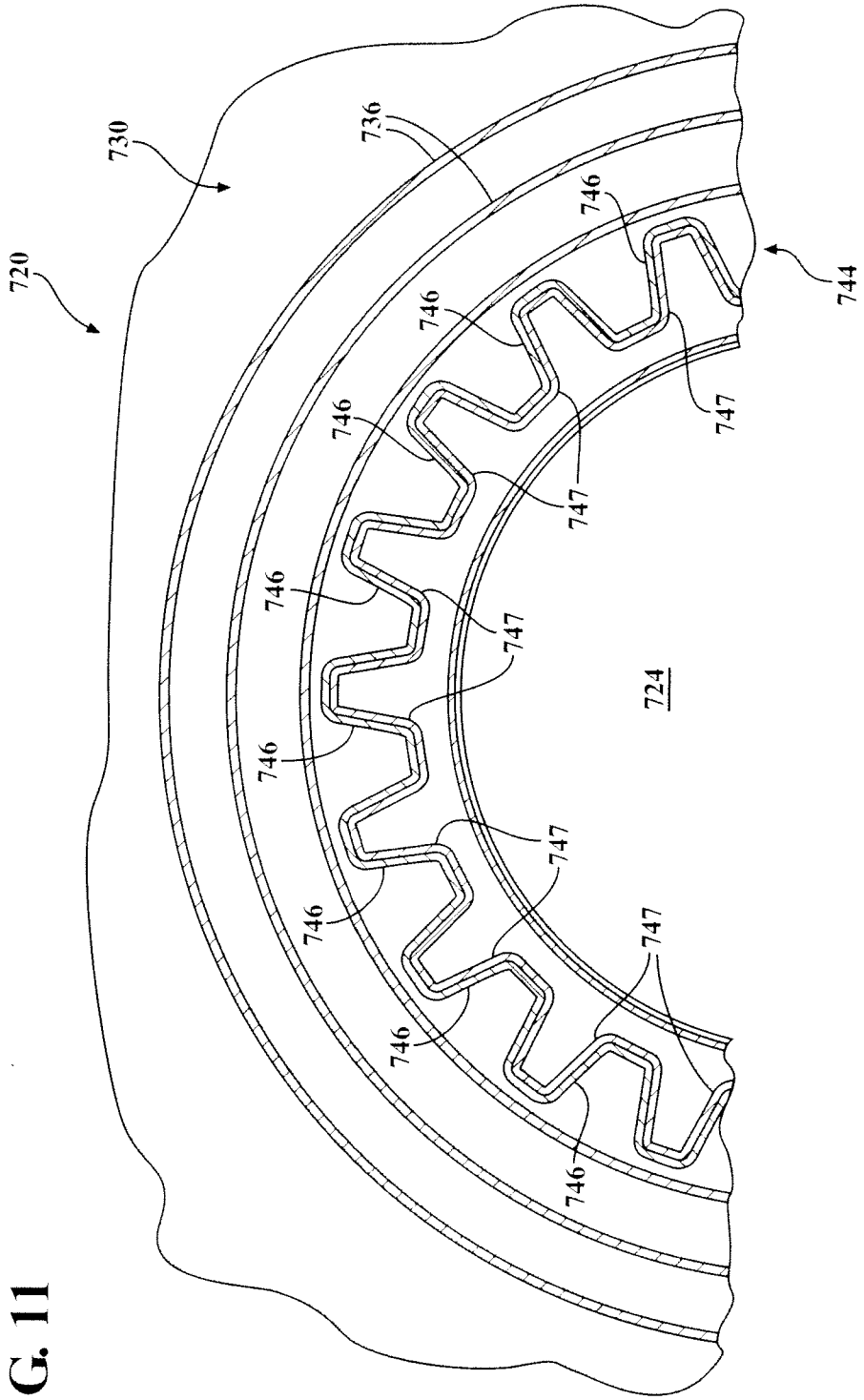

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/063811

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16J15/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 298 364 A2 (ELRINGKLINGER AG [DE]) 2 April 2003 (2003-04-02) abstract; figures	1-14
X	EP 1 635 093 A1 (ELRINGKLINGER AG [DE]) 15 March 2006 (2006-03-15) abstract; figures	1-14
X	WO 2008/004723 A1 (DONGAH MFG CORP [KR]; KOO KYO-NAM) 10 January 2008 (2008-01-10) abstract; figures	1-14
A	EP 1 852 638 A1 (FREUDENBERG CARL KG [DE]) 7 November 2007 (2007-11-07) abstract; figures	1-14

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 February 2013	14/02/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Narminio, Adriano

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/063811

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010/149774 A1 (FEDERAL MOGUL SEALING SYS SPA [DE]; SCHMITT KLAUS [DE]; SCHNEIDER BURK) 29 December 2010 (2010-12-29) abstract; figures	1-14

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/063811

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1298364 A2	02-04-2003	NONE	
EP 1635093 A1	15-03-2006	AT 413548 T	15-11-2008
		DE 102004044851 A1	16-03-2006
		EP 1635093 A1	15-03-2006
		US 2006055121 A1	16-03-2006
		US 2009224486 A1	10-09-2009
WO 2008004723 A1	10-01-2008	NONE	
EP 1852638 A1	07-11-2007	AT 426117 T	15-04-2009
		EP 1852638 A1	07-11-2007
		FR 2900715 A1	09-11-2007
WO 2010149774 A1	29-12-2010	CN 102388244 A	21-03-2012
		DE 102009030559 A1	10-03-2011
		EP 2446175 A1	02-05-2012
		JP 2012530888 A	06-12-2012
		KR 20120094891 A	27-08-2012
		US 2012098210 A1	26-04-2012
		WO 2010149774 A1	29-12-2010