June 24, 1924. 1,499,073

L. H. POMEROY

PISTON

Filed Sept. 4, 1919

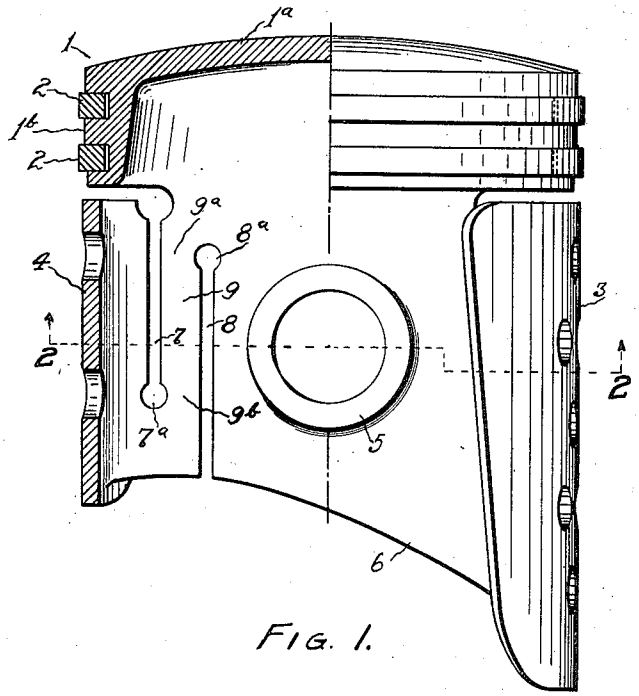


FIG. 1.

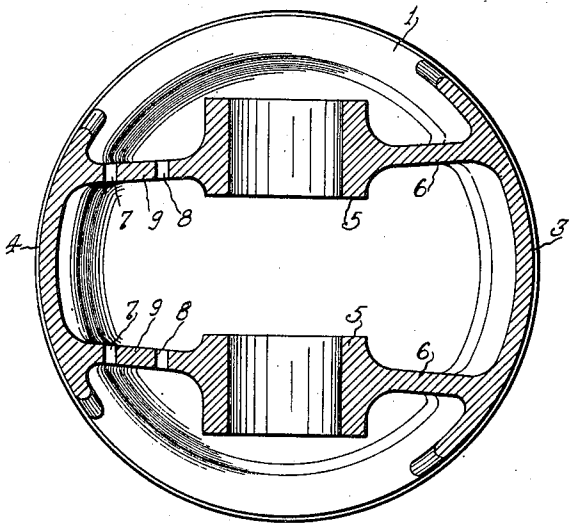


FIG. 2.

INVENTOR,
Laurence Henry Pomeroy
By Ray S. Sehr
his Attorney

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UNITED STATES PATENT OFFICE.

LAURENCE HENRY POMEROY, OF CLEVELAND, OHIO, ASSIGNOR TO THE ALUMINUM COMPANY OF AMERICA, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

PISTON.

Application filed September 4, 1919. Serial No. 321,696.

To all whom it may concern:

Be it known that I, LAURENCE HENRY POMEROY, a subject of the King of Great Britain and Ireland, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Pistons, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates more particularly to pistons adapted for use in internal combustion engines or under conditions in which the piston is subjected to considerable heat.

As is well known, the clearance with which the pistons of internal combustion engines are fitted is determined in a large measure by the difference in thermal expansion of the piston and the cylinder wall. This difference in thermal expansion is due to the fact that the working temperature of the piston is somewhat higher than that of the cylinder wall and, in some cases, to the use of different piston and cylinder materials having different co-efficients of thermal conductivity and expansion. Thus in the case of pistons of aluminum or magnesium alloys working in iron cylinders the co-efficient of expansion of the aluminum or the magnesium being higher than that of iron, it is necessary to give the pistons a larger clearance than is required for iron pistons working in iron cylinders. This larger clearance, with pistons as heretofore constructed, results in piston slap or knock when the engine is running cold at starting and, in fact, whenever the thermal conditions of the cylinder and piston are such that the large clearance required to obviate seizure at high temperatures exists between the piston and cylinder wall.

One object of the present invention is the provision of a piston of aluminum alloy or other light weight metal, that will operate without piston slap.

Another object of the invention is the provision of a piston so constructed that it can be given a small working clearance independent of differences of thermal expansion of the piston and the cylinder wall.

A further object of the invention is the provision of a piston capable of adjusting itself to the cylinder as wear occurs of the piston or cylinder or both.

Another object of the invention is the provision of a piston that will wear evenly from end to end.

Another object of the invention is the attainment of the ends above mentioned in an integrally cast piston.

These and other more or less incidental objects, are attained in the manner set forth in the following description of the preferred form of construction.

In the drawings,

Fig. 1 is a view partly in side elevation and partly in section of a piston embodying the invention.

Fig. 2 is a section on the line 2—2, Fig. 1.

My improvements are applicable to pistons of various forms of construction but in the drawings, for purposes of explanation, I have shown the invention applied to the slipper type of piston shown in United States Letters Patent No. 1,294,833, to H. R. Ricardo.

Referring in detail to the construction illustrated, the piston has a head section 1 comprising a crown 1^a and a side wall 1^b which is formed with grooves to receive suitable packing rings 2, 2. The guide section of the piston comprises diametrically opposite cylinder-engaging slippers 3 and 4, a pair of wrist pin bosses 5, 5 arranged between the slippers, and a pair of webs 6, 6 which join the slippers and bosses together and extend upward and merge with the crown and side wall of the head section of the piston, the entire piston being cast in one. Aside from the rings 2, 2, only the slipper parts 3, 4 are designed to contact with the cylinder wall, the piston differing in this respect from the prior trunk or skirted pistons which have a guide part in the form of a continuous sleeve or skirt that contacts with the cylinder wall on all sides.

In the construction shown the slippers 3 and 4 are made unequal in size, the larger slipper 3 being designed to take the angular thrust or reaction of the connecting rod during the explosion stroke of an internal combustion engine, while the smaller slipper 4 is designed to take the angular thrust during the compression stroke of the engine. The above described features of the construction are characteristic of the Ricardo slipper piston.

My improvements constituting the present invention are effected by forming the piston

so that some part of the guide structure is capable of resiliently yielding at points between the cylinder-engaging surfaces on opposite sides of the wrist pin to compensate for differences in thermal expansion of the piston and cylinder and I prefer to make the guide structure so that it will yield more readily between the wrist pin bosses and the cylinder-engaging surface which takes the thrust during the compression stroke of the piston, than between said bosses and the cylinder-engaging surface which takes the thrust during the explosion stroke. The means, when applied to the slipper type of piston illustrated, that the major yield shall occur between the pin bosses 5 and the cylinder-engaging surface of the slipper 4, and in the construction illustrated I have made provision for a resilient yielding in the webs 6, 6 which permits movement of the slipper 4 toward and from the slipper 3. To secure relative movement of the slipper 4 in parallelism, the web structure is formed to yield in two separated sections, which are preferably adjacent the respective ends of the slipper.

In the construction illustrated this is accomplished by forming each of the webs 6 with two parallel slots 7 and 8. the slot 7 being open at its upper end and closed at its lower end, while the slot 8 is closed at its upper end and open at its lower end. The slots 7 and 8 terminate at their closed ends with enlarged cylindrical aperatures 7^a and 8^a, respectively. Thus it will be seen that the slipper 4 is supported by elongated strips or sections 9 of the webs 6, and each of the sections 9 has reduced and weakened cross sections at 9^a and 9^b, so that any yielding of the web structure is localized at these points 9^a and 9^b.

My improved form of construction can be applied to pistons cast of any suitable metal but it is especially useful in connection with pistons of aluminum alloy or other light metals having high co-efficients of thermal expansion in comparison with iron as it makes it possible to fit such pistons with as small a clearance as is possible with iron pistons of prior forms of construction. Iron pistons of internal combustion engines fitted with a clearance of 0.00075 inch per inch of piston diameter are found to operate with substantial freedom from piston slap, and pistons of aluminum alloy made in accordance with my invention can readily be operated with similar clearances. Indeed a still smaller clearance is made possible by my invention.

In the operation of aluminum pistons of my improved form of construction, asuming a cold working clearance of 0.00075 inch per inch of piston diameter, or less, to insure freedom from piston slap when starting, as the engine heats up the excess expansion of the piston as compared with the surrounding cylinder wall of iron will reduce this clearance; but as the clearance approaches zero the construction of the piston webs permits them to yield so as to compensate for the excess expansion of the guide section of the piston and all danger of the seizing of the piston is obviated. When the engine is stopped and the parts again cool down the resilience of the web structure causes it to return to normal form and a suitable small clearance between the piston guide and the cylinder wall is maintained. It will, of course, be understood that the piston head proper is given a smaller diameter than the guide and does not function as a guide. As has been explained the yielding of the web structure occurs at the points 9^a and 9^b adjacent to the upper and lower parts of the slipper 4 so that the slipper 4 is maintained in parallelism with the axis of the cylinder. This insures uniform contact and wear throughout the full length of the slippers. As only a relatively light thrust, incident to the compression of the combustible charge in the engine cylinder, is applied to the smaller slipper 4, the resilient web structure is able to sustain the stresses to which it is subjected, it being possible, of course, to make the guide structure between the wrist pin bosses and the cylinder-engaging surface of the slipper 3 adequately strong to sustain the heavy thrust due to the explosion of the engine charge. This is an important feature of my invention since in most, if not all, cases it is found that a construction that is capable of yielding sufficiently to adequately compensate for differences of expansion, will fail if subjected to the angular thrust of the connecting rod in the working or explosion stroke of the piston.

It is to be understood that the dimensions of the yieldable web sections, as at 9^a and 9^b, will be determined by the diameter of the piston and other factors such as the compression pressure and the maximum engine speed, the requirements being that the web sections 9^a and 9^b yield sufficiently to prevent seizing under the pressure set up between the cylinder wall and the piston due to thermal expansion, but do not yield too much under the thrust due to compression and inertia, and that they yield, whether under said expansion pressure or under the thrust due to compression and inertia, in a manner to maintain the slipper 4 parallel to the piston axis.

It will be seen that the amount of yielding in the piston webs will be determined, for the most part, by the cold working clearance of the piston. By making this clearance sufficiently small the clearance will be rendered nil when the parts heat up in operation and a resilient pressure of the slippers against the cylinder wall will be secured.

Under these conditions the resiliency of the piston web structure will insure the maintenance of close working contacts between the slippers and the cylinder wall as wear of these parts occurs and, as above noted, the movement of the slipper 4 parallel to the piston axis will insure a uniform contact and wear of the parts throughout the full lengths of the slippers. In other words, my resiliently yieldable piston structure, by compensating for excess expansion of the piston, secures an automatic adjustment of the piston to the cylinder as wear occurs.

My improvements, while applicable in their broader aspects to other types of pistons, are especially applicable to the slipper type of piston illustrated and it will be seen that this is due, in part at least, to the fact that the yieldable web parts have no contact with the cylinder wall and thus are free, in so far as the cylinder is concerned, to accommodate themselves to the movement of those parts which do engage the cylinder.

It is obvious that my invention can be embodied in various forms of construction and it is to be understood that it is not limited to the particular construction illustrated in the drawing except as specified in the following claims.

What I claim is:

1. An integrally cast piston comprising a head, diametrically opposite guide slippers, a pair of wrist pin bosses between the slippers and a pair of webs joining the head, slippers and bosses together, said webs being formed at points between the bosses and one of the slippers so as to resiliently yield and permit movement of said slipper toward and from the other slipper.

2. An integrally cast piston comprising a head, diametrically opposite guide slippers, a pair of wrist pin bosses between the slippers and a pair of webs joining the head, slippers and bosses together, said webs being formed at points between the bosses and one of the slippers so as to resiliently yield and permit movement of said slipper in parallelism toward and from the other slipper.

3. An integrally cast piston comprising a head, diametrically opposite guide slippers, a pair of wrist pin bosses between the slippers and a pair of webs joining the head, slippers and bosses together, said webs being formed between the bosses and one of the slippers each with a pair of parallel slots of which one is open at its end adjacent the piston head and the other is open at its end away from said head.

4. A piston comprising a head and a guide structure connected thereto having wrist pin bosses and cylinder-engaging surfaces on opposite sides of the bosses, the guide structure being adapted to resiliently yield to a greater extent between the pin bosses and one of said cylinder-engaging surfaces than between the said pin bosses and the other cylinder-engaging surface.

5. A piston having a head and a guide structure connected thereto, said guide structure comprising diametrically opposite parts having cylinder-engaging surfaces, wrist pin bosses, between said opposite parts, and means for joining said bosses and cylinder-engaging parts, said joining means being arranged not to engage the cylinder and the guide structure being adapted to resiliently yield to a greater extent between the pin bosses and one of said cylinder-engaging surfaces than between the said pin bosses and the other cylinder-engaging surface.

6. A piston having a head and a guide structure connected thereto, said guide structure comprising diametrically opposite slippers having cylinder-engaging surfaces, wrist pin bosses between the slippers and means joining said bosses and slippers together, the guide structure being adapted to resiliently yield to a greater extent at points between the pin bosses and the cylinder-engaging surfaces of one slipper than between the said pin bosses and the cylinder-engaging surfaces of the other slipper.

7. A piston having a head and a guide structure connected thereto which comprises diametrically opposite cylinder-engaging parts, wrist pin bosses between the cylinder-engaging parts, and means joining said bosses and cylinder-engaging parts together, the said joining means being resiliently yieldable to a greater extent on one side of the wrist pin bosses than on the other side thereof.

8. A piston having a head and a guide structure connected thereto which comprises diametrically opposite slippers, wrist pin bosses between the slippers and means joining said bosses and slippers together, the said joining means being resiliently yieldable to a greater extent on one side of the wrist pin bosses than on the other side thereof.

9. A piston as claimed in claim 4 characterized by being integrally cast.

10. A piston as claimed in claim 5 characterized by being integrally cast.

11. A piston as claimed in claim 6 characterized by being integrally cast.

12. A piston as claimed in claim 7 characterized by being integrally cast.

13. A piston as claimed in claim 8 characterized by being integrally cast.

In testimony whereof, I hereunto affix my signature.

LAURENCE HENRY POMEROY.