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(54) **Lower casing of engine crankcase**

(57) In an example, an engine 1 includes a pair of left and right aluminum side members 11, 12 extending along a crankshaft 5 and disposed on the left and right thereof, and a laterally extending cross member 13 provided between the side members 11, 12. The cross member 13 comprises an aluminum cross member body 14 provided between the side members 11, 12, and a cast-iron supporting member 17 formed with a semicircular supporting recess 15 on its top surface 16 for the crankshaft 5 to be fitted in at the lower half of its journal

4, and built in the cross member body 14 while leaving the top surface 16. The side members 11, 12 and the cross member body 14 are formed together through aluminum casting by using the supporting member 17 as an insert member. A notch 23 is formed at a lower end of the supporting member 17 below the supporting recess 15.

Such an arrangement can prevent casting defects from occurring in casting a lower casing of a crankcase for supporting a crankshaft.

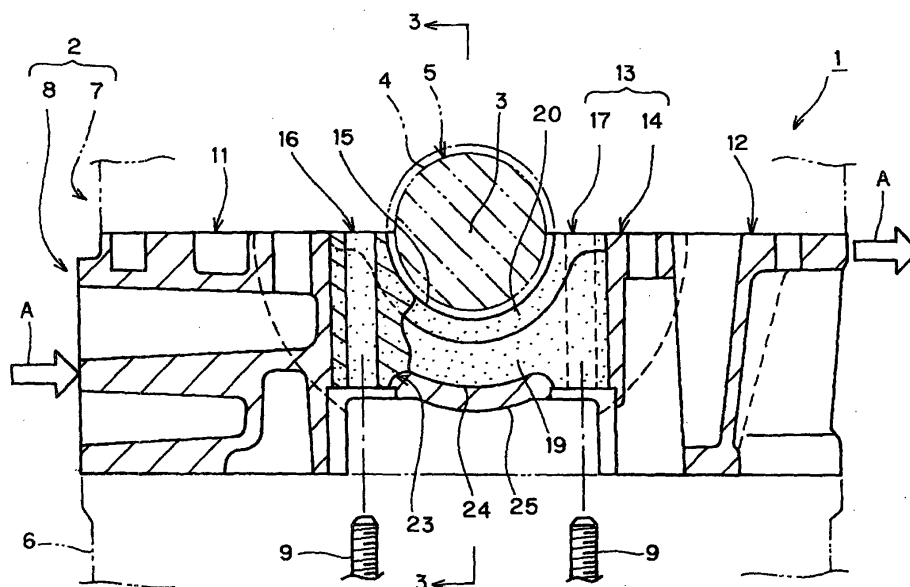


FIG. 1

Description

[0001] This invention relates to a lower casing of an engine crankcase. In preferred examples, it is formed through aluminum casting by using a supporting member for supporting a crankshaft as an insert member.

[0002] A conventional lower casing of the engine crankcase is disclosed in JP-A-H10-331715. The lower casing of the crankcase disclosed in the above publication comprises a pair of left and right aluminum side members extending along a crankshaft and disposed on the left and right thereof, and a laterally extending cross member provided between the side members and formed with a semicircular supporting recess on its top surface for the crankshaft to be fitted in and supported at the lower half of its journal.

[0003] In the foregoing conventional configuration, the cross member comprises an aluminum cross member body provided between the side members, and a cast-iron supporting member formed with the supporting recess on its top surface and built in the cross member body while leaving the top surface, and the side members and the cross member body are formed together through aluminum casting by using the supporting member as an insert member. Since the supporting member is made of cast iron as described, its strength of supporting the crankshaft is reliably secured.

[0004] Methods of casting the lower casing of the crankcase described above include the following.

[0005] First, a mold for the lower casing is formed with the supporting member as an insert member disposed in position. Next, liquid aluminum is poured into an inner mold of the mold for one of the side members, that is, one of inner molds for the side members. The liquid aluminum flows along inside of an inner mold for the cross member body longitudinally from the inner mold for one of the side members toward the inner mold for the other side member. Filling the inside of the mold with the liquid aluminum in such a way as described forms the lower casing, with the supporting member built in the cross member body.

[0006] A longitudinal midsection of the cross member body has a top surface formed with a recess corresponding to the supporting recess formed on the top surface of the supporting member. The midsection of the cross member body, therefore, tends to become smaller in cross-sectional area than longitudinal ends thereof.

[0007] Thus, at the time of the casting, when the liquid aluminum flows longitudinally in the inner mold for the cross member body as described above, the rate of its flow changes between at the ends and at the midsection of the inside of the inner mold for the cross member body. This causes unevenness in the flow of the liquid aluminum in the inner mold for the cross member body, as well as casting defects including pores, which is undesirable.

[0008] In view of the foregoing, an object of examples of this invention is to prevent casting defects from oc-

curing in casting the lower casing of the crankcase for supporting the crankshaft and to maintain good strength of the lower casing supporting the crankshaft.

[0009] In order to seek to solve the foregoing problems, the lower casing of the engine crankcase of an aspect of the invention is as follows. Incidentally, reference numerals denoting the terms herein are not to be interpreted as a limitation of the technical scope of the present invention to the descriptions of embodiments of the invention to be discussed later, or a limitation in any other way.

[0010] According to an aspect of the invention, there is provided a lower casing of an engine crankcase comprising: a pair of left and right aluminum side members 11, 12 extending along a crankshaft 5 and disposed on the left and right thereof; and a laterally extending cross member 13 provided between the side members 11, 12, the cross member 13 including: an aluminum cross member body 14 provided between the side members 11, 12; and a cast-iron supporting member 17 formed with a semicircular supporting recess 15 on its top surface 16 for the crankshaft 5 to be fitted in at the lower half of its journal 4, and built in the cross member body 14 while leaving the top surface 16, the side members 11, 12 and the cross member body 14 being formed together through aluminum casting by using the supporting member 17 as an insert member,

in which a notch 23 is formed at a lower end of the supporting member 17 below the supporting recess 15.

[0011] Preferably the notch 23 has a ceiling 24 formed in an arcuate protrusion approximately centered on an axis 3 of the crankshaft 5.

[0012] Preferably a bottom surface 25 of the cross member body 14 below the supporting recess 15 is formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5.

[0013] A further aspect of the invention provides a mold for use in casting a lower casing as described herein.

[0014] A further aspect provides a method of casting a lower casing as described herein.

[0015] A further aspect of the invention provides a supporting member for use in casting a lower casing as described herein.

[0016] Also provided by a broad aspect of the invention is a lower casing of an engine crankcase comprising:

a supporting member formed with a supporting recess on its surface for a crankshaft, further including a notch at the lower end of the supporting member below the supporting recess.

[0017] A further aspect of the invention provides an insert member for use in casting a lower casing of an engine crankcase, the insert member comprising a notch configured to increase the cross-sectional area of a part of the lower casing.

[0018] In a further broad aspect of the invention, the insert and/or mold is such that longitudinal cross sections of parts of the casing are made more equal in area to one another. Preferably the cross sections are substantially equal.

[0019] A further aspect of the invention provides a lower casing of an engine crankcase comprising a cross member body and a supporting member, at least part of the cross section of the cross member body being defined by a lower surface of the supporting member, wherein the lower surface of the supporting member comprises a notch such that the cross sectional area of the cross member body in the region of the notch is substantially invariable in a longitudinal direction.

[0020] Also provided by the invention is a supporting member or insert member as described herein.

[0021] The invention extends to methods and/or apparatus substantially as herein described with reference to the accompanying drawings.

[0022] Any feature in one aspect of the invention may be applied to other aspects of the invention, in any appropriate combination. In particular, method aspects may be applied to apparatus aspects, and vice versa.

[0023] Preferred features of the present invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view as seen along the arrows of the line 1-1 of Fig. 2;

Fig. 2 is a plan, partially cutaway view of a lower casing of a crankcase; and

Fig. 3 is a sectional view as seen along the arrows of the line 3-3 of Fig. 1.

[0024] In the drawings, reference numeral 1 denotes a four-stroke multi-cylinder (four-cylinder) engine (internal combustion engine).

[0025] The engine 1 comprises a crankcase 2, a crankshaft 5 including a journal 4 supported by the crankcase 2 to be rotatable about its approximately horizontally extending axis 3, and an oil pan 6 supported at a lower end of the crankcase 2.

[0026] The crankcase 2 is divided into an upper and a lower casing 7, 8 with reference to the axis 3 of the crankshaft 5. The upper and the lower casings 7, 8 are connectable to each other with fasteners 9. The crankshaft 5 is interposed and supported between the upper and the lower casings 7, 8.

[0027] The lower casing 8 is shaped like a ladder frame. The lower casing 8 comprises a pair of left and right aluminum side members 11, 12 extending along the crankshaft 5 and disposed on the left and right thereof, and a laterally extending cross member 13 provided between the side members 11, 12. The cross member 13 comprises an aluminum cross member body 14 provided between the side members 11, 12, and a cast-iron supporting member 17 formed with a semicircular supporting recess 15 on its top surface 16 for the crankshaft

5 to be fitted in and supported at the lower half of the journal 4, and built in the cross member body 14 while leaving the top surface 16.

[0028] The supporting recess 15 has an arcuate surface approximately centered on the axis 3 of the crankshaft 5. The supporting member 17 comprises a supporting member body 19 shaped like a cuboid as a whole and formed with the supporting recess 15 on its top surface 16, and a projecting rib 20 integrally formed on an outer surface of the supporting member body 19 around the edge of the supporting recess 15 (the axial edge of the crankshaft 5). The rib 20 is formed in an arcuate shape approximately centered on the axis 3 of the crankshaft 5.

[0029] A notch 23 is formed at a lower end of the supporting member 17 below the supporting recess 15. The notch 23 is formed to face approximately the entire region of the supporting recess 15. The notch 23 has a ceiling 24 formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5. The cross member body 14 below the supporting recess 15 has a bottom surface 25 formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5 and protruded downward of the bottom surface of the supporting member 17. In this configuration, longitudinal (lateral) cross sections of the cross member body 14 below the supporting recess 15 are made generally equal in area to one another.

[0030] The supporting member 17 is built in the cross member body 14 while leaving its top surface 16 and the rib 20 close to the top surface 16. The side members 11, 12 and the cross member body 14 are formed together through aluminum casting by using the supporting member 17 as an insert member.

[0031] Now, description will be made of a method of casting the lower casing 8 of the crankcase 2, as an example.

[0032] First, a mold for the lower casing 8 is formed with the supporting member 17 as an insert member disposed in position. Next, liquid aluminum A is poured into an inner mold of the mold for the side member 11, that is, one of inner molds for the side members 11, 12. The liquid aluminum A flows along inside of an inner mold for the cross member body 14 longitudinally from the inner mold for one of the side members 11 toward the inner mold for the other side member 12. Filling the inside of the mold with the liquid aluminum A in such a way as described forms the lower casing 8, with the supporting member 17 built in the cross member body 14.

[0033] According to the foregoing configuration, the notch 23 is formed at the lower end of the supporting member 17 below the supporting recess 15.

[0034] Forming the notch 23 provides increased cross-sectional area of a longitudinal midsection of the cross member body 14 below the supporting recess 15.

[0035] The midsection of the cross member body 14 has a top surface formed with a recess of a semicircular shape corresponding to the shape of the supporting re-

cess 15 formed on the top surface 16 of the supporting member 17. The midsection of the cross member body 14, therefore, tends to become smaller in cross-sectional area than longitudinal ends thereof. Forming the notch 23, however, allows the midsection of the cross member body 14 to be increased in cross-sectional area as described above, so that the longitudinal cross sections of the cross member body 14 are made more equal in area to one another.

[0036] Therefore, at the time of casting the lower casing 8 of the crankcase 2, when the liquid aluminum A flows longitudinally in the inner mold for the cross member body 14, the rate of its flow is prevented from changing between at the ends and at the midsection of the inside of the inner mold for the cross member body 14. As a result, unevenness in the flow of the liquid aluminum A in the inner mold for the cross member body 14 is prevented from occurring, as well as casting defects including pores.

[0037] Further, the ceiling 24 of the notch 23 is formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5, as described above.

[0038] Therefore, even if the notch 23 is formed in such a manner as described, cross sections, around the periphery of the crankshaft 5, of the supporting member 17 below the supporting recess 15 are made generally equal in area to one another, so that the strength of the lower casing 8 supporting the crankshaft 5 is maintained good.

[0039] Furthermore, the bottom surface 25 of the cross member body 14 below the supporting recess 15 is formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5, as described above.

[0040] Protruding the bottom surface 25 of the cross member body 14 downward provides increased cross-sectional area of the midsection of the cross member body 14. Therefore, for the same reason as in the foregoing, unevenness in the flow of the liquid aluminum A in the inner mold for the cross member body 14 is more reliably prevented from occurring, as well as casting defects including pores.

[0041] Still further, the ceiling 24 of the notch 23, as well as the bottom surface 25 of the midsection of the cross member body 14, is formed in an arcuate protrusion approximately centered on the axis 3 of the crankshaft 5, as described above. Therefore, the longitudinal cross sections of the cross member body 14 below the supporting recess 15 are made generally equal in area to one another.

[0042] This prevents further reliably unevenness from occurring, at the time of casting, in the flow of the liquid aluminum A in the inner mold for the cross member body 14 below the supporting recess 15, as well as casting defects including pores.

[0043] Incidentally, the foregoing description is based on the drawings shown as an example. The engine may be a two-stroke single-cylinder engine.

[0044] Effects of preferred features of the invention are as follows:

[0045] An aspect of the present invention provides a lower casing of an engine crankcase comprising: a pair of left and right aluminum side members extending along a crankshaft and disposed on the left and right thereof; and a laterally extending cross member provided between the side members, the cross member including: an aluminum cross member body provided between the side members; and a cast-iron supporting member formed with a semicircular supporting recess on its top surface for the crankshaft to be fitted in at the lower half of its journal, and built in the cross member body while leaving the top surface, the side members and the cross member body being formed together through aluminum casting by using the supporting member as an insert member,

in which a notch is formed at a lower end of the supporting member below the supporting recess.

[0046] Forming the notch provides increased cross-sectional area of a longitudinal midsection of the cross member body below the supporting recess.

[0047] The midsection of the cross member body has a top surface formed with a recess of a semicircular shape corresponding to the shape of the supporting recess formed on the top surface of the supporting member. The midsection of the cross member body, therefore, tends to become smaller in cross-sectional area than longitudinal ends thereof. Forming the notch, however, allows the midsection of the cross member body to be increased in cross-sectional area as described above, so that longitudinal cross sections of the cross member body are made more equal in area to one another.

[0048] Therefore, at the time of casting the lower casing of the crankcase, when liquid flows longitudinally in an inner mold for the cross member body, the rate of its flow is prevented from changing between at the ends and at the midsection of the inside of the inner mold for the cross member body. As a result, unevenness in the flow of the liquid in the inner mold for the cross member body is prevented from occurring, as well as casting defects including pores.

[0049] Preferably the notch has a ceiling formed in an arcuate protrusion approximately centered on an axis of the crankshaft.

[0050] Therefore, even if the notch is formed in such a manner as described, cross sections, around the periphery of the crankshaft, of the supporting member below the supporting recess are made generally equal in area to one another, so that the strength of the lower casing supporting the crankshaft is maintained good.

[0051] Preferably a bottom surface of the cross member body below the supporting recess is formed in an arcuate protrusion approximately centered on the axis of the crankshaft.

[0052] Protruding the bottom surface of the cross member body downward provides increased cross-sectional area of the midsection of the cross member body below the supporting recess.

tional area of the midsection of the cross member body. Therefore, for the same reason as in the forgoing, unevenness in the flow of the liquid in the inner mold for the cross member body is more reliably prevented from occurring, as well as casting defects including pores.

[0053] According to a combination of these two preceding features, the ceiling of the notch, as well as the bottom surface of the midsection of the cross member body, is formed in an arcuate protrusion approximately centered on the axis of the crankshaft. Therefore, the longitudinal cross sections of the cross member body below the supporting recess are made generally equal in area to one another.

[0054] This can reliably prevent further unevenness from occurring, at the time of casting, in the flow of the liquid in the inner mold for the cross member body below the supporting recess, as well as casting defects including pores.

[0055] In a preferred example an engine 1 includes a pair of left and right aluminum side members 11, 12 extending along a crankshaft 5 and disposed on the left and right thereof, and a laterally extending cross member 13 provided between the side members 11, 12. The cross member 13 comprises an aluminum cross member body 14 provided between the side members 11, 12, and a cast-iron supporting member 17 formed with a semicircular supporting recess 15 on its top surface 16 for the crankshaft 5 to be fitted in at the lower half of its journal 4, and built in the cross member body 14 while leaving the top surface 16. The side members 11, 12 and the cross member body 14 are formed together through aluminum casting by using the supporting member 17 as an insert member. A notch 23 is formed at a lower end of the supporting member 17 below the supporting recess 15.

[0056] Such an arrangement can prevent casting defects from occurring in casting a lower casing of a crankcase for supporting a crankshaft.

[0057] It will be understood that the present invention has been described above purely by way of example, and modification of detail can be made within the scope of the invention.

[0058] Each feature disclosed in the description, and (where appropriate) the claims and drawings may be provided independently or in any appropriate combination.

Explanation of Reference Numerals & Symbol

[0059]

- 1 engine
- 2 crankcase
- 3 axis
- 4 journal
- 5 crankshaft
- 7 upper casing
- 8 lower casing

- 9 fastener
- 11 side member
- 12 side member
- 13 cross member
- 14 cross member body
- 15 supporting recess
- 16 top surface
- 17 supporting member
- 19 supporting member body
- 20 rib
- 23 notch
- 24 ceiling
- 25 bottom surface
- A liquid aluminum

Claims

1. A lower casing of an engine crankcase comprising:

a pair of left and right aluminum side members extending along a crankshaft and disposed on the left and right thereof; and
a laterally extending cross member provided between the side members, the cross member including:

an aluminum cross member body provided between the side members; and
a cast-iron supporting member formed with a semicircular supporting recess on its top surface for the crankshaft to be fitted in at the lower half of its journal, and built in the cross member body while leaving the top surface, the side members and the cross member body being formed together through aluminum casting by using the supporting member as an insert member,

wherein a notch is formed at a lower end of the supporting member below the supporting recess.

2. The lower casing of an engine crankcase according to Claim 1, wherein the notch has a ceiling formed in an arcuate protrusion approximately centered on an axis of the crankshaft.

3. The lower casing of an engine crankcase according to Claim 1 or 2, wherein a bottom surface of the cross member body below the supporting recess is formed in an arcuate protrusion approximately centered on the axis of the crankshaft.

4. A mold for use in casting a lower casing according to any of Claims 1 to 3.

5. A supporting member for use in casting a lower cas-

ing according to any of Claims 1 to 3.

6. A lower casing of an engine crankcase comprising:

a supporting member formed with a supporting recess on its surface for a crankshaft, further including a notch at the lower end of the supporting member below the supporting recess.

7. An insert member for use in casting a lower casing of an engine crankcase, the insert member comprising a notch configured to increase the cross-sectional area of a part of the lower casing.

8. A lower casing of an engine crankcase comprising a cross member body and a supporting member, at least part of the cross section of the cross member body being defined by a lower surface of the supporting member, wherein the lower surface of the supporting member comprises a notch such that the cross sectional area of the cross member body in the region of the notch is substantially invariable in a longitudinal direction.

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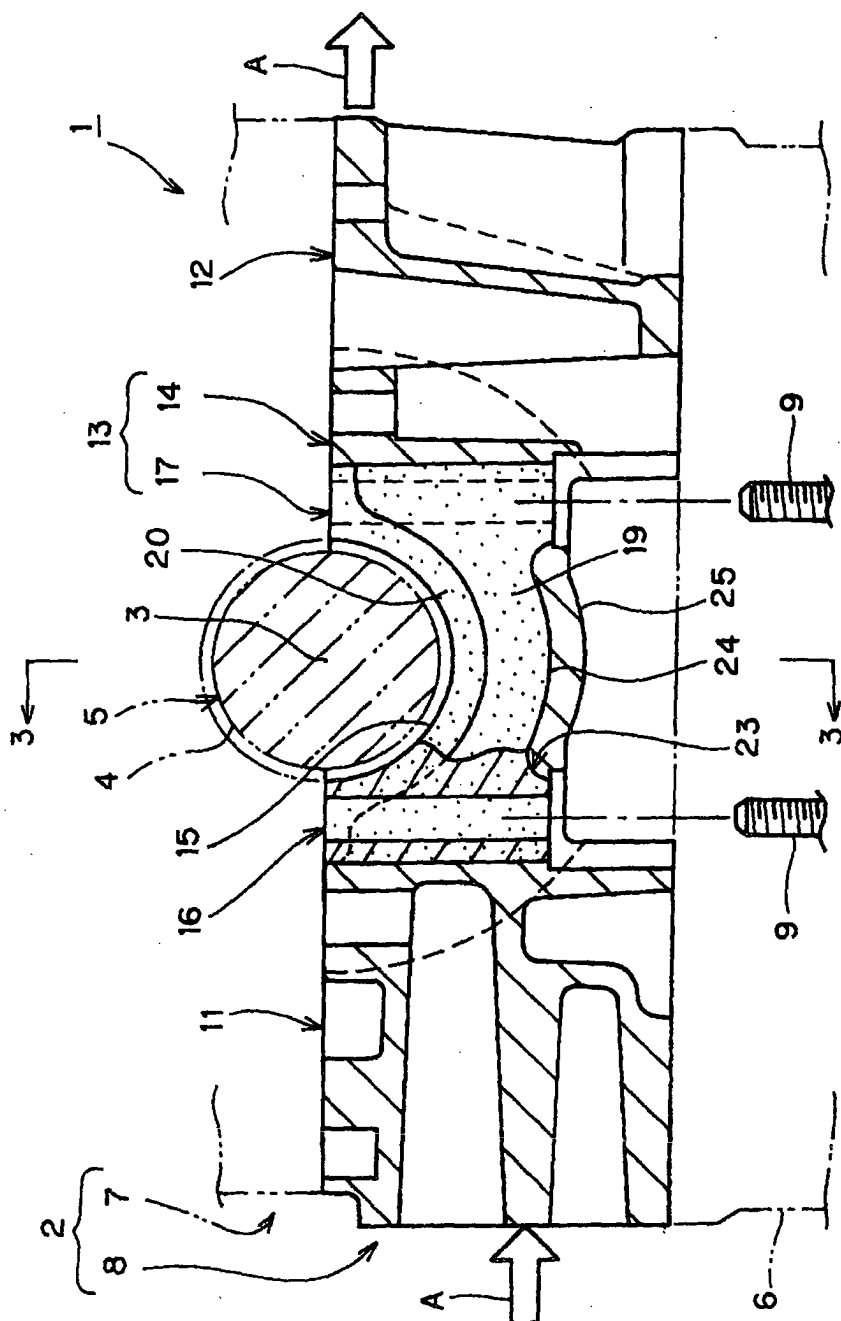


FIG. 1

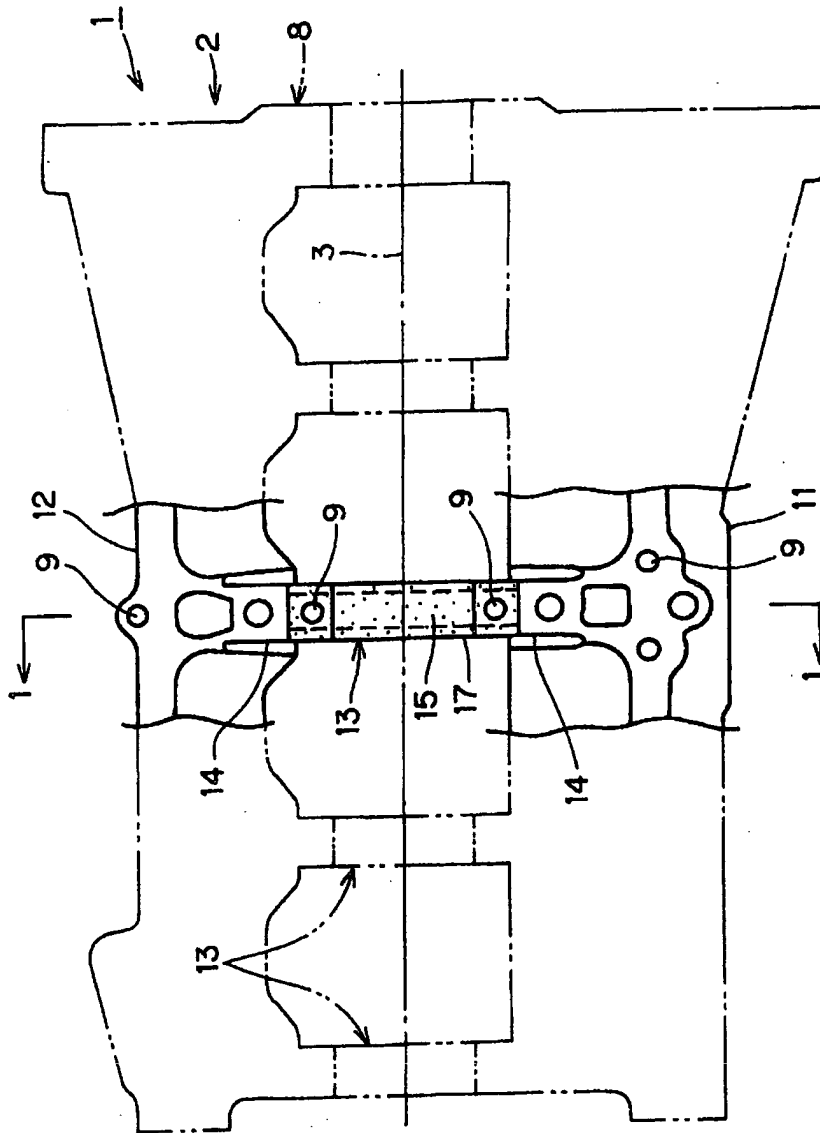


FIG. 2

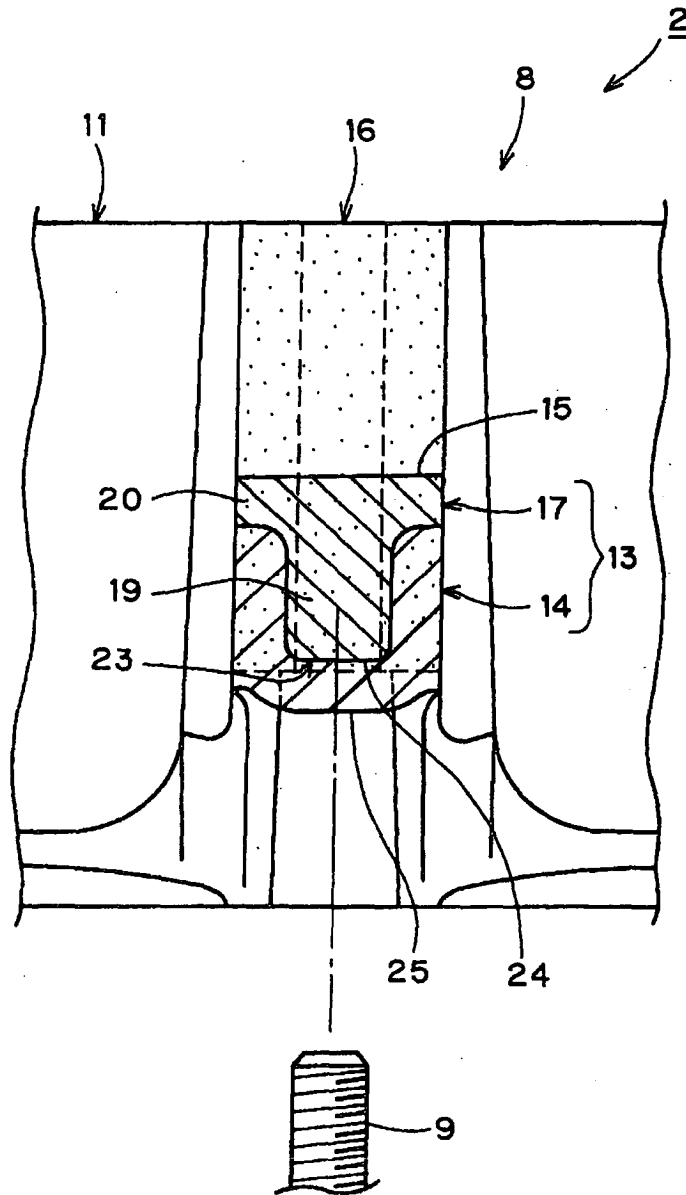


FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 3155

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 196 40 719 C (IAV MOTOR GMBH) 16 October 1997 (1997-10-16) * the whole document *	1-8	F02F7/00 B22D19/00
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 15, 6 April 2001 (2001-04-06) & JP 2000 337348 A (TOYOTA MOTOR CORP), 5 December 2000 (2000-12-05) * abstract *	1	
A	----- DE 195 32 326 C (DAIMLER BENZ AG) 2 January 1997 (1997-01-02) * figures 1,2 * * abstract * * claims 1-4 *	2	
X	----- US 2003/118260 A1 (SUZUKI TAKASHI) 26 June 2003 (2003-06-26) * figures 1,10 * * abstract * * claims 1-9 *	1,3,5	
A,P	----- US 2003/118260 A1 (SUZUKI TAKASHI) 26 June 2003 (2003-06-26) * figures 1,10 * * abstract * * claims 1-9 *	1,3,4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F02F B22D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 August 2004	Examiner Wassenaar, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 25 3155

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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25-08-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19640719 C	16-10-1997	DE 19640719 C1	16-10-1997
		DE 19732838 A1	04-02-1999

JP 2000337348 A	05-12-2000	NONE	

DE 19532326 C	02-01-1997	DE 19532326 C1	02-01-1997

US 2003118260 A1	26-06-2003	JP 2003193909 A	09-07-2003
		CN 1428517 A	09-07-2003
		DE 10259747 A1	17-07-2003
