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(58) Field of search
F2T

(54) Piston-ring combination

(57) The combination comprises a compression ring 10 and an oil ring 20 having outside upper and lower edges 21,22 bevelled to have a thin outer periphery 23 for contacting engagement with the inner wall 64 of an engine cylinder 60. The compression ring 10 is easily twistable in the form of a dish to contact the inner wall 64 of the cylinder 60 with its outside lower edge 14 and the bottom wall 43 of a compression-ring groove 40 in a piston 30 with its inside lower edge 13, thereby being prevented from being raised from the bottom wall 43 of the compression-ring groove 40. Each ring 10,20 has a high plane pressure to seal up gas or scrape down oil notwithstanding having a small expanding force to reduce its frictional resistance. Other compression ring cross-sections and gap configurations are disclosed.

FIG. 1

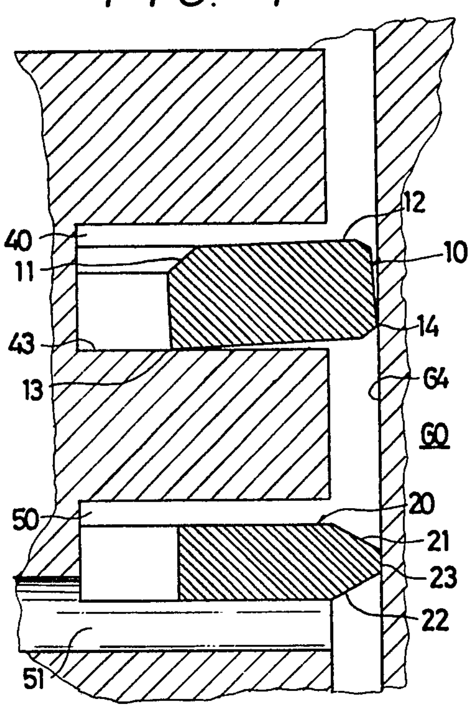

FIG. 8

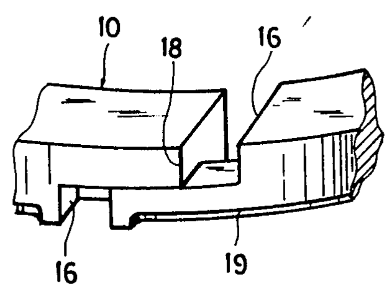

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FIG. 1

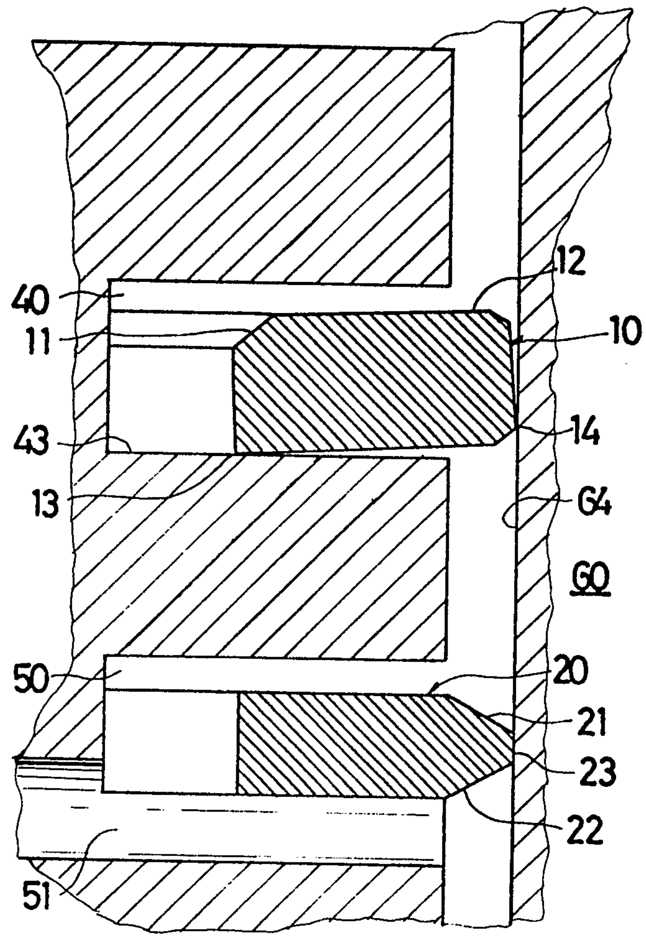


FIG. 2

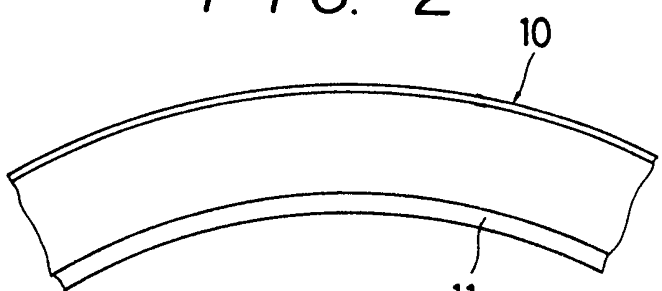


FIG. 3

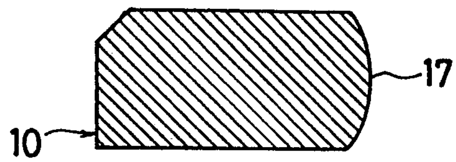


FIG. 4

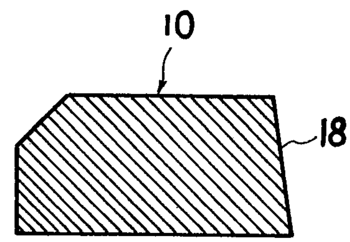


FIG. 5

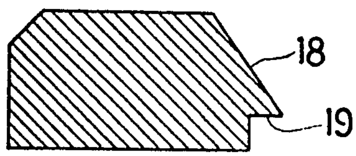


FIG. 6

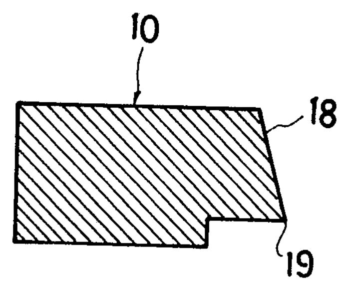


FIG. 7

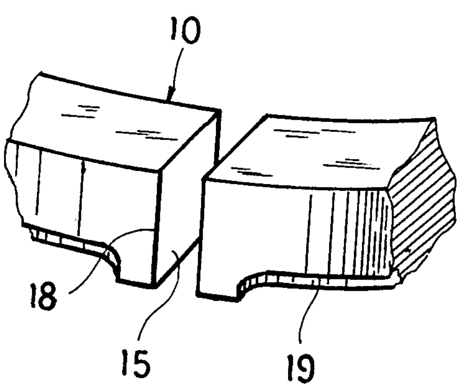
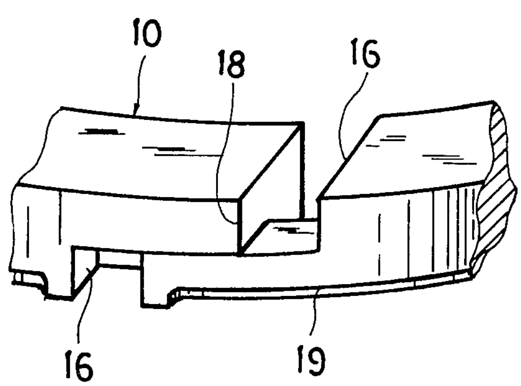


FIG. 8



SPECIFICATION

Piston-ring combination

The present invention relates to a piston-ring combination comprising a compression ring and an oil ring. each preferably having a relatively small expanding force.

In general, a four-stroke water-cooled internal combustion engine is equipped with a piston-ring combination consisting of three piston rings. namely first and second compression rings and an oil ring. The three piston ring combination has a disadvantage that it is difficult to reduce the weight of engine because the piston as well as the cylinder is lengthened and weighted so as to accommodate three piston rings. Every piston ring has a frictional resistance against reciprocal motion of a piston. The resistance increases with the expanding force of the piston ring. The resultant frictional resistance of three piston rings is relatively large even if each piston ring has a small expanding force. This leads to another disadvantage: it is difficult to reduce the consumption of fuel in an engine provided with the conventional combination of three piston rings.

It is known to use another combination, consisting of a compression ring and an oil ring, in order to reduce engine weight and fuel consumption. However, the known combination of two piston rings is less effective to seal up gas and prevent blow-by than the conventional combination of three piston rings, thereby bringing the problem that the consumption of lubricating oil rather increases. The known combination cannot have a sufficiently small frictional resistance to reduce the consumption of fuel, because the two piston rings each have a somewhat large expanding force. Otherwise, the blow-by problem would become very severe.

What is desired is an improved combination of two piston rings that has a small frictional resistance without decreasing the sealing effect and that can save fuel as well as lubricating oil and enable one to reduce the engine weight.

The present invention provides a piston-ring combination comprising a compression ring and an oil ring respectively installed in compression- and oil-ring grooves formed in a piston which is to reciprocate within a cylinder, the compression ring having inside and outside lower edges and being easily twistable to warp up its outer periphery in the compression-ring groove so that its outside lower edge will contact the inner wall of the cylinder and so that its inside lower edge contacts the bottom wall of the compression-ring groove, the oil ring having outside upper and lower edges bevelled to provide a reduced annular surface for contacting engagement with the inner wall of the cylinder.

Thus, the compression ring is easily twistable in the form of a dish when installed in a compression-ring groove in a piston, and the oil ring has a thin outer surface.

The compression ring preferably has a generally rectangular cross-section and an inside upper edge bevelled in a manner such that the compression ring is easily deformable to warp up the outer periphery, which may (when unstressed) be vertical, barrel-faced, tapered, or undercut. A compression ring having an upwardly tapered outer periphery with an outside lower undercut edge is not always required to have its inside upper edge bevelled. The oil ring has outside upper and lower edges bevelled, preferably similarly, to form a thin outer surface.

The compression ring (in the piston-head side) is easily deformable to warp up the outer periphery so that it contacts the inner wall of an engine cylinder with its outside lower edge as well as the bottom wall of the compression groove with the inside lower edge. The oil ring (in the crank-space side) contacts the inner wall of the cylinder with a relatively thin surface as compared with the known oil ring.

The number of piston rings is two (i.e. fewer than the three used in the conventional one), therefore being less in frictional resistance owing to the resultant small expanding force of two piston rings even if each piston ring has the same expanding force as that of the conventional one. The resistance can further be reduced when the compression and oil rings have an expanding force smaller than those of the conventional one. An inside upper bevelled edge allows the compression ring to easily deform in the form of a dish so that the compression ring cross-sectionally has the outside lower edge thereof in line-contact with the inner wall of the cylinder and the inside lower edge in line-contact with the bottom wall of the compression-ring groove, resulting in that it is seldom raised from the bottom wall of the compression-ring groove in use. Therefore, the compression ring is superior in a sealing property and very effective against blow-by. In preference, the compression ring has a narrow or double stepped split-gap in order to improve the sealing effect. Chromium inert rings and sprayed rings are desirably; used as compression rings without being chamfered, for improvement in sealing effect. The compression ring may be formed with an undercut outer periphery, of which the opposite portions remain without being undercut in the vicinity of its split gap.

The oil ring has outside upper and lower edges bevelled to have a reduced annular surface for contacting engagement with the cylinder wall, so that it has a high plane pressure even if it has a relatively small expanding force. Therefore, the oil ring can prevent the consumption of lubricating oil from increasing, notwithstanding being less frictional owing to the small expanding force. Lubricating oil is scraped out of the cylinder wall into drain holes in the piston, then rapidly flowing down to the crank case. Thus, the oil pressure below the oil ring is low enough to prohibit the oil from passing by the oil ring, resulting in that the consumption of lubricating oil is prevented from increasing.

The advantages offered by the present invention are mainly that the cylinder and the piston can be smaller in length and weight than those for use with the conventional combination of three piston rings and that fuel as well as oil can be saved because the combination of two piston rings has a relatively small frictional resistance as compared with that of the known combinations of two or three piston rings. The present combination of two piston rings has a sealing function to prevent blow-by or increase in consumption of lubricating oil, being different from the known combination of two piston rings in which blow-by is insufficiently protected.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of the relevant portion of an internal combustion engine equipped with a piston-ring combination in accordance with the invention, the parts being shown enlarged and without regard to relative dimensions;

Figure 2 is an enlarged partial plan view of the compression ring;

Figures 3 to 6 are enlarged cross-sectional views of various embodiments of the compression ring; and

Figures 7 and 8 are enlarged fragmentary perspective views showing the gap in two embodiments of the compression ring.

As seen in Figure 1, the piston-ring combination comprises a compression ring 10 and an oil ring 20. The compression ring 10 is installed in a compression-ring groove 40 formed in the head side of a piston 30, which reciprocates within an engine cylinder 60. The oil ring 20 is fitted in an oil-ring groove 50 below the compression-ring groove. The both rings 10 and 20 are, in cross-section, generally rectangular and thinner than the respective grooves 40 and 50, in which there exist axial voids.

As seen in Figure 2, the compression ring 10 has an inside upper bevelled edge 11. The compression ring 10 with the bevelled edge 11 is easy to warp up its outer periphery in the form of a dish when installed in the compression-ring groove 40, contacting the bottom wall 43 of the compression-ring groove 40 with the inside lower edge 13 and the inner wall 64 of the engine cylinder 60 with the outside lower edge 14, as seen in Figure 1. The contacting surface area is very small because they make cross-sectionally point-contact or spatially line-contact with each other. This means that the contacting pressure is high enough to have a sufficient sealing effect and prevent blow-by even if the expanding force of the piston ring is small.

The oil ring 20 has its outer periphery formed with outside upper and lower bevelled edges 21 and 22 to contact the inner 64 with a thin annular surface 23, so that a very thin oil film is formed between them. This leads to a contacting pressure which is high and effective to scrape the lubricating oil from the inner wall. The scraped oil immediately returns to the crank case through a drain hole 51 extending along the bottom wall 53 of the oil ring groove 50 into the hollow portion of the piston 30. The oil cannot rise beyond the oil ring 20, because the outside lower edge 32 decreases the oil pressure thereon below that in the oil film.

The compression ring is not limited to the shape as shown in Figure 1. The compression ring 10 can have a barrel-faced outer periphery 17 as seen in Figure 3, an upwardly tapered outer periphery 18 as seen in Figure 4, or an upwardly tapered outer periphery with an undercut edge 19 as seen in Figure 5. In thecase that the compression ring 10 has a tapered outer periphery 18 with an undercut edge 19, its inside upper edge is not always bevelled, as seen in Figure 6. The compression rings of Figures 3 to 6 are easily twistable to warp up the outer periphery in the form of a dish and effective to seal up gas and prevent blow-by in the same manner as that of Figure 1.

For the purpose of improving the sealing effect, the compression ring desirably has a narrow or double stepped split-gap. The opposite portions of the upwardly tapered outer periphery 18 remain without being undercut in the vicinity of the rectangular gap 15 of Figure 7 and the double stepped gap 16 of Figure 8 in the case of a compression ring 10 having an outside lower undercut edge 19.

CLAIMS

1. A piston-ring combination comprising a compression ring and an oil ring respectively installed in compression- and oil-ring grooves formed in a piston which is to reciprocate within a cylinder, the compression ring having inside and outside lower edges and being easily twistable to warp up its outer periphery in the compression-ring groove so that its outside lower edge will contact the inner wall of the cylinder and so that its inside lower edge contacts the bottom wall of the compression-ring groove, the oil ring having outside upper and lower edges bevelled to provide a reduced annular surface for contacting engagement with the inner wall of the cylinder.

2. A piston-ring combination as claimed in claim 1, in which the compression ring has a generally rectangular cross-section and a bev-

elled inside upper edge.

3. A piston-ring combination as claimed in claim 1 or 2, in which the compression ring has a barrel-faced outer periphery.

4. A piston-ring combination as claimed in claim 1 or 2, in which the compression ring has an upwardly tapered outer periphery.

5. A piston-ring combination as claimed in claim 4, in which the upwardly tapered outer periphery is formed with an undercut outside lower edge except in the vicinity of a split gap of the compression ring.

6. A piston-ring combination as claimed in claim 1, in which the compression ring has a generally rectangular cross-section and an upwardly tapered out periphery and is formed with an undercut outside lower edge except in the vicinity of a split gap of the compression ring.

7. A piston-ring combination substantially as described with reference to, and as shown in, the accompanying drawings.

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