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(54) **Piston ring lubrication in internal combustion engines**

(57) An internal combustion engine having a piston ring (28) and a cylinder running surface formed with lubrication openings (20). The running surface (34) of the piston ring (28) is formed with at least one recess (43) extending in the axial direction of the piston ring (28) as far as its end face on the cylinder head side, the recess having on the crankshaft side a boundary edge extending in the running surface (34) at an inclination to the peripheral direction.

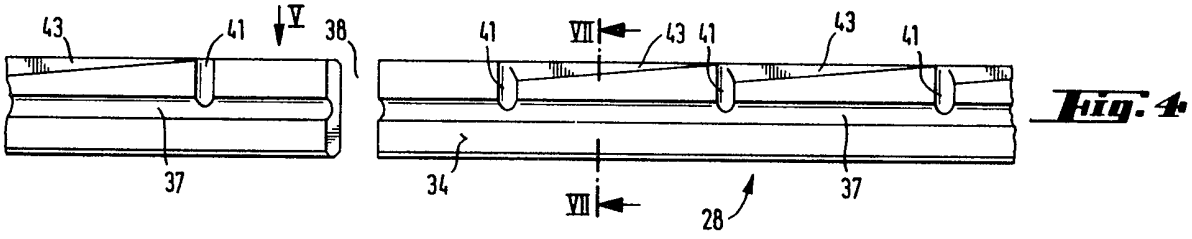

Fig. 4

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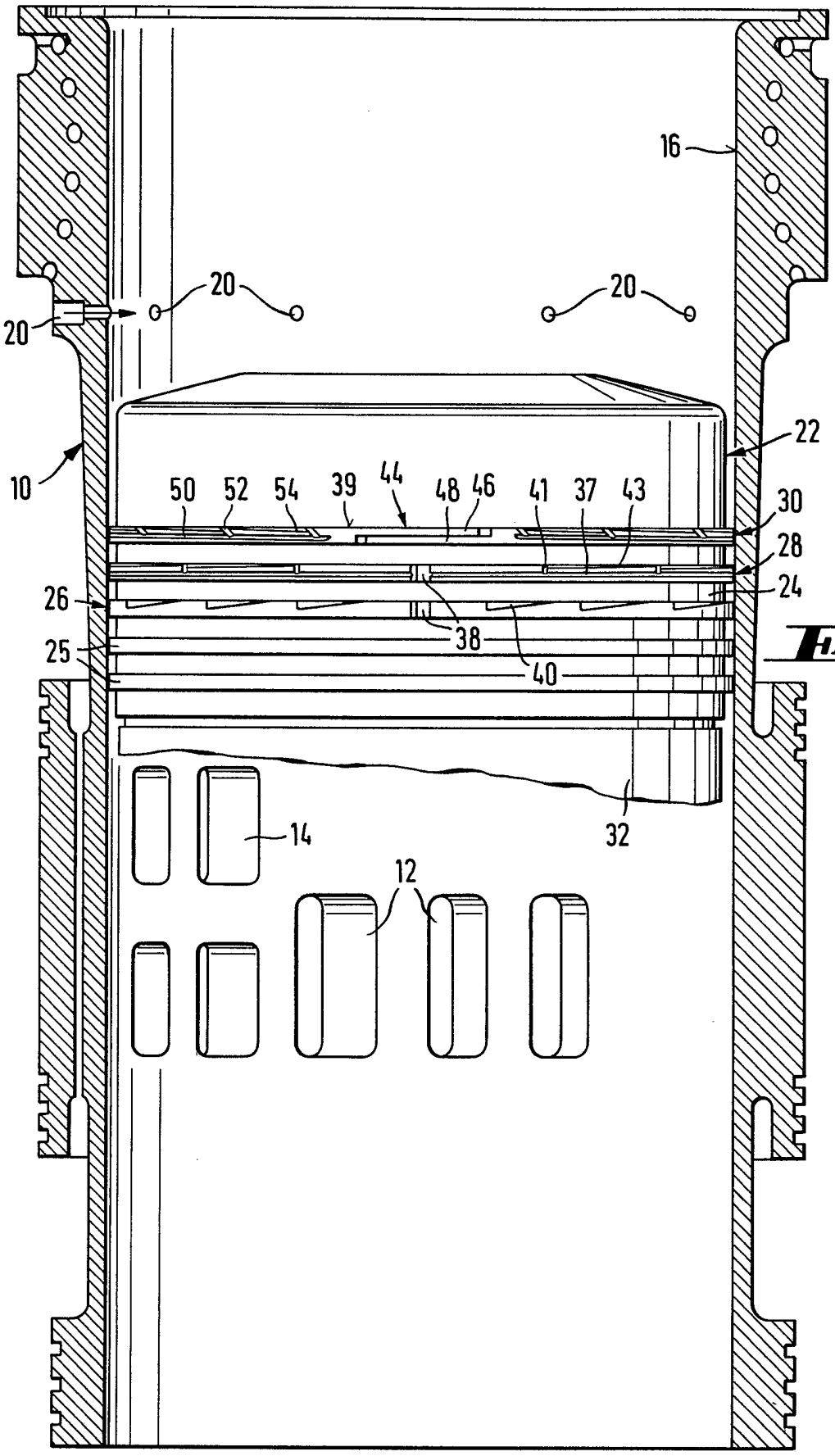
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Fig. 1

Fig. 2

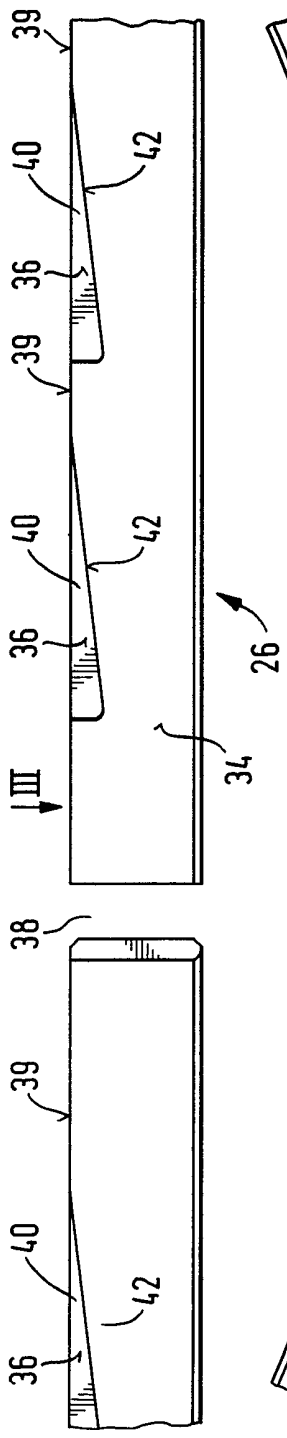


Fig. 3

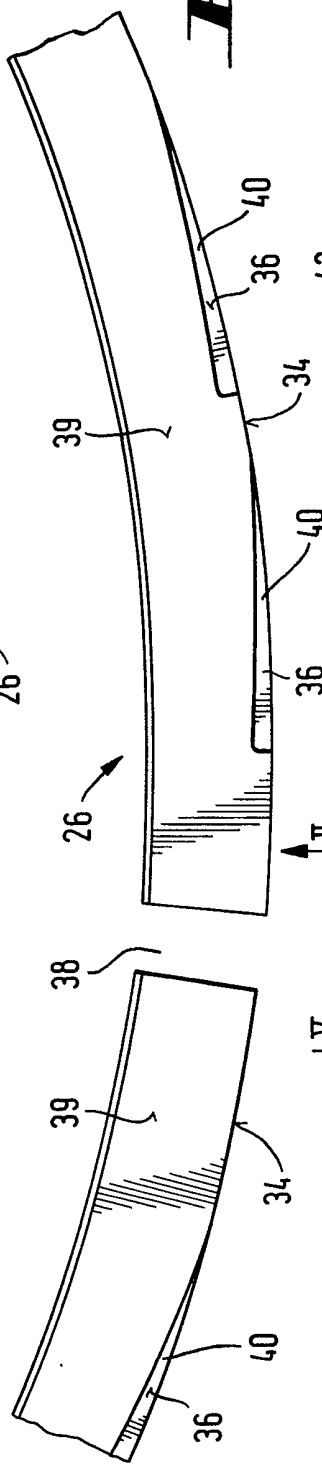


Fig. 4

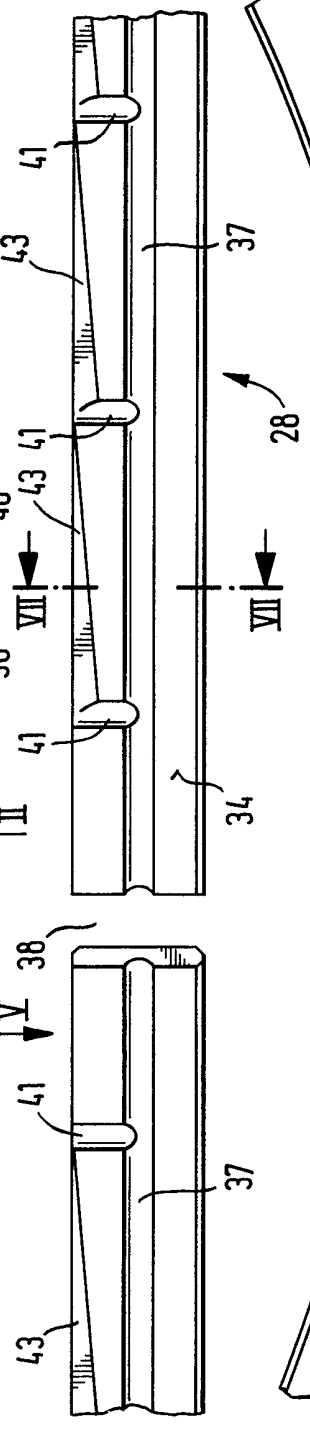
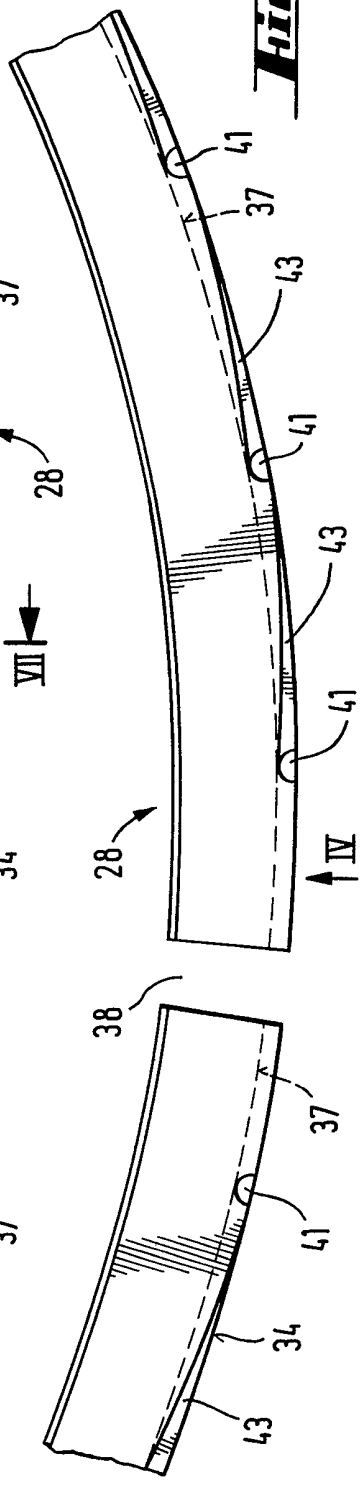


Fig. 5



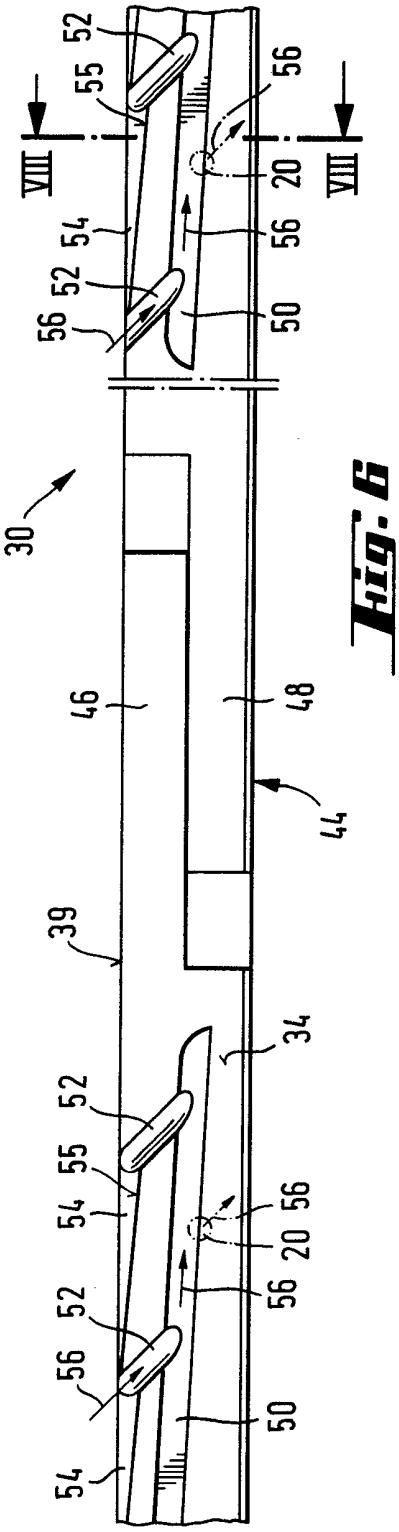


Fig. 6

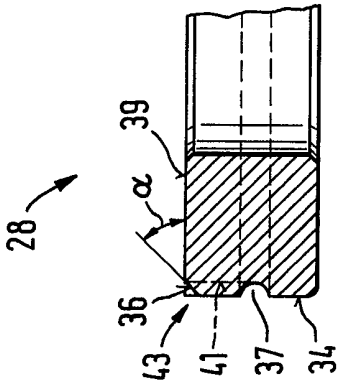


Fig. 7

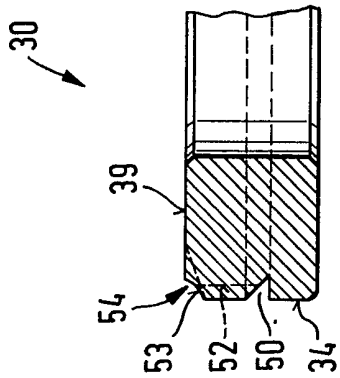


Fig. 8

SPECIFICATION

Internal combustion engines

This invention relates to an internal combustion engine having a piston ring and a cylinder running surface formed with lubrication openings.

Engines of the aforementioned kind have a disadvantage in that oil is inadequately distributed in the peripheral direction, since the piston ring, when it travels over the lubrication openings, has a wiping action, as a result of which the edge of the piston ring on the cylinder head side drives the oil from the lubrication opening in a bead or drop in the axial direction of the cylinder. The result is an excessive concentration of oil in the immediate neighbourhood of the lubrication opening, whereas the oil film is inadequate in the regions between lubrication openings. This causes excessively rapid wear of the cylinder liner in the region between lubrication openings, and a corresponding deterioration in running properties and an increase in the consumption of lubricant by the engine.

It is known from Swiss Patent Specification CH-A-616 989 for the lubrication openings to be in the form of inclined lubrication grooves in the cylinder wall, but this construction is relatively expensive to manufacture.

An object of the invention is to design an internal combustion engine of the initially mentioned kind which is relatively cheap to manufacture but ensures good distribution of oil in the peripheral direction and thus improves the running properties and reduces the consumption of lubricant.

According to the present invention, an internal combustion engine has a cylinder with a running surface formed with lubrication openings, and a piston reciprocatable in the piston and having a piston ring the running surface of which is formed with at least one recess extending in the axial direction of the piston ring as far as its end face adjacent the cylinder head and having on the crankshaft side a boundary edge extending in the running surface at an inclination to the peripheral direction. As a result, when the piston ring travels over the lubrication openings, it scrapes the lubricating oil and spreads it out peripherally over the entire cylinder running surface. The lubrication openings can be ordinary capillary bores, without the need to form expensive lubrication grooves in the contact surface.

In a specially advantageous embodiment, the recess has a concave surface, thus increasing the oil-storing action of the recess.

In a preferred form, the running surface of the piston ring is formed with a groove extending transversely of the piston ring axis, the groove communicating with the side of the piston ring adjacent the cylinder head via at least two ducts extending in a direction having at least a component transversely to the peripheral direction, the recess extending between those openings of two successive ducts which are adjacent the cylinder head. This further increases the oil-storing action of the groove in the piston ring.

Preferably, the groove and/or the ducts are inclined to the peripheral direction and that boundary wall of the recess which is adjacent the crankshaft is inclined to the peripheral direction in the same sense as the groove and/or ducts. This additionally increases the scraping and oil-distributing action of the recess.

The invention may be carried into practice in various ways but one engine embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section through the cylinder of an internal combustion engine with a piston fitted with piston rings;

Figure 2 is an enlarged view of part of one of the piston rings in Fig. 1, shown from the front in the ring plane;

Figure 3 is a plan view corresponding to Fig. 2;

Figure 4 shows part of another piston ring, in a view corresponding to Fig. 2;

Figure 5 is a plan view corresponding to Fig. 4;

Figure 6 shows part of a gas-tight piston ring in a view corresponding to Fig. 2;

Figure 7 is a section along line VII–VII in Fig. 4; and

Figure 8 is a section along line VIII–VIII in Fig. 6

A cylinder liner (Fig. 1) of a two-stroke diesel engine, e.g. for ships, is formed with inlet ports 12 and exhaust ports 14 and has an inner wall 16 formed with lubrication bores 20 supplied with lubricating oil. A piston 22 reciprocates in the liner 10 and has a top part 24 in which both conventional piston rings 25 and piston rings 26, 28, 30 formed with recesses or peripheral grooves and ducts are guided in grooves. The top part 24 merges into a bottom part 32 having a substantially cylindrical outer surface, the outer diameter of which is less than the outer diameter of part 24. The piston 22 is secured to a piston-rod (not shown), the other end of which is pivoted to a cross-head (not shown).

The piston ring 26 (Figs. 2, 3) has a running surface 34 which engages against the wall 16 of the liner 10 and has, as latch, a slit 38 to provide resilience to enable the running surface 34 to be pressed against the wall 16.

The running surface of the piston ring 26 has at least one recess 40 extending axially as far as the ring end face 39 adjacent the cylinder head and having on the side adjacent the crankshaft a boundary edge 42 extending in the running surface 34 at an inclination to

the peripheral direction. Each recess 40 has a plane inclined surface 36 which, as shown in Fig. 7, extends towards the upper end face 39 at an angle α which is advantageously more than about 10° but less than 90°.

Piston ring 28 (Figs. 4, 5) is formed with a peripheral groove 37 and ducts 41, which latter extend perpendicularly to the peripheral direction and between which the recesses 43 extend. The groove 37 has a semi-circular cross-section.

The gas-tight piston ring 30 (Figs. 6, 8) has a latch 44 in the form of interlocking tabs or fingers 46, 48 at its ends, as described, for example, in Swiss Patent Specification CH-A-482 954. In this case a helical groove 50 ends before the latch 44 and ducts 52 which extend at an inclination to the top end face open into the groove 50. As in the previous example, recesses 54 extend between ducts 52. In the present case, the boundary edge 55 on the crankshaft side is inclined to the peripheral direction in the same sense as and at approximately the same angle of inclination as the groove 50 but could be closer to the inclination of the ducts 52. As Fig. 8 shows, in this case the recess 54 has a concave surface 53 whereas the groove 50 has a triangular cross-section which also enables the wear and rotational position of the piston ring to be determined.

When the engine described is in operation and the gas pressure drives the piston 22 from its bottom dead-centre position towards the cylinder head, a film of lubricating oil which is stored in the recess 54 is scraped over the surface of the cylinder wall 16 and spread out by the oblique boundary edge 55 as shown in Fig. 6, the diagrammatically indicated lubrication bore 20 coinciding with the groove 50 in the position shown. Gas flows in the direction of arrows 56 through the ducts 52 and the groove 50, and then flows past the bores 20 and accelerates the peripheral distribution of lubricating oil. The ducts 52 also co-operate with the groove 50 to equalise the pressure.

Of course, each of recesses 40, 43, 54 may alternatively be formed so as to extend as a single recess substantially around the entire periphery of the piston ring.

CLAIMS

1. An internal combustion engine having a cylinder with a running surface formed with lubrication openings, and a piston reciprocatable in the piston and having a piston ring the running surface of which is formed with at least one recess extending in the axial direction of the piston ring as far as its end face adjacent the cylinder head and having on the crankshaft side a boundary edge extending in the running surface at an inclination to the peripheral direction.

2. An engine as claimed in Claim 1 in which the recess has a concave surface.

3. An engine as claimed in Claim 1 or Claim 2 in which the running surface of the piston ring is formed with a groove extending transversely of the piston-ring axis, the groove communicating with the side of the piston ring adjacent the cylinder head via at least two ducts extending in a direction having at least a component transverse to the peripheral direction, and the recess extending between those openings of two successive ducts which are adjacent the cylinder head.

4. An engine as claimed in Claim 3 in which the groove and/or the ducts are inclined to the peripheral direction and that boundary wall of the recess which is adjacent the crankshaft is inclined to the peripheral direction in the same sense as the groove and/or ducts.

5. An internal combustion engine substantially as described herein with reference to Fig. 1 and having a piston ring substantially as described herein with reference to Figs. 2 and 3 or a piston ring substantially as described herein with reference to Figs. 4 and 5 or a piston ring substantially as described herein with reference to Figs. 6, 7 and 8 of the accompanying drawings.

CLAIMS (13 Oct 1983)

1. An internal combustion engine having a cylinder with a running surface formed with lubrication openings, and a piston reciprocatable in the cylinder and having a piston ring the running surface of which is formed with at least one recess extending in the axial direction of the piston ring as far as its end face adjacent the cylinder head, (the recess being open here along its full length), and having on the crankshaft side a boundary edge extending in the running surface at an inclination to the peripheral direction.

2. An engine as claimed in Claim 1 in which the recess has a concave surface.

3. An engine as claimed in Claim 1 or Claim 2 in which the running surface of the piston ring is formed with a groove extending transversely of the piston ring axis, the groove communicating with the side of the piston ring adjacent the cylinder head via at least two ducts extending in a direction having at least a component transverse to the peripheral direction, and the recess extending between those openings of two successive ducts which are adjacent the cylinder head.

4. An engine as claimed in Claim 3 in which the groove and/or the ducts are inclined to the peripheral direction and that boundary wall of the recess which is adjacent the crankshaft is inclined to the peripheral direction in the same sense as the groove and/or ducts.

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