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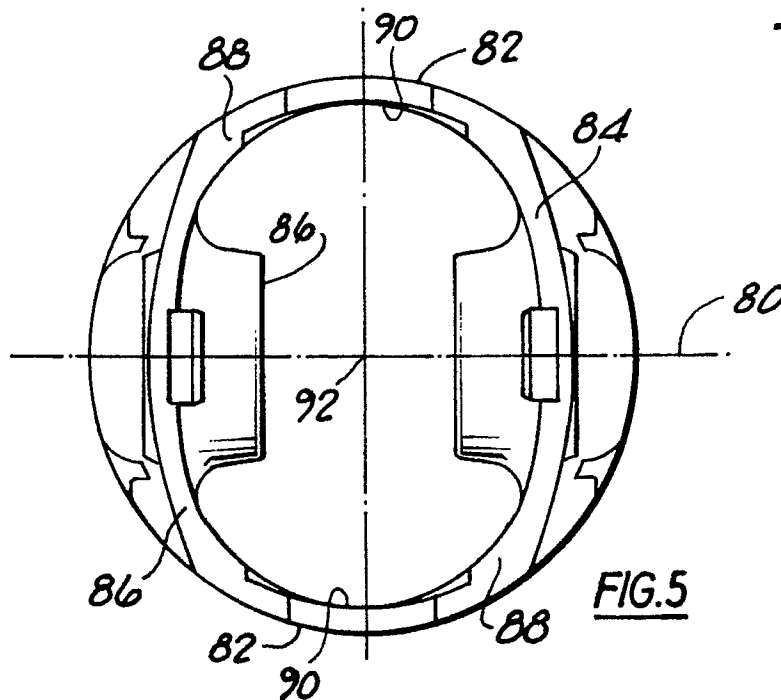
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54 **Pistons.**

57 Pistons are described including a crown portion, gudgeon pin bosses (58) and a skirt portion, the skirt portion comprising thrust faces (70,72) which are joined at their outer extremities (66,68) by curved skirt wall members which include the gudgeon pin bosses characterised in that when viewed along the

piston axis (64) towards the open, lower-end of the skirt portion, the skirt wall members present an oval form, at least from the lower external surface (56) of the gudgeon pin bosses (58) to the open lower extremity of the skirt.



**FIG.5**

EP 0 430 362 A1

## PISTONS

The present invention relates to pistons for internal combustion engines and compressors.

The skirts of pistons for internal combustion engines and compressors have generally been of either a substantially cylindrical form when viewed from the open end or have appeared to comprise two circular arcs, constituting the piston thrust faces, joined at their circumferential ends by generally planar panels extending normally to the wrist pin axis. This statement ignores the fact that the piston thrust faces are machined to a slightly oval curvature, the degree of which is not normally visible to the naked eye.

In the first instance the fully cylindrical skirt suffers from the disadvantage of being relatively heavy; it being highly desirable to reduce reciprocating mass in an engine.

The second type of conventional piston having generally planar panels between the thrust faces, and known in the art as a "slipper" piston, whilst being lighter than the cylindrical piston, has other disadvantages. These disadvantages lie in the fact that there is a high stress concentration at the junction between the thrust face arcs and the planar panels and there is a steep, skirt stiffness gradient from the centre of the thrust faces to the thrust face/panel junction.

Because of the high stiffness gradient, a high ovality, i.e. a large departure from a truly circular form, is required on the thrust faces to prevent "scuffing" at the thrust face to panel junction where the stiffness is greatest. "Scuffing" is localised seizure of the piston with the co-operating cylinder wall. A disadvantage stemming directly from the high ovality is that a narrow contact bearing land is formed between piston and cylinder which leads to high noise generation and perhaps some piston instability. A further disadvantage in some engine designs which may be prone to detonation or have bores prone to distortion from true cylindrical form due to siamesing, for example, is that a high ovality piston is intolerant; the higher loads due to detonation or distortion cause even more skirt deformation which again leads to scuffing, notwithstanding the high ovality, and consequently greater noise due to piston slap.

According to the present invention there is provided a piston, the piston including a crown portion, gudgeon pin bosses and a skirt portion, the skirt portion comprising thrust faces which are joined at their outer extremities by curved skirt wall members which include the gudgeon pin bosses characterised in that when viewed along the piston axis towards the open, lower-end of the skirt portion, the skirt wall members present an oval form,

at least from the lower external surface of the gudgeon pin bosses to the open lower extremity of the skirt.

If desired the oval form of the skirt wall members may extend over substantially all of the axial length of the skirt below the crown, the crown being considered to also include all of the piston ring grooves, or over any intermediate length of skirt.

In gravity cast pistons there is generally a feature known as a "stiffening belt" which is a radially thickened portion of the skirt occurring at an axial level around the lower region of the gudgeon pin bosses and generally extending around a major proportion of the skirt periphery. Some pistons have a gap in the stiffening belt, generally coinciding with the circumferential centres of the thrust faces. Preferably, the oval open end shape lies at or about the axial level of the stiffening belt and axially below.

The oval appearance of the skirt open end may be formed by the skirt wall members comprising arcs of circles having centres of curvature offset from the piston axis.

In order that the present invention may be more fully understood examples will now be described by way of illustration only with reference to the accompanying drawings, of which:

Figure 1 shows a composite view of open ends of prior art pistons; the left-hand side being of a conventional, substantially cylindrical piston and the right-hand side of a conventional "slipper" type piston;

Figure 2 shows the open end of a piston according to the present invention;

Figure 3 shows a section through the plane including the piston axis and the normal to the gudgeon pin axis of the piston of Figure 2;

Figure 4 shows a section taken at the level of the gudgeon pin axis of a second embodiment of a piston according to the present invention; and

Figure 5 which shows the piston of Figure 4 when viewed along the piston axis towards the open end.

Referring now to the left-hand side of Figure 1 and where the piston skirt 10 is of substantially circular construction and has a stiffening belt 12 disposed around the inner peripheral wall 14 of the skirt 12. The stiffening belt 12 is thickest at a plane containing both the piston axis 16 and gudgeon pin axis 18. The stiffening belt is present to control the stiffness gradient at the lower skirt end and lies adjacent the lower extremity of the gudgeon pin bosses 20. Although this design of piston has many advantages in terms of the ability to control

skirt stiffness it is nevertheless relatively heavy. The slipper type piston shown on the right-hand side of Figure 1 is lighter in weight than a cylindrical piston due to the reduced quantity of metal needed in construction. The piston has thrust faces 30, 32 linked at their outer extremities 34, 36 by generally planar skirt wall panels 38. The stiffness gradient from the centre 40 of the thrust faces to the outer extremities 34, 36 is very high, leading to scuffing in these outer regions.

The piston shown in Figures 2 and 3 has an oval shaped open end as defined by the skirt wall members 50, 52. A stiffening belt 54 of thicker material is included at a level adjacent the lower extremity 56 of the gudgeon pin boss 58. The oval shape comprises the arcs of circles having centres 60, 62 displaced from the piston axis 64. The walls 50, 52 join the outer extremities 66, 68 of the thrust faces 70, 72. The oval shape extends from the stiffening belt 54 to the lowest extremities of the piston; above the belt 54, in the region of the gudgeon pin bosses the walls 50 become waisted as indicated by the dashed lines 74. However, the presence of the oval open end, where skirt flexibility is highest, has been found to reduce the stiffness gradient, allowing lower ovality on the thrust faces themselves and to obviate any scuffing tendencies whilst reducing weight compared with a circular section piston.

Figures 4 and 5 show a piston having an oval open end, which oval section is continued along substantially the whole of the axial length of the skirt. Figure 4 is a section taken through the gudgeon pin axis 80. The thrust faces 82 are joined by curved walls 84 which also include gudgeon pin bosses 86. A stiffening belt 88 is also included, but which has a gap 90 at the centre of the skirt about the plane including both the piston axis 92 and the normal to the gudgeon pin axis 80.

Although the above pistons have been described where the skirt walls joining the thrust face extremities have been formed from arcs of circles having their centres offset from the piston axis, the walls may be of non circular form.

the lower external surface (56) of the gudgeon pin bosses (58) to the open lower extremity of the skirt.

- 5 2. A piston according to claim 1 characterised in that the skirt wall members (84) extend over substantially all of the axial length of the skirt below the crown.
- 10 3. A piston according to claim 1 characterised in that the lower end of the skirt also includes an axially extending portion of thickened material (54;88), the oval form of the open lower end of the skirt portion coinciding with this axially extending, thickened portion.
- 15 4. A piston according to any one preceding claim characterised in that the oval appearance of the skirt open end is formed by the skirt wall members comprising arcs (50, 52) of circles having centres (60,62) offset from the piston axis (64).
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### Claims

1. A piston, the piston including a crown portion, gudgeon pin bosses (58;86) and a skirt portion, the skirt portion comprising thrust faces (70,72;82) which are joined at their outer extremities (66,68) by curved skirt wall members (50,52;84) which include the gudgeon pin bosses characterised in that when viewed along the piston axis (64;92) towards the open, lower-end of the skirt portion, the skirt wall members present an oval form, at least from
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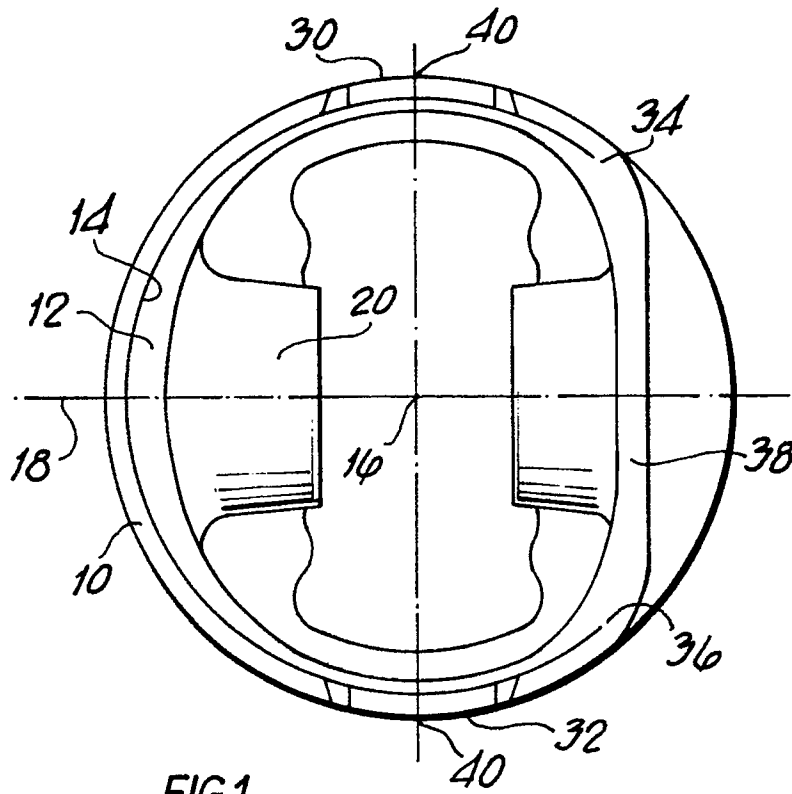


FIG. 1  
PRIOR ART

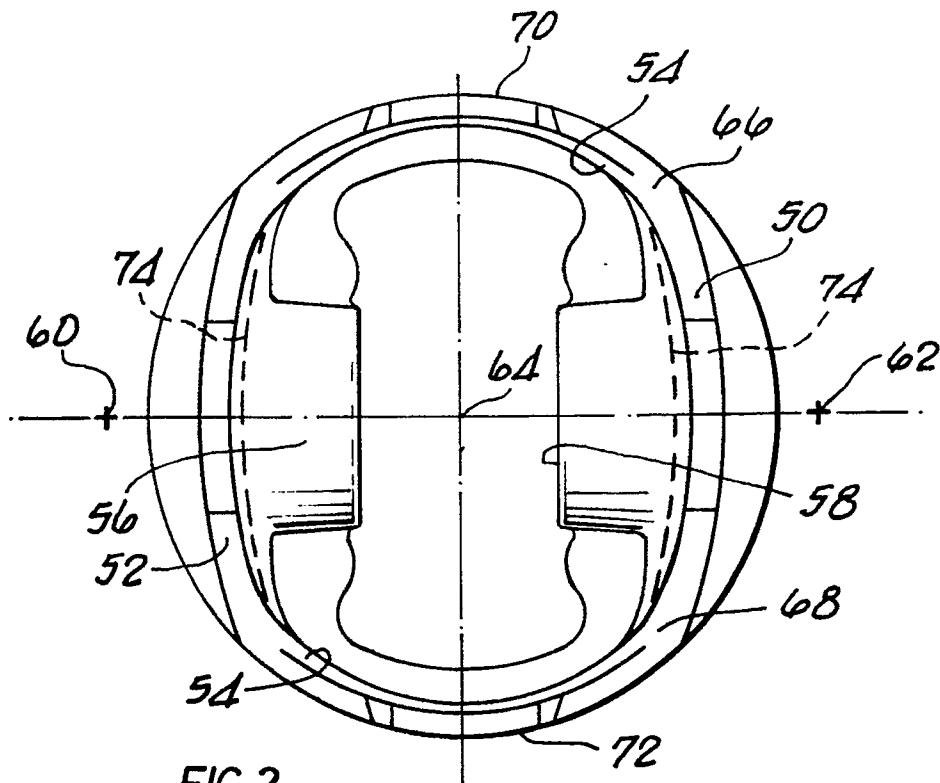


FIG. 2

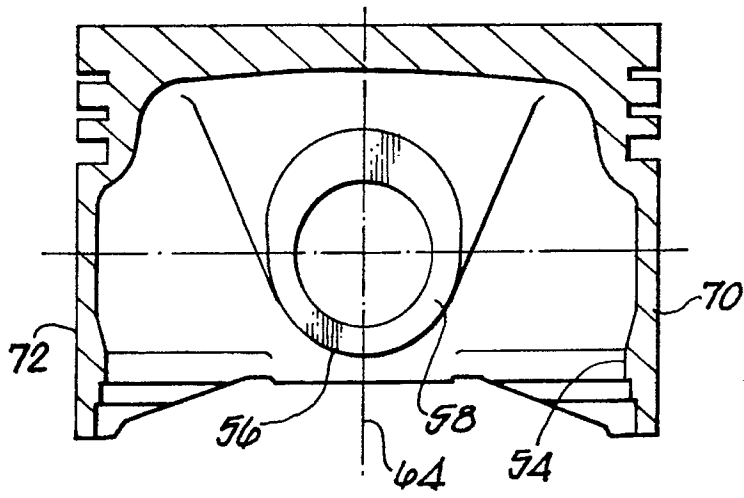


FIG. 3

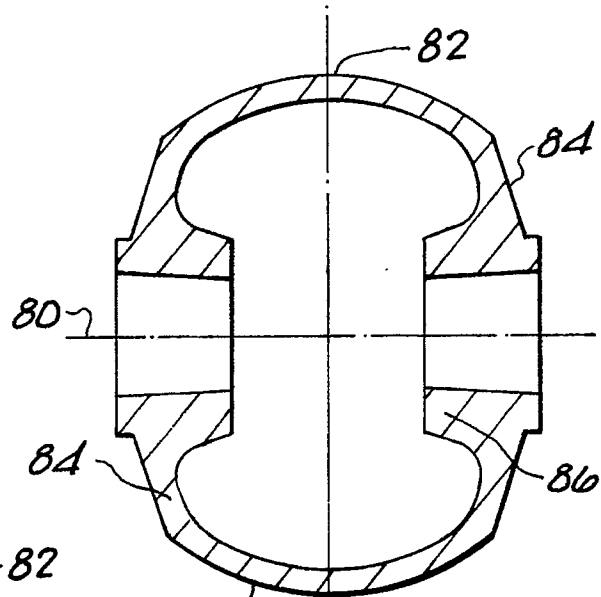


FIG. 4

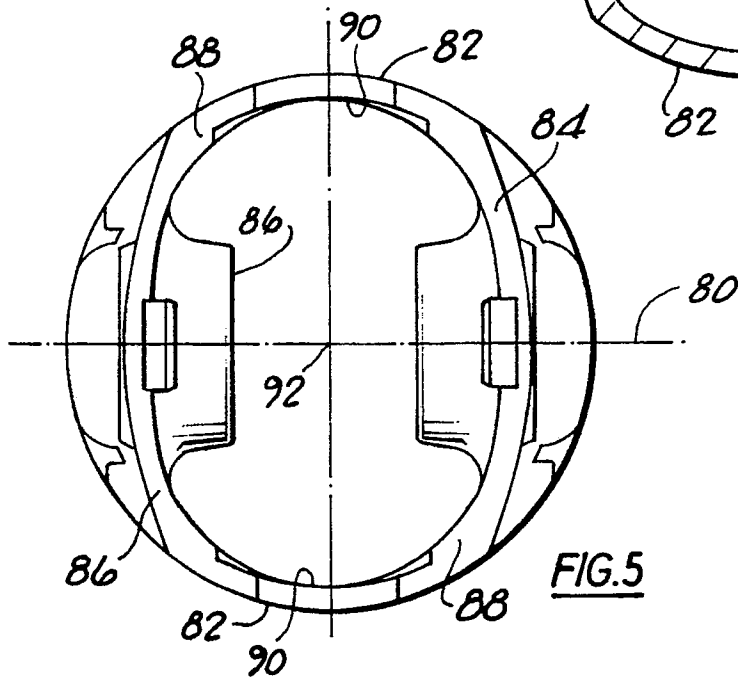


FIG. 5



EUROPEAN SEARCH  
REPORT

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.5)
A	GB-A-1 002 060 (KARL SCHMIDT GMBH) * the whole document * - - -	1	F 02 F 3/02
A	CH-A-2 252 28 (KARL SCHMIDT GMBH) * the whole document * - - -	1	
A	DE-A-1 475 846 (KARL SCHMIDT) * page 5, paragraph 1 - page 5, paragraph 1 * - - -	1	
A	WO-A-8 807 132 (KIEVSKY AVTOMOBILNO) * abstract * - - - - -	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F 02 F F 16 J
The present search report has been drawn up for all claims			
Place of search	Date of completion of search	Examiner	
The Hague	07 February 91	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	