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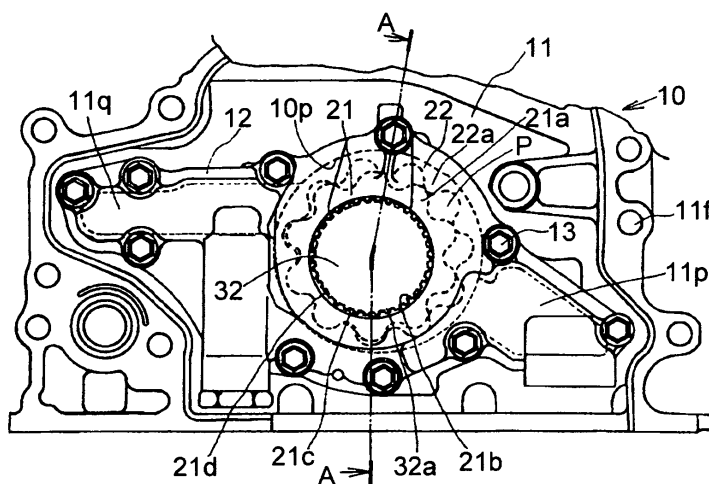
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(54) **Oil pump**

(57) An oil pump comprising a housing (10) that forms a pump chamber (10p), an inner rotor (21, 221) and rotatably driven by engaging with a driving shaft (32, 232), the inner rotor forming with an outer periphery of the driving shaft a communicating groove (21d, 221d), an outer rotor (22) and rotating by means of engagement between outer gears (21a) of the inner rotor and inner gears (22a) of the outer rotor, and an oil seal (33) ar-

ranged between the housing and the driving shaft characterized in that the oil pump further comprises a separating portion (11b) formed on the housing for separating between the pump chamber and the oil seal. The separating portion includes a cylindrical portion (11e) including an inner wall (11d) extending towards the inner rotor, and a guide portion (11c) inclining towards the communicating groove and connected to the inner wall.

FIG. 1



Description

FIELD OF THE INVENTION

[0001] This invention generally relates to an oil pump. More particularly, the invention pertains to an oil pump that includes an oil seal arranged between a housing in which a pump chamber is formed, and a driving shaft for driving the oil pump.

BACKGROUND

[0002] A known oil pump is disclosed in JP2573717Y2. The oil pump disclosed includes a housing accommodating an inner rotor and an outer rotor rotatable and engageable with each other, a driving shaft penetrating through a substantially center portion of the housing and to which the inner rotor is connected, and an oil seal disposed between one end portion of the housing and the driving shaft and accommodating a seal chamber. The oil pump further includes a drain hole formed at a connecting portion between the inner rotor and the driving shaft along an axial direction of the driving shaft and whose one opening portion faces the seal chamber while the other opening portion faces a crank case, and a collecting member disposed rearward in a rotational direction of the driving shaft relative to the one opening portion of the drain hole and whose end portion faces the seal chamber.

[0003] According to the oil pump disclosed, oil flowing from the housing to the seal chamber is forcedly collected by the collecting member formed on an end portion of the inner rotor, and then guided to the drain hole. However, oil flowing from the housing to the seal chamber receives centrifugal force and leaks to an outer periphery of the collecting member. Therefore, oil may not be collected sufficiently. Further, since only two collecting members are formed in the peripheral direction, oil flowing to the seal chamber may not be sufficiently collected.

[0004] Thus, a need exists for an oil pump in which oil leaking from a housing is surely prevented from flowing into an oil seal and at the same time discharged so as not to increase pressure of oil added to the oil seal.

SUMMARY OF THE INVENTION

[0005] According to an aspect of the present invention, an oil pump comprising a housing that forms a pump chamber, an inner rotor arranged within the pump chamber and rotatably driven by engaging with a driving shaft extending through the pump chamber, the inner rotor forming with an outer periphery of the driving shaft a communicating groove extending along the driving shaft, an outer rotor arranged within the pump chamber and rotating by means of engagement between outer gears of the inner rotor and inner gears of the outer rotor, and an oil seal arranged between the housing and the driving shaft characterized in that the oil pump further comprises a

separating portion formed on the housing for separating between the pump chamber and the oil seal. The separating portion includes a cylindrical portion including an inner wall extending towards the inner rotor, and a guide portion inclining towards the communicating groove and connected to the inner wall.

[0006] According to the aforementioned invention, oil leaking from the housing is surely prevented from flowing into the oil seal, and at the same time discharged so as not to increase pressure of oil added to the oil seal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing and additional features and characteristics of the present invention will become more apparent from the following detailed description considered with reference to the accompanying drawings, wherein:

[0008] Fig. 1 is a front view of an oil pump according to a first embodiment of the present invention;

[0009] Fig. 2 is a cross-sectional view taken along the line A-A in Fig. 1;

[0010] Fig. 3 is an enlarged view of a main portion of the oil pump according to the first embodiment of the present invention; and

[0011] Fig. 4 is a front view showing a communicating groove according to a second embodiment of the present invention.

DETAILED DESCRIPTION

[0012] A first embodiment of the present invention is explained with reference to the attached drawings.

[0013] Fig. 1 is a front view of an oil pump according to the first embodiment. The oil pump mainly includes a housing 10 that forms a pump chamber 10p, an inner rotor 21 arranged within the pump chamber 10p and rotatably driven by a crankshaft (driving shaft) 32, and an outer rotor 22 rotatable by means of engagement between inner gears 22a of the outer rotor 22 and outer gears 21a of the inner rotor 21. In addition, the oil pump includes an oil seal 33 (see Fig. 2) fixed to the housing 10 and disposed between the housing 10 and the crankshaft 32.

[0014] As shown in Figs. 1 and 2, the inner rotor 21 includes the outer gears 21a and an inner bore 21b. The inner bore 21b is formed by spline gears 21c engageable with spline gears 32a formed on an outer periphery of the crankshaft 32. The inner rotor 21 is rotatably driven by means of engagement between the spline gears 21c formed on the inner bore 21b and the spline gears 32a of the crankshaft 32. Multiple portions (7 portions, for example) on the inner bore 21b of the inner rotor 21 are not formed by the spline gears 21c respectively for the purposes of defining communicating grooves 21d. The communicating grooves 21d extending in a rotational axis direction of the inner rotor 21 are provided between the spline gears 32a formed on the outer periphery of the crankshaft 32, which penetrates through the pump cham-

ber 10p, and the inner bore 21b. Further, as shown in Fig. 2, both side faces 21f and 21g of the inner rotor 21 are respectively slidably in contact with inner side faces 11r and 12b of the housing 10. Then, a gap is formed between the side face 21f and the inner side face 11r such that oil flows for lubrication into the gap when the side face 21f and the inner side face 11r are slidably in contact with each other. Furthermore, as shown in Fig. 2, an annular projecting portion 21e is formed on the inner bore 21 b of the inner rotor 21 for the purposes of specifying a position of the inner bore 21b relative to the crankshaft 32. Alternatively, however, the projecting portion 21e may not be provided.

[0015] The outer rotor 22 includes the inner gears 22a respectively and sequentially engaging with the outer gears 21a of the inner rotor 21. Multiple volume chambers P are respectively formed between the outer gears 21a of the inner rotor 21 and the inner gears 22a of the outer rotor 22. As shown in Fig. 2, the outer rotor 22 is accommodated in a recess portion 11s formed on a main body 11 of the housing 10 such that the outer rotor 22 is rotatable, by means of the inner rotor 21, relative to a point decentered by a predetermined amount from a rotational center of the inner rotor 21. At this time, an outside diameter of an outer periphery 22b of the outer rotor 22 is defined such that a gap is formed between the outer periphery 22b and an inner periphery of the recess portion 11s of the housing 10 for the purposes of absorbing a rotational vibration of the crankshaft 32.

[0016] The housing 10 includes the main body 11 and a cover 12 assembled to the main body 11 by means of bolts 13 so as to form the pump chamber 10p. The oil pump is assembled first by assembling the inner rotor 21 and the outer rotor 22 to the main body 11 of the housing 10, and then assembling the cover 12 to the main body 11. Inner bores 11a and 12a within which the crankshaft 32 is positioned are respectively formed on the main body 11 and the cover 12. Further, the inner side faces 11r and 12b to which the side faces 21f and 21g of the inner rotor 21 respectively slide are formed around the inner bores 11a and 12a respectively.

[0017] The pump chamber 10p is formed on one end side of the main body 11 while the oil seal 33 is assembled to the other end side of the main body 11. Further, a separating portion 11b for separating between the pump chamber 10p and the oil seal 33 is formed on the main body 11 as shown in Figs. 2 and 3. A cylindrical portion 11e is formed on a side of the pump chamber 10p in the separating portion 11b so as to extend towards the inner rotor 21. A recess portion S defined by an inner wall 11d of the cylindrical portion 11e, and a guide portion 11c inclining towards the communicating groove 21d and in connection with the inner wall 11d, i.e. the guide portion 11c is formed on an axially inner peripheral side of the inner wall 11d, is formed on the separating portion 11b. The guide portion 11c is formed on an entire inner peripheral side of the inner wall 11d. The recess portion S accommodates therein the projecting portion 21e which

projects from the inner rotor 21 towards the guide portion 11c. The projecting portion 21e and the cylindrical portion 11e overlap each other in a radial direction of the crankshaft 32. In addition, an axial depth of the recess portion S is specified such that an end face of the projecting portion 21e and an axially bottom face of the recess portion S are prevented from interfering each other when the inner rotor 21 axially moves by a distance corresponding to a gap formed between the side face 21 f of the inner rotor 21 and the inner side face 11r of the housing 10.

[0018] Further, the main body 11 includes a reference bore with which a positioning pin (not shown) engages, and multiple fitting bores 11 f into which respective fitting bolts (not shown) penetrate, when the main body 11 is assembled to an engine block (not shown). Furthermore, the main body 11 includes an inlet port 11p and a discharge port 11q as shown in Fig. 1.

[0019] Next, an operation of thus-structured oil pump is explained below.

[0020] When the crankshaft 32 rotates, the inner rotor 21 engaging with the crankshaft 32 by means of the spline gears 21c and the spline gears 32a rotate together with the crankshaft 32. In addition, the outer rotor 22 engaging with the inner rotor 21 by means of the inner gears 22a and the outer gears 21 a rotates together with the inner rotor 21.

[0021] The multiple volume chambers P respectively formed between the outer gears 21a of the inner rotor 21 and the inner gears 22a of the outer rotor 22 are enlarged or reduced in response to a rotation of the inner rotor 21 and the outer rotor 22 engaging with each other. Then, oil is supplied from the inlet port 11p and discharged to the discharge port 11q.

[0022] At this time, oil from the pump chamber 10p leaks through the gap formed between the side face 21f and the inner side face 11r, i.e. the gap into which oil may flow for lubrication when the main body 11 and the inner rotor 21 slide to each other. At this time, there may be a possibility that leaking oil flows into the oil seal 33 and thus pressure in the oil seal 33 is increased, thereby causing oil to leak to an outside due to decrease of sealability of the oil seal 33.

[0023] However, the separating portion 11b is formed between the pump chamber 10p and the oil seal 33. In addition, the cylindrical portion 11e extending towards the inner rotor 21 is formed on a side of the pump chamber 10p in the separating portion 11b. Further, the recess portion S constituted by the inner wall 11d of the cylindrical portion 11e and the guide portion 11c inclining to the communicating groove 21d and in connection with the inner wall 11d is formed on the separating portion 11b. Thus, oil leaking through the gap formed between the housing 10 and the inner rotor 21 flows to the guide portion 11c along the inner wall 11d of the recess portion S because of centrifugal force. Oil is prevented from flowing into the oil seal 33 as being blocked by the guide portion 11c, and at the same time guided to the commu-

nicating groove 21d. Further, since the guide portion 11c is formed on the entire inner peripheral side of the inner wall 11d, oil is therefrom guided to the communicating groove 21d. The oil guided to the communicating groove 21d is discharged, for example, to a crank case (not shown).

[0024] Next, a second embodiment is explained with reference to Fig. 4. According to the second embodiment, shapes of a crankshaft and a communicating groove are different from those of the first embodiment as shown below.

[0025] As shown in Fig. 4, a crankshaft 232 includes an outer periphery constituted by two faces 232a facing each other. The crankshaft 232 is disposed into an inner rotor 221 via an inner bore 221b. According to the second embodiment, communicating grooves 221d each having a semi-circular cross section are respectively formed in a substantially center portion of two faces 221c of the crankshaft 232 respectively facing the two faces 232a. The rest of the structure of the second embodiment is same as those of the first embodiment and thus explanation is omitted.

[0026] According to the aforementioned embodiments, the separating portion 11b for separating between the pump chamber 10p and the oil seal 33 is formed on the housing 11. In addition, the inner wall 11d of the cylindrical portion 11e extending towards the inner rotor 21, and the guide portion 11c in connection with the inner wall 11d and inclining towards the communicating groove 21 d are formed on a side of the pump chamber 10p in the separating portion 11b. Thus, oil from the pump chamber 10p leaking through the gap formed between the cylindrical portion 11e and the inner rotor 21 in the separating portion 11b of the housing 11 flows into the guide portion 11c along the inner wall 11d. Further, oil is prevented by means of the guide portion 11c from flowing into the oil seal 33 and at the same time guided to the communicating groove 21d so as to be discharged there-through.

[0027] Further, according to the aforementioned embodiments, the guide portion 11c is formed on the entire peripheral side of the inner wall 11d so that oil is guided therefrom to the communicating groove 21d.

It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. An oil pump comprising a housing (10) that forms a pump chamber (10p), an inner rotor (21, 221) arranged within the pump chamber and rotatably driven by engaging with a driving shaft (32, 232) extending through the pump chamber, the inner rotor forming with an outer periphery of the driving shaft a communicating groove (21 d, 221 d) extending along the driving shaft, an outer rotor (22) arranged within the pump chamber and rotating by means of engagement between outer gears (21a) of the inner rotor and inner gears (22a) of the outer rotor, and an oil seal (33) arranged between the housing and the driving shaft **characterized in that** the oil pump further comprises a separating portion (11b) formed on the housing for separating between the pump chamber and the oil seal, wherein the separating portion includes a cylindrical portion (11e) including an inner wall (11d) extending towards the inner rotor, and a guide portion (11c) inclining towards the communicating groove and connected to the inner wall.
2. An oil pump according to claim 1, wherein the guide portion (1c) is formed on an entire peripheral side of the inner wall (11d).
3. An oil pump according to either one of claims 1 and 2, wherein a plurality of communicating grooves (21 d, 221d) are arranged at even intervals on an inner periphery of the inner rotor.
4. An oil pump according to either one of claims 1 to 3, wherein the guide portion (11c) extends from the inner wall (11d) in a direction separating from the oil seal (33).
5. An oil pump according to either one of claims 1 to 4, wherein the inner rotor (21) includes an annular projecting portion (21e) projecting towards the guide portion (11c), and the projecting portion (21 e) and the cylindrical portion (11e) overlap each other in a radial direction of the driving shaft (32, 232).

FIG. 1

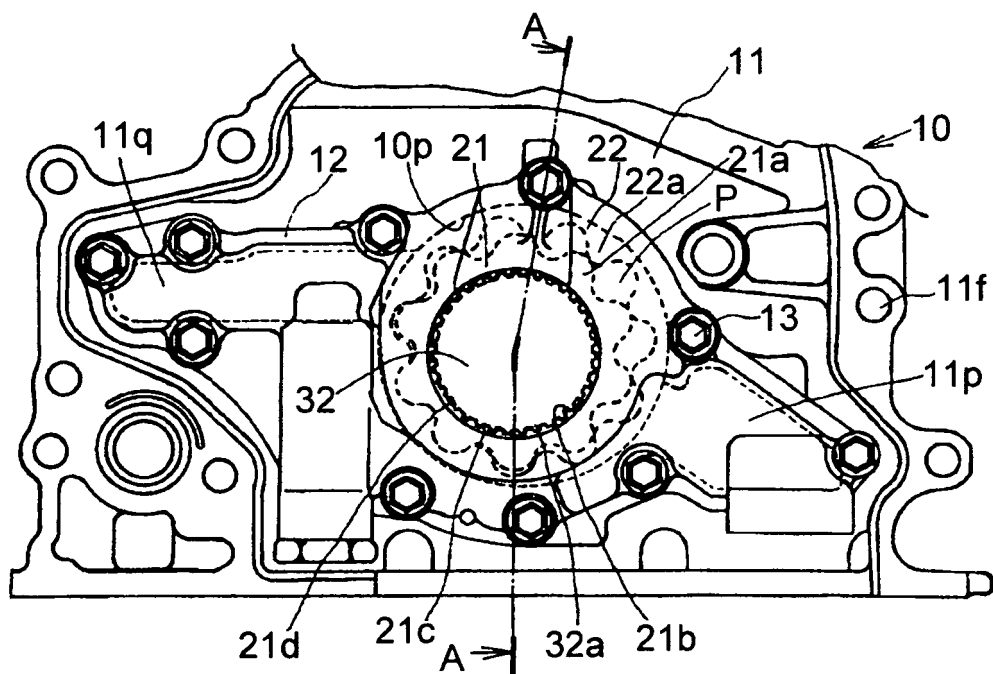


FIG. 2

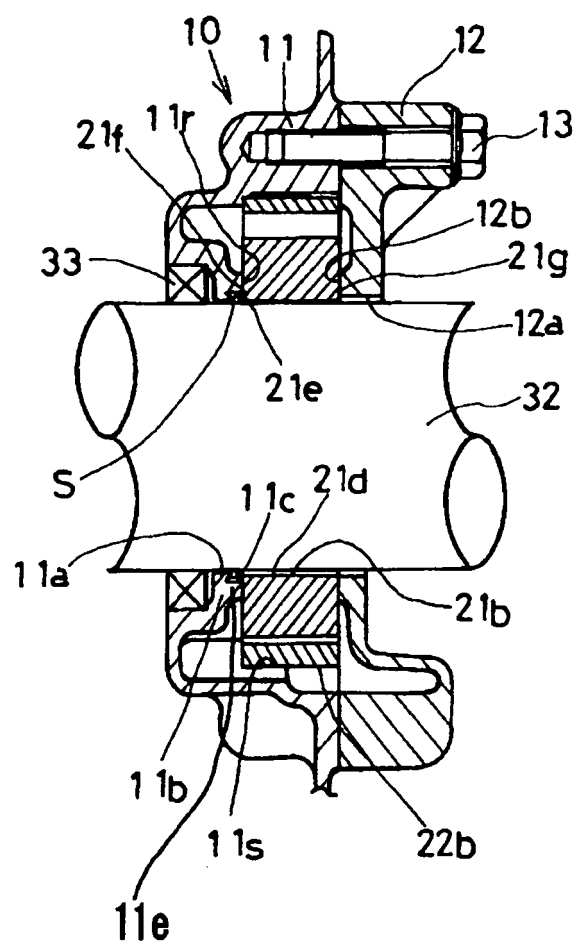


FIG. 3

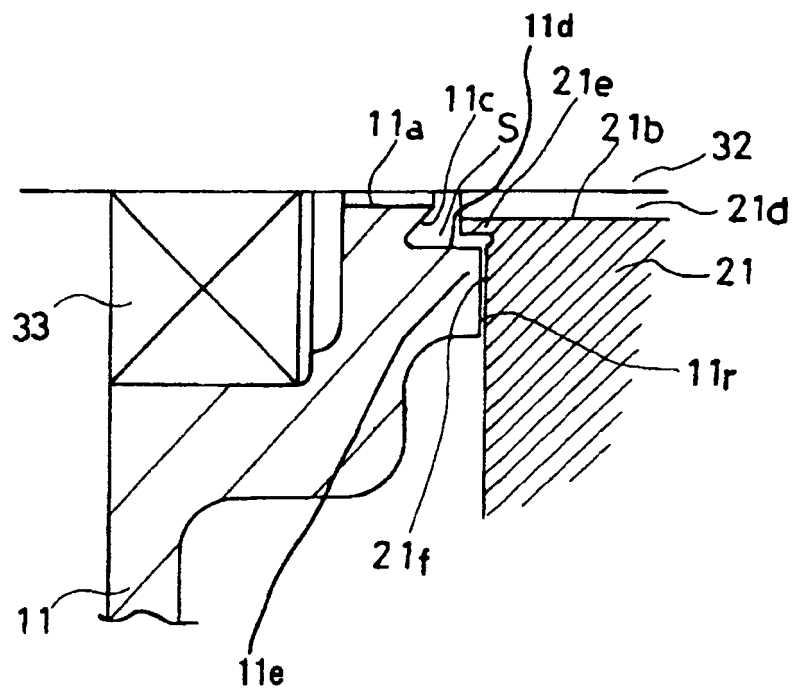
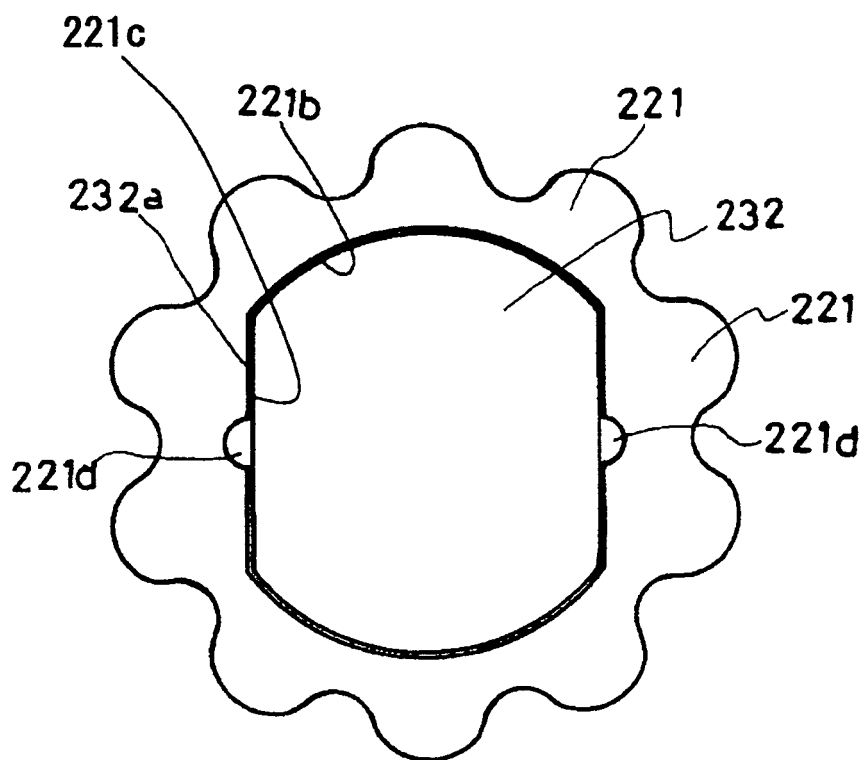


FIG. 4





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 01 5021

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 October 2005	Examiner Descoubes, P
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			

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EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 05 01 5021

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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26-10-2005

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