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(54) **Piston crown for an internal combustion engine.**

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Description

The present invention relates to piston crowns for the piston of internal combustion engines.

One known construction of piston crown is illustrated in Figure 1. In this Figure, the piston crown 01 is formed with an annular support skirt 02, which projects form the inner surface 06 of the top (head) wall 05 said crown, the free edge of the skirt providing an annular butt surface 07 which is supported by the periphery of the upper (head) surface 03a of its associated piston rod 03. The annular skirt 02 holds the crown spaced above the upper surface 03a of the piston rod, and the skirt 02 divides this space into coolant liquid chambers 08 and 09 which are connected by a coolant liquid passageway 04 which extends through said skirt 02. In such a piston crown, gas pressure exerted upon the piston crown 01 is transmitted via the support skirt 02 to the piston rod 03. However, there is a disadvantage with such a crown in that, due to deformation of the crown caused by the gas pressure, an uneven surface pressure and/or relative displacement in the radial direction tends to arise between the butt surface 07 of the support skirt 02 and the piston ring 03, and so, fretting may sometimes occur on said butt surface.

An object of the present invention is to provide a piston crown, in which occurrence of fretting on the butt surface of the support skirt and/or the head surface of its associated piston rod can be prevented.

According to the present invention a piston crown for an internal combustion engine piston of the kind having an annular support skirt which projects from an inner surface of the top (head) wall of said crown with its free edge providing a flat butt surface which is only axially supported on the flat head surface of its associated piston rod, the annular butt surface and the piston rod being fastened together by means of a plurality of circumferentially spaced bolts, is characterised in that the annular support skirt is angled (or tilted) radially so that the inner and outer diameters of said annular support skirt at a point adjacent the inner surface of said head wall is larger than the inner and outer diameters thereof at a point where its butt surface engages said head surface of the piston rod, the angle is such that the bending moments working on the butt surface caused by the gas pressure exerted upon the outer surface of the crown and the gas pressure exerted upon the side surface of the crown offset each other, whereby uneven surface pressure and relative displacement in the radial direction between the support skirt and head surface is reduced to substantially zero for preventing the occurrence of fretting.

Thus, the invention provides for the surface pressure on said butt surface to be kept constant against a varying load of gas pressure, so that displacement in the radial direction of said butt surface may be restricted to zero, or at least to a minute value, thereby virtually eliminating wear at this point, and consequently prolonging the life of the crown/piston rod assembly.

The present invention can be widely applied to internal combustion engines.

The above-mentioned and other features and objects of the present invention will become more apparent by reference to the following description of two preferred embodiments of the invention taken in conjunction with the accompanying drawings, in which:

Figure 1 is a cross-sectional view showing one known form of piston crown,

Figure 2 is a cross-sectional view showing a piston crown according to a first preferred embodiment of the present invention, and,

Figure 3 is a cross sectional view showing a piston crown according to a second preferred embodiment of the present invention.

Referring now to Figure 2, in said first embodiment, the piston crown 01 is basically similar to the known form described in Figure 1 and like parts have the same reference numbers. However, in accordance with the invention, the annular support skirt 02a is angled (or tilted), radially, as shown, so that its inner diameter D_1 at the point adjacent the inner surface 06 of the head wall 05 of the crown is larger than its inner diameter D_2 at the point adjacent the head surface 03a of the piston rod 03. The particular shape and dimensions of the above-described annular support skirt 02a for any particular application can be determined by a calculation method, such as a finite element method, or the like. The annular butt surface 07 of the support skirt 02a butts against the peripheral part of the head surface 03a of the piston rod 03, and they are fastened together by means of a plurality of circumferentially spaced bolts 010.

In use of a piston crown constructed as described above, upon operating the internal combustion engine equipped therewith, gas pressure exerted upon the outer surface 011 of the head wall 05 of the piston crown 01 is transmitted through the annular support skirt 02a to the piston rod 03.

In such instance, if the heretofore known support skirt 02 as shown in Figure 1 is used, then by a resultant force of the gas pressure exerted substantially in the vertical direction upon the outer surface 011 of the piston crown 01 and gas pressure exerted substantially in the horizontal direction upon the side surface 013 above the piston ring grooves 012 of the piston crown 01, there would be a tendency for the butt surface 07 of the support skirt 02 to produce a gap clearance from the head surface 03 around its outer periphery, whereas around the inner periphery of said butt surface, it would press strongly against said head surface 03a, resulting in unevenness of pressure produced by the butt surface 07, and hence a tendency for relative displacement in the radial direction between the support skirt 02 and the piston rod 03 to occur.

On the other hand, in the piston crown having

the free edge of the support rib 02 displaced towards the center of the piston crown, as is the case with the angled annular support skirt 02a according to the present invention, due to the inner diameter D_1 being larger than the inner diameter D_2 as described above, at the butt surface 07, gas pressure exerted upon the outer surface 011 of the crown generates a clockwise bending moment M_1 as viewed in Figure 2, while the gas pressure exerted upon the side surface generates an anticlockwise bending moment M_2 as viewed in Figure 2, and these bending moments M_1 and M_2 can be made to offset each other, so that the pressure produced by the butt surface 07 is made uniform and, consequently, relative displacement in the radial direction between the annular support skirt 02a and the piston rod 03 is reduced to zero or virtually eliminated.

By emplpoying a piston crown constructed as described above in accordance with the invention, the following advantage can be obtained. That is, since the surface pressure unevenness as well as relative displacement in the radial direction at the butt surface 07 between the support skirt 02a and the piston rod 03, are reduced to zero or minimized, generation of fretting on that butt surface can be prevented. Thereby, wear of the piston crown 01 and the piston rod 03 can be precluded.

In the second preferred embodiment of the present invention illustrated in cross-section in Figure 3 the piston crown 01 is basically similar to the first embodiment, except that it is provided with two annular support skirts as shown, although in general any appropriate number of support skirts could be provided. In Figure 3, in addition to the support skirt 02a as described in the first embodiment, a further support skirt 015 of smaller diameter is provided and is fixed to the piston rod 03 by circumferentially spaced bolts 015.

The further skirt 014 divides the chamber 08 into two smaller chambers 08a and 08b and these are connected by a further coolant passageway 4a. The inner diameters D_1 and D_3 adjacent the surface 06 of the head wall 05 of the crown 01 of the larger diameter support skirt 02a and the smaller diameter support skirt 014, respectively, are formed larger than their respective inner diameters D_2 and D_4 adjacent the head surface 03a of the piston rod 03. The fixing bolts 015 could be omitted, if necessary.

The effects and advantages of the embodiment shown in Figure 3 are similar to those of the first preferred embodiment shown in Figure 2.

While the present invention has been described above in connection with two preferred embodiments, as a matter of course it is intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

Claims

1. A piston crown for an internal combusion engine piston of the kind having an annular support skirt (02) which projects from an inner surface (06) of the head wall (05) of said crown (01) with its free edge providing a flat butt surface (07) which is only axially supported on the flat head surface (03a) of its associated piston rod (03), the annular butt surface (07) and the piston rod (03) being fastened together by means of a plurality of circumferentially space bolts (010), characterised in that the annular support skirt (02a) is angled (or tilted) radially so that the inner (D_1) and outer diameters of said annular support skirt at a point adjacent the inner surface (06) of said head wall (05) is larger than the inner (D_2) and outer diameters thereof at a point where its butt surface (07) engages with head surface (3a) of the piston rod (03), the angle is such that the bending moments working on the butt surface caused by the gas pressure exerted upon the outer surface of the crown and the gas pressure exerted upon the side surface of the crown offset each other, whereby uneven surface pressure and relative displacement in the radial direction between the support skirt and head surface is reduced to substantially zero for preventing the occurrence of fretting.

2. A piston crown in an internal combustion engine as claimed in Claim 1, characterised in that at least two annular support skirts (02a, 014) are provided in radially juxtaposed relationship, each being of larger inner diameter (D_1, D_3 respectively) where they project from said inner surface of the head wall than their respective inner diameters (D_1, D_2) adjacent their said butt surfaces.

Patentansprüche

1. Kolbenboden für den den Kolben einer Verbrennungskraftmaschine mit einer ringförmigen Tragschürze (02), die von einer inneren Fläche (06) der oberen Wand (05) des Bodens (01) hervorragt und dabei mit ihrem freien Ende eine flache Anschlagfläche (07) bildet, die ihrerseits auf der flachen oberen Fläche (03a) der zugeordneten Kolbenstange axial ruht, dadurch gekennzeichnet, dass die ringförmige Tragschürze (02a) radial derart abgewinkelt (oder geneigt) ist, dass der Innendurchmesser (D_1) und der Aussendurchmesser der genannten ringförmigen Tragschürze an einer Stelle im Bereich der inneren Fläche (06) der genannten oberen Wand (05) grösser als deren innerer und äusserer Durchmesser (D_2) an einer Stelle ist, an welcher ihre Anschlagfläche (07) an der oberen Fläche (3a) der Kolbenstange (03) angreift, dass der Winkel derart gewählt ist, dass die auf die Anschlagfläche (07) wirkenden Biegemomente, die durch den auf die Aussenfläche des Bodens (01) wirkenden Gasdruck hervorgerufen sind, und der Gasdruck, der auf die Seitenfläche des Bodens (01) ausgeübt wird, einander aufheben, und dass ein un-

gleichmässiger Flächendruck und eine relative Verschiebung in radialer Richtung zwischen der Tragschürze (02) und der oberen Fläche (03a) im wesentlichen auf null reduziert wird, um ein Fressen zu vermeiden.

2. Kolbenboden einer Verbrennungskraftmaschine nach Anspruch 1, dadurch gekennzeichnet, dass wenigstens zwei ringförmige Tragschürzen (02a, 014) radial einander gegenüberliegend vorgesehen sind, deren jede an der Stelle, an welcher sie von der inneren Fläche der oberen Wand hervorragen, einen grösseren inneren Durchmesser (D_1 bzw. D_3) haben als ihre jeweiligen inneren Durchmesser (D_2, D_4) im Bereich ihrer genannten Anschlagflächen.

Revendications

1. Tête de piston pour moteur à combustion interne, du type comportant une jupe annulaire de support (02) faisant saillie à partir de la surface intérieure (06) du plateau (05) de la tête de piston (01), le bord libre de cette jupe formant une surface de butée plate (07) qui est supportée seulement axialement par la surface frontale (03a) de la tige de piston associée (03), la surface annulaire de butée (07) et la tige de piston (03) étant fixées mutuellement au moyen d'une série de boulons (010) espacés en direction circonférentielle, caractérisée en ce que la jupe annulaire de support (02a) est oblique (ou inclinée) radialement de telle manière que les diamètres intérieur (D_1) et extérieur de ladite jupe en un point adjacent à la surface intérieure (06) dudit plateau (05) sont plus grands que ses diamètres intérieur (D_2) et extérieur en un point où sa surface de butée (07) est en appui contre la surface frontale (03a) de la tige de piston (03), l'angle d'obliquité étant tel que les moments de flexion respectifs agissant sur la surface de butée sous l'effet de la pression des gaz exercée sur la surface extérieure de la tête et sous l'effet de la pression des gaz exercée sur la surface latérale de la tête se compensent mutuellement, de sorte qu'un défaut d'uniformité de pression et un déplacement relatif en direction radiale entre la jupe de support et la surface frontale sont réduits sensiblement à zéro pour empêcher la production d'une érosion.

2. Tête de piston pour moteur à combustion interne selon la revendication 1, caractérisée en ce qu'elle comporte au moins deux jupes annulaires de support (02a, 014) juxtaposées radialement, chacune d'elles ayant un diamètre intérieur plus grand (resp. D_1, D_3), là où elle est raccordée à ladite surface intérieure du plateau de la tête de piston, que son diamètre intérieur (D_2, D_4) à proximité de ladite surface du butée.

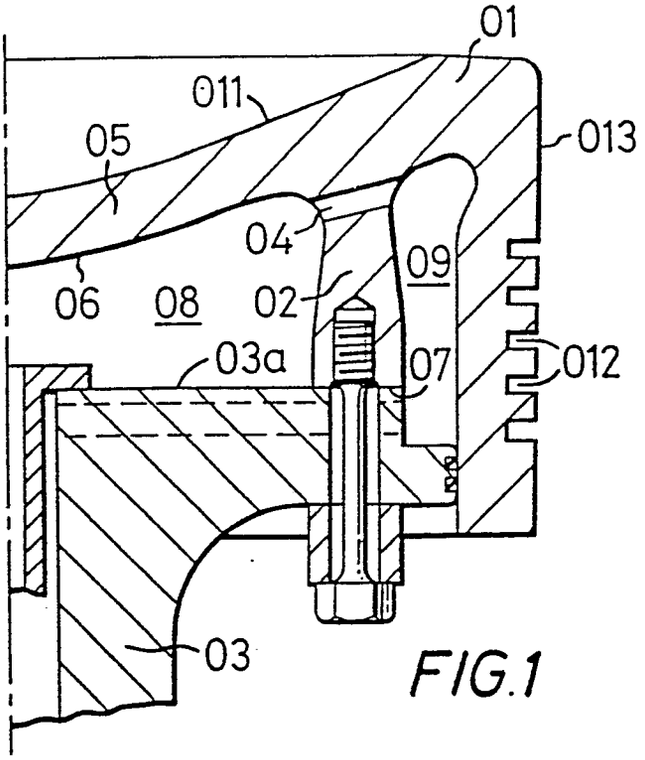
01
011
05
013
04
09
06
08
02
012
07
03a
03

FIG.1

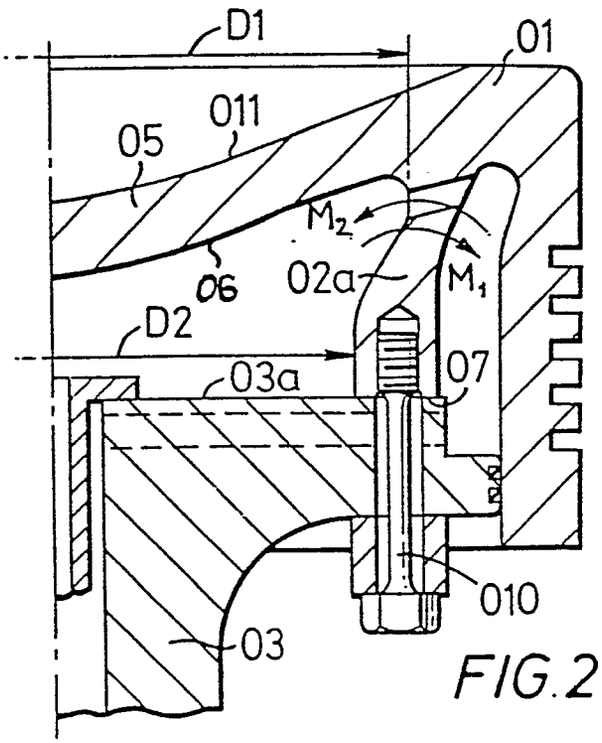
D1
01
011
05
M2
06
02a
M1
D2
07
03a
010
03

FIG.2

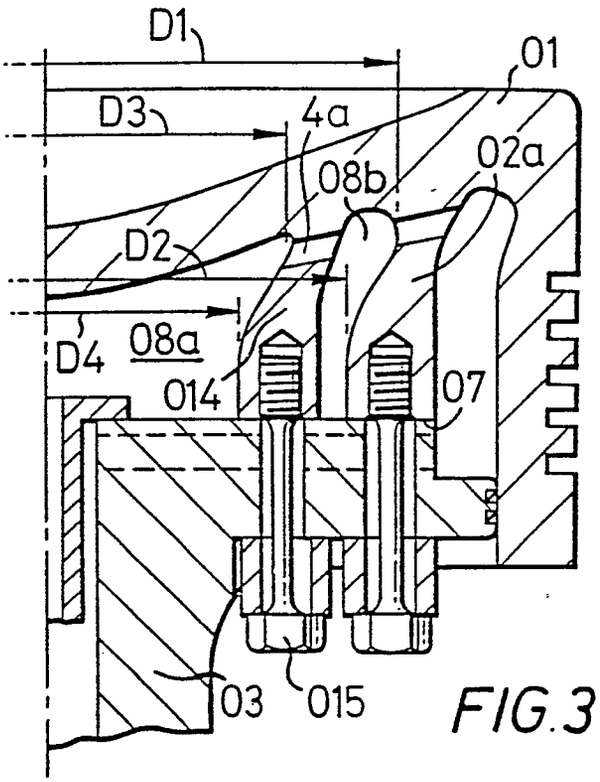

FIG.3