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(71) Applicant(s)
T & N Technology Limited

(Incorporated in the United Kingdom)

Cawston House, Cawston Lane, RUGBY, Warwickshire, CV22 7SA, United Kingdom

(72) Inventor(s)
Alan William Atkinson
Melanie Jane Walsh

(74) Agent and/or Address for Service
P L Drury et al
T & N Plc, Group Patent Department, Bowdon House, Ashburton Road West, Trafford Park, MANCHESTER, M17 1RA, United Kingdom

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(56) Documents Cited
EP 0449268 A2 **EP 0428458 A1** **EP 0387652 A1**
EP 0263402 A1

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(54) Gasket

(57) A gasket (10;) comprises a resiliently-compressible layer (16;) of expanded graphite, vermiculite or mica and a sheet (18; 22;) of flexible metal foil secured to the layer by adhesive. The sheet forms a surface (12, 14) arranged to make sealing contact with a member against which the gasket seals. Each foil may have a coating (19, 26) of seal-enhancing material such as graphite-filled nitrile rubber. The adhesive used to join the compressible layer and the metal foil may be a phenolic resin. The metal foil may be made of nickel, stainless steel, aluminium or other suitable metals. There may be a rigid member at the centre of the gasket to give strength thereto and make it easier to install and remove. The layer of expanded graphite, vermiculite or mica is up to 1.5 mm thick whilst the metal foil is up to 20 microns thick.

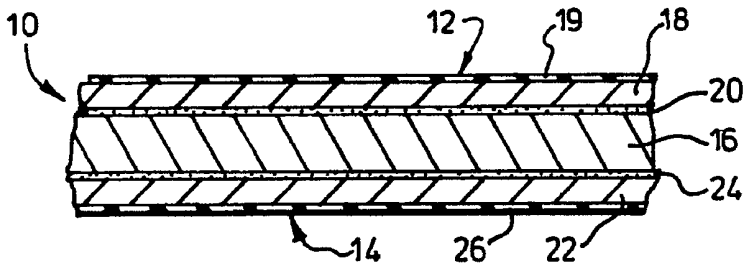

FIG. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

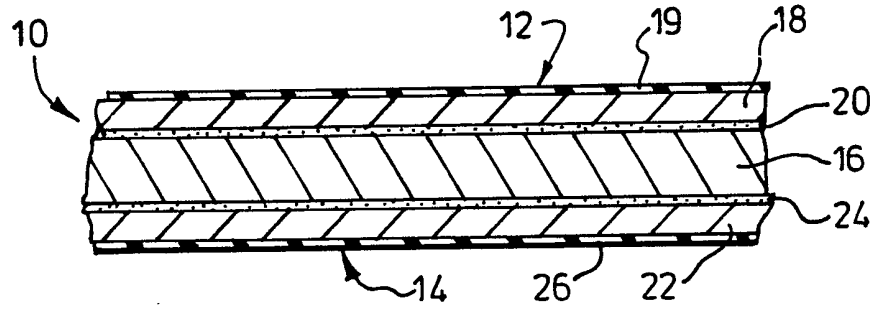

FIG. 1

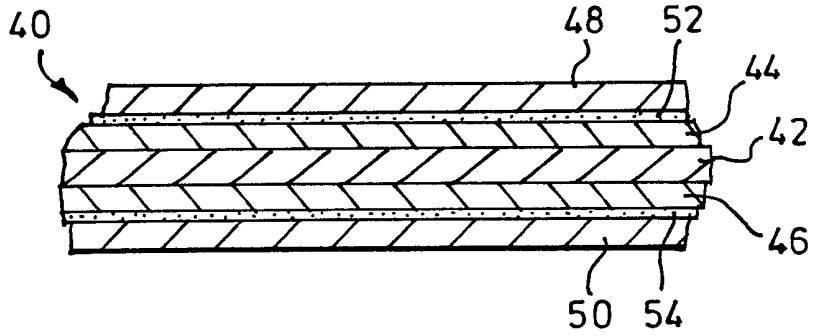

FIG. 2

GASKETS

This invention is concerned with a gasket for making a seal between two members, for example for making a seal between an engine block and a head of an internal combustion engine or between the elements of a shell and tube heat exchanger.

Gaskets need to be resiliently-compressible in order to make a good seal and must be resistant to the conditions that they will undergo in service. Thus, a heat exchanger gasket must withstand a wide range of chemicals, temperatures and pressures. Equally the head gasket of an internal combustion engine must be resistant to the oil and anti-freeze that it may encounter and also the resistance to thermal decomposition at the temperatures experienced in the engine.

The resiliently-compressible material used in a gasket may be expanded graphite which is also known as exfoliated graphite or flexible graphite foil. This material has excellent resilient properties and is also resistant to the materials and temperatures which it will encounter in service. However, expanded graphite is relatively weak so that it often needs to be reinforced before it can be used as a gasket. It is, therefore, known to embed a substantially-rigid member in the layer of expanded graphite to provide additional strength. It is also known to provide two layers of expanded graphite on opposite sides of the substantially-rigid member which may be a metal sheet. The weakness of expanded graphite, however, may cause portions of the layer to break off or suffer from scratches/gouges that cause leak-paths and may cause the layer to stick to the members between which the gasket

makes a seal so that removal of the gasket may be difficult.

The resiliently compressible material may also be vermiculite or mica.

It is an object of the present invention to provide a gasket in which the problems associated with the weakness of the layer of expanded graphite, vermiculite or mica are overcome.

The invention provides a gasket for making a seal between two members, the gasket having a first surface arranged to make sealing contact with one of said members and a second surface arranged to make sealing contact with the other of said members, the gasket comprising a resiliently-compressible layer of expanded graphite, vermiculite or mica and a sheet of flexible metal foil secured to the layer of expanded graphite, vermiculite or mica by adhesive, the sheet forming said first surface.

In a gasket in accordance with the invention, the sheet of foil serves to prevent scratching or gouging and material breaking away from the resilient-compressible layer and also reinforces the gasket. The metal foil also serves to prevent the expanded graphite, vermiculite or mica from sticking to the member against which the gasket seals. Thus, a gasket in accordance with the invention reverses the usual principle of gaskets which have their resiliently-compressible material pressing directly on to the member against which the gasket seals and instead has the resiliently-compressible material pressing a flexible foil against said member.

Preferably, in a gasket according to the invention, a further sheet of flexible metal foil forms said second surface, said further sheet being secured by adhesive to

said layer of expanded graphite, vermiculite or mica or to a further layer of expanded graphite, vermiculite or mica of the gasket. This construction gives the advantages described above on both of the sealing surfaces of the gasket.

A gasket according to the invention may also comprise a substantially-rigid member positioned between said layer of expanded graphite, vermiculite or mica and a further layer thereof. Such a substantially-rigid member adds strength to the gasket and makes it easier to install or remove. Said substantially-rigid member may also prevent the material from being extruded from between the members with which the gasket makes a seal. Such a substantially-rigid member may be in the form of a sheet of, for example, stainless steel.

The layer of expanded graphite, vermiculite or mica may be up to 1.5mm in thickness, for example said layer may be between 0.2 and 0.7mm in thickness.

The sheet or sheets of flexible metal foil may be up to 20 microns in thickness, for example 15 microns in thickness has been found to be suitable for many applications. The flexible metal foil may be made of nickel, stainless steel, aluminium or other suitable metals. The metal sheet may be thicker when using softer metals.

The adhesive used to secure the foil or foils to the expanded graphite, vermiculite or mica may comprise a cross-linkable phenolic resin. It is desirable that the adhesive does not decompose at the temperatures at which the gasket will operate or be chemically attacked by the fluids which will be encountered. However, this is not essential for all applications since the adhesive may only serve to hold the gasket together until it has been

installed. After installation, decomposition of the adhesive may not be important.

The sheet or sheets of flexible foil may be provided, on the surface away from the layer of expanded graphite, vermiculite or mica with a coating of a seal-enhancing material, for example nitrile rubber or graphite-filled nitrile rubber. Such a coating is thin, ie a few microns in thickness.

There now follows a detailed description to be read with reference to the accompanying drawings, of two gaskets which are illustrative of the invention.

In the drawings:

Figure 1 is a diagrammatic cross-sectional view of the first illustrative gasket; and

Figure 2 is a view similar to Figure 1 but of the second illustrative gasket.

The first illustrative gasket 10, shown in Figure 1, is for making a seal between two members (not shown). The gasket 10 has a first surface 12 arranged to make sealing contact with one of said members and a second surface 14 arranged to make sealing contact with the other of said members.

The gasket 10 comprises a resiliently-compressible layer 16 of expanded graphite which is 1.5mm in thickness. The gasket 10 also comprises a sheet of flexible metal foil 18 which, in this case, is made of 15 micron thick nickel. The layer 16 and the sheet 18, are both of substantially uniform thickness. The sheet 18 is secured to the layer 16 by adhesive 20 which comprises a phenolic resin. The sheet 18 which forms the first surface 12 of the gasket, also has a thin coating 19 (a few microns in thickness) of graphite-filled nitrile rubber applied to the surface thereof away

from the layer 16 to provide a seal-enhancing material coating on the foil 18.

The gasket 10 also comprises a further sheet of flexible nickel foil 22 which forms the second surface 14 of the gasket. The further sheet 22 is secured by adhesive 24 to the layer 16 on the opposite side of the layer to the sheet 18. The adhesive 24 is similar to the adhesive 20. The sheet 22 is of the same thickness as the sheet 18. The sheet 22 has a coating 26 which is similar to the coating 19. Thus, a coating 26 of seal-enhancing material is provided on the surface of the sheet 22 away from the layer 16.

The first illustrative gasket 10 is circular having an internal diameter of 50mm and an external diameter of 90mm. The gasket 10 was subjected to a gas leakage test in which it was clamped between two flanges (roughness, Ra = 2 microns). A gasket stress of 32 MPa was applied. The test rig was then pressurised with gas (N_2 at a pressure of 40 Bar) and the leak rate was then recorded. The average leak rate was measured at 0.009 ml/min which is well within the acceptable limit of less than 0.1 ml/min. The test was repeated with a rougher, grooved flange (1.27 grooves per millimetre with the grooves up to 0.25mm deep). The average leak rate was recorded as 0.08 ml/min.

The second illustrative gasket 40 is shown in Figure 2 and comprises a substantially-rigid sheet of stainless steel 42 having a layer of expanded graphite 44 secured to one side thereof and a further layer 46 of expanded graphite secured to the other side thereof. Each layer 44 and 46 has a sheet 48 or 50 of flexible metal foil, specifically nickel, secured thereto by adhesive 52 or 54. The foils 48 and 50 form the first and second sealing surfaces of the gasket 40 and, in this case, are not coated with seal-enhancing material. Each of the layers 44 and 46

is approximately 0.7mm in thickness while the sheets 48 and 50 are approximately 12 microns in thickness. The rigid member 42 is approximately 3mm in thickness.

CLAIMS

1 A gasket for making a seal between two members, the gasket having a first surface arranged to make sealing contact with one of said members and a second surface arranged to make sealing contact with the other of said members, the gasket comprising a resiliently-compressible layer of expanded graphite, vermiculite or mica and a sheet of flexible metal foil secured to the layer of expanded graphite, vermiculite or mica by adhesive, the sheet forming said first surface.

2 A gasket according to claim 1, wherein the gasket also comprises a further sheet of flexible metal foil forming said second surface, said further sheet being secured by adhesive to said layer or to a further layer of expanded graphite, vermiculite or mica of the gasket.

3 A gasket according to either one of claims 1 and 2, wherein the gasket also comprises a substantially-rigid member positioned between said layer of expanded graphite, vermiculite or mica and a further layer of expanded graphite, vermiculite or mica of the gasket.

4 A gasket according to any one of claims 1 to 3, wherein said layer of expanded graphite, vermiculite or mica is up to 1.5mm in thickness.

5 A gasket according to claims 4, wherein said layer is 0.2 to 0.7mm in thickness.

6 A gasket according to any one of claims 1 to 5, wherein the sheet of flexible metal foil is up to 20 microns in thickness.

7 A gasket according to any one of claims 1 to 6, wherein the sheet of flexible metal foil is made of nickel.

8 A gasket according to any one of claims 1 to 6, wherein the sheet of flexible metal foil is made of stainless steel.

9 A gasket according to any one of claims 1 to 8, wherein said adhesive comprises a phenolic resin.

10 A gasket according to any one of claims 1 to 9, wherein the sheet of flexible metal foil, on its surface away from the layer of expanded graphite, vermiculite or mica, has a coating of seal-enhancing material.

11 A gasket substantially as hereinbefore described with reference to, and as shown in, Figure 1, or Figure 2 of the accompanying drawings.

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I. .miner's report to the Comptroller under Section 17
(The Search report) 9

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Relevant Technical Fields

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(ii) Int Cl (Ed.5) F16J 15/10, 15/12

Search Examiner
R L WILLIAMS

Date of completion of Search
23 FEBRUARY 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE: WPI

Documents considered relevant following a search in respect of Claims :-
1-11

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0449268 A2	(NISSHIN STEEL)	1-6, 8 and 9
X	EP 0428458 A1	(LE CARBONE LORRAINE)	1-7
X	EP 0387652 A1	(NIPPON PILLAR PACKING)	1-3 and 7
X	EP 0263402 A1	(FELT PRODUCTS MFG)	1-3

Databases:The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).