PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and relating to the Packing of the Pistons of Internal Combustion Engines.

I, HUGO JUNKERS, a German Citizen, of 21, Kaiserplatz, Dessau, Anhalt, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

The pistons of internal combustion engines are usually packed in relation to the cylinders by means of one or more rings inserted in grooves in the piston body, the outer surface or surfaces of the ring or rings bearing against the cylinder wall. The rings are rendered resilient or flexible by splitting them at one point or they may be notched at several points to obtain the same results. In order to obtain reliable packing, the rings must fit all round as uniformly as possible, against the inner wall of the cylinder. Attempts have been made to obtain this contact by specially treating the rings, such as by hammering the insides, thereof, or also by means of the gas pressure in the interior of the cylinder, for example by admitting said pressure into the inner side of cupped rings rendered flexible by notching. It has, however, been found that these means are not always sufficient to provide a satisfactory packing, and travel of the piston rings over the sliding-contact surface, trouble occurring particularly when the cylinder is not truly round. In such case, the ring will no longer fit all round the cylinder wall, but leaves, here and there, gaps through which the hot gases escape from the interior of the cylinder to the outside, and, in so doing, heat the ring unduly and either burn or blow out the lubricating oil. This causes the ring to seize in its groove, and it is then no longer able to perform its functions. This seizing occurs the more readily since the usual ring can only exert a restricted spring pressure, on the one hand, because the thickness of the ring is limited in view of its having to be slipped over the piston, and also because otherwise the friction of the ring against the cylinder wall would be excessive. Experience has shewn that even the provision of several rings on the piston does not remedy this drawback, inasmuch as the rings seize one after the other.

It has previously been proposed to use closed packing rings but it has not hitherto been recognized that in order to ensure a correct packing and at the same time avoid seizing, a flow of heat from the ring to the cylinder wall is necessary and that steps must be taken to produce such a flow of heat. The known rings are not suitably shaped to cause this flow of heat as either only a small part of the surface comes into contact with the cylinder wall so that heat will not flow in sufficient strength or with sufficient certainty, or the radial dimension of the rings is relatively great in comparison with their axial dimension, so that the rings are not flexible and are prevented from expanding freely.

According to the present invention, a solid ring of uniform cross section in all parts of its periphery, is used for packing the piston in relation to the cylinder, because, owing to the perfectly uniform distribution of constructional material over the entire periphery, such a ring affords the most certain prospect of a uniform bearing against the cylinder wall all round.

The employment of such a ring, however, is open to the objection that, by reason of the inevitable fluctuations in the thermal conditions of the engine and the resulting changes in the expansion of the ring through heat, it is impossible to adjust it in the cylinder in such a manner that it will always fit correctly therein and therefore will not alternately have too much play at one time and thus leak, and expand so much at another time as to seize.

The problem of the invention is therefore to regulate the amount of play between the ring and the cylinder wall (the fit of the ring), so that on the one hand, the packing effect is assured, and on the other, seizing of the ring is prevented, even during changes in the thermal condition of the engine.

According to the invention, the automatic regulation of the fit of the ring is

effected by means of a flow of heat from the ring to the cylinder wall. Such flow of heat can be produced by inserting the ring in the body of the piston, in close proximity to the combustion chamber, so that, when in operation, it becomes strongly heated by the hot gases contained in the combustion chamber, and either directly by contact or indirectly by transmission from the hot piston to the ring. In this way there occurs, between the heated ring and the externally cooled cylinder wall, a temperature drop resulting in the contemplated flow of heat.

The ring is radially displaceable in relation to the piston, so that its expansion, on heating, is not impeded by the latter. The fit of the ring in the cylinder is such that there is a certain small play between the two in the cold.

When the engine is started, the result of this play is that the resistance to heat transmission from the ring to the cylinder is still considerable. The ring accordingly is rapidly heated by the gases of combustion and consequently expands, thus progressively decreasing the distance between the ring and the cylinder wall, and therefore the resistance to heat transmission. On this account, the flow of heat from the ring to the cylinder wall progressively increases, until, finally, when the ring attains a certain temperature, a state of equilibrium is set up in which the amount of heat absorbed and given out by the ring is identical. This state of equilibrium is established in all cases, irrespective of the load on the engine, though, in accordance with the greater generation of heat in the cylinder, the flow of heat from the ring to the cylinder is stronger when the engine load is heavy than when it is light. This difference in the flow of heat from the ring, however, has an equalising influence on its temperature, so that the latter undergoes comparatively little change, even under considerable fluctuations of load. Consequently, if the initial play be arranged accordingly, reliable packing, without risk of seizing, will be obtained under all conditions of load.

Since, especially when air cooled, the cylinder will be hotter in the vicinity of the clearance than in the parts more remote therefrom, the increase in the internal diameter of the cylinder, through expansion by heat, will also be greatest in the vicinity of the clearance. Now, in order that the solid piston ring which in view of the dimensions of its circumference can only " give " to a slight extent, will bear as uniformly as possible in all parts of the cylinder, during the reciprocating movement of the piston, that is to say, neither seizes nor fits too loosely, it is advisable to construct the cylinder in such a manner that, when cold, the internal diameter is slightly smaller, in the vicinity of the clearance than in the more remote portions, so that, under the thermal conditions obtaining when running, the diameter of the piston track may be as nearly uniform as possible throughout.

The ring is so designed that its thickness i.e. the dimension transverse in relation to the axis of the piston, is small in comparison with its diameter. Such design affords various advantages. In the first place, the temperature drop in the ring, from its heat-absorbing inner side to its outer side which transmits the heat to the cylinder wall, is small, and the ring will therefore not become unduly hot in any part. Above all, such a comparatively thin ring will continue to produce a good packing effect when the cylinder cross section has deviated slightly from a true circle and therefore, as the result, for example, of irregular distribution of temperature, uneven wear, or the like, has become somewhat oval, since the expansive thrust set up in the comparatively flexible ring by the heat, pushes the ring into these slightly non-circular portions of the cavity of the cylinder as well, so that it also makes a good fit therewith.

It is preferable to construct the ring of material with a small modulus of elasticity, since the ring will then offer a lower resistance to the compression which may be produced, for example, by changes occurring in the diameter of the inner wall of the cylinder, along the track of the piston, so that, in such case, the friction between the ring and the cylinder wall, and therefore also the wear, will be less than with a ring material of a higher modulus of elasticity.

It is also advisable to construct the ring of material with a low coefficient of heat expansion, because the peripheral length of such a ring and therefore its fit in relation to the cylindrical wall, varies to only a very slight extent, under changes in the temperature of the ring which depend to some extent on the engine load.

As a rule, even a single ring of the new type will suffice to pack the piston, but several such rings may also be arranged in series.

To enable the invention to be fully understood it will now be described by

reference to the accompanying drawing in which two typical embodiments of the invention are illustrated in section along the axis of the cylinder.

In the example shewn in Fig. 1 a solid ring 5 is inserted in a recess 4, provided in that end of the piston 3 which is next the clearance 1 of the cylinder 2. Measured transversely in relation to the axis, this ring is comparatively thin. It is retained in position by an overlapping plate 7 secured on the base 6 of the piston. The annular groove formed by the plate 7 and recess 4 of the piston is of such dimensions as to allow the ring 5 freely to expand or contract at all times in relation to the piston. In this case, the heating of the ring up to working temperature is substantially effected by contact with, or radiation from, the hot body of the piston.

In the example shewn in Fig. 2, the solid ring 5^1 is applied on the outer surface of the base 6^1 of the piston. On the side nearest the piston 3^1, the ring is provided, all round, with a narrow, inwardly directed flange 8 engaging in an annular groove 9 provided in the rim of a plate 7^1 attached to the piston. Between the inner wall of the ring 5^1 and the lateral rim of the plate 7^1 is a space 10 which allows the ring to expand freely in accordance with its temperature, and assures direct access of the hot gases in the clearance 1 to the inner side of the ring. Such an arrangement prevents formation of carbon, otherwise readily occurring between the ring and the body of the piston, inasmuch as any carbon that may be formed in this space is burnt off at once, owing to the high gas temperature and the flow of gas therethrough.

In the case of engines with piston controlled cylinder ports, a further advantage is afforded by this type of ring, in that the ports are controlled by the free outer edge of the ring, which fits closely against the cylinder, so that very accurate control is obtained, whereas, with the usual method of controlling such ports by the terminal edge of the body of the piston, which is always at a certain distance, from the sliding-contact surface of the cylinder, the closing or uncovering of the ports is not so precise.

In the arrangement shewn, further rings 11, 12, 13 are provided on the piston in addition to the packing ring 5^1 situated next the combustion chamber. The rings 11 and 12, adjoining the ring 5^1, but on the side remote from the combustion chamber 1, are piston rings of the usual pattern and chiefly serve the purpose of assuring the close fit of the piston when starting the engine from cold, since, at that time the packing ring 5^1 may be still leaky. The ring 13 nearest the outer end of the piston serves, in known manner, for wiping surplus lubricating oil from the wall of the cylinder.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A packing for the piston of an internal combustion engine, wherein the gap between the piston and the cylinder is closed by a solid ring having a relatively small radial dimension compared with its axial dimension, displaceable in the radial direction in relation to the piston, the close fitting of the said ring against the cylinder wall, to produce the desired packing effect being automatically regulated by means of a flow of heat from the ring to the cylinder wall.

2. A piston packing according to claim 1, wherein the solid packing ring is so thin that it adapts itself, elastically, to any slight deviation from the circular form of the periphery of the cylinder, under the effort of expansion set up in the ring when heated.

3. A piston packing according to claim 1 or 2, wherein the packing ring is constructed of material with a low modulus of elasticity.

4. A piston packing according to any one of the preceding claims having, in addition to the solid packing ring situated next the combustion chamber, other packing rings of the ordinary type, for the purpose of assuring adequate packing of the piston in starting the engine even from the cold.

5. A piston packing according to any one of the preceding claims wherein the piston track of the cylinder is so designed that, when cold, it is slightly narrower in the vicinity of the clearance than in the portions remote from the latter, and in such a manner that the internal diameter is as uniform as possible throughout when the operative thermal condition is attained.

6. Packings for the pistons of internal combustion engines substantially as hereinbefore described with reference to the accompanying drawing.

Dated this 8th day of December, 1930.

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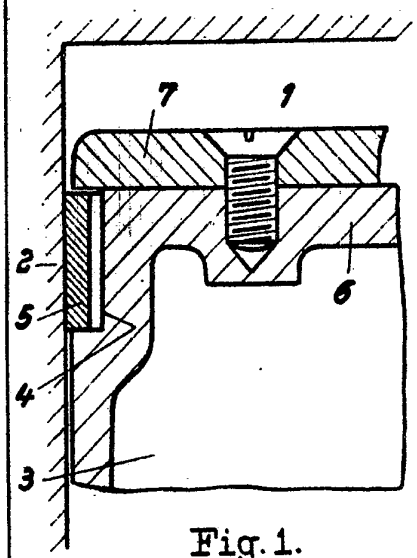

Fig. 1.

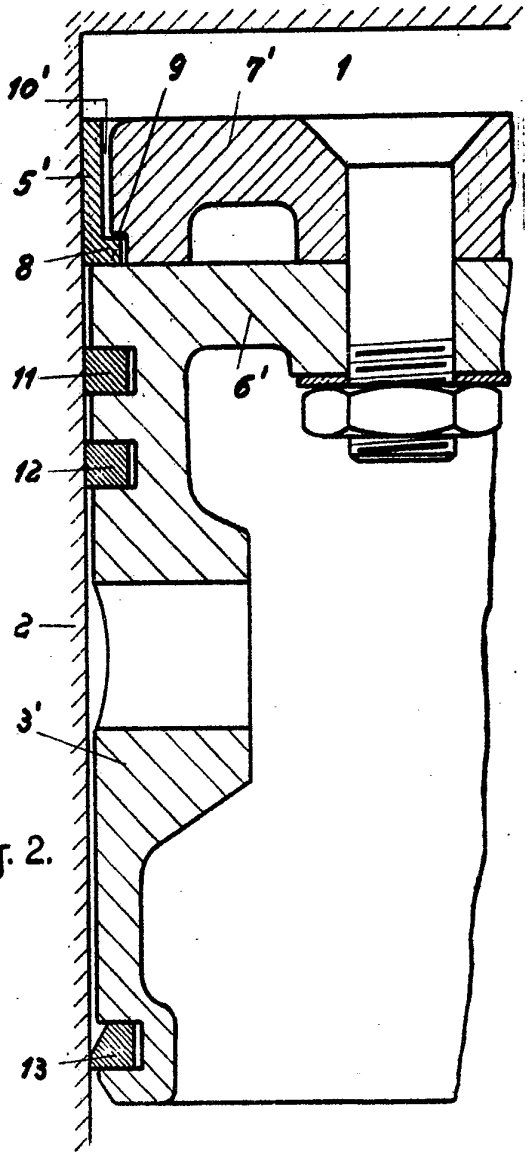

Fig. 2.

Charles & Read Ltd. Photo. Litho.