

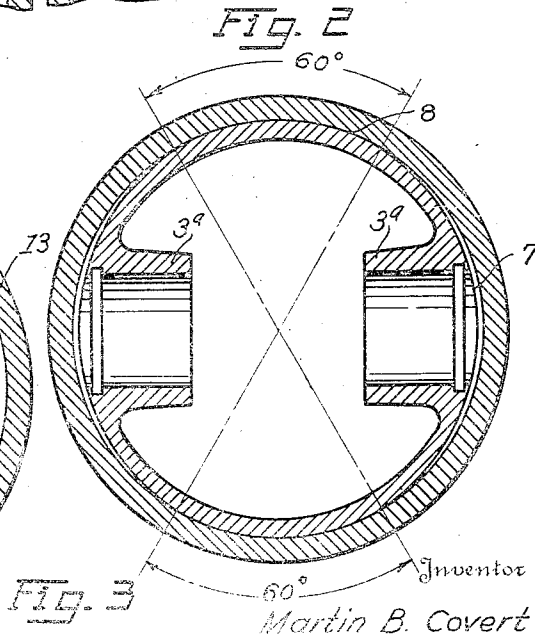
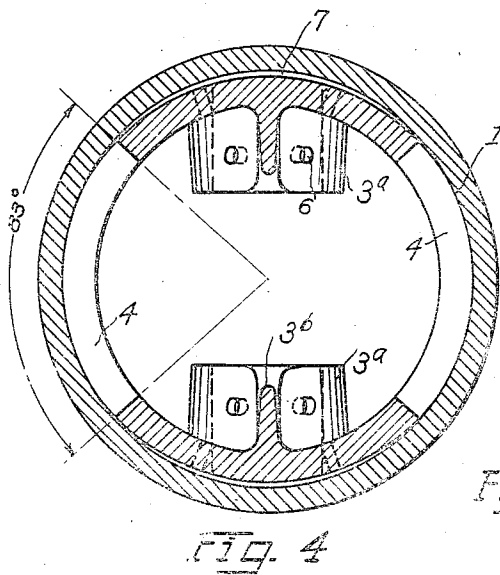
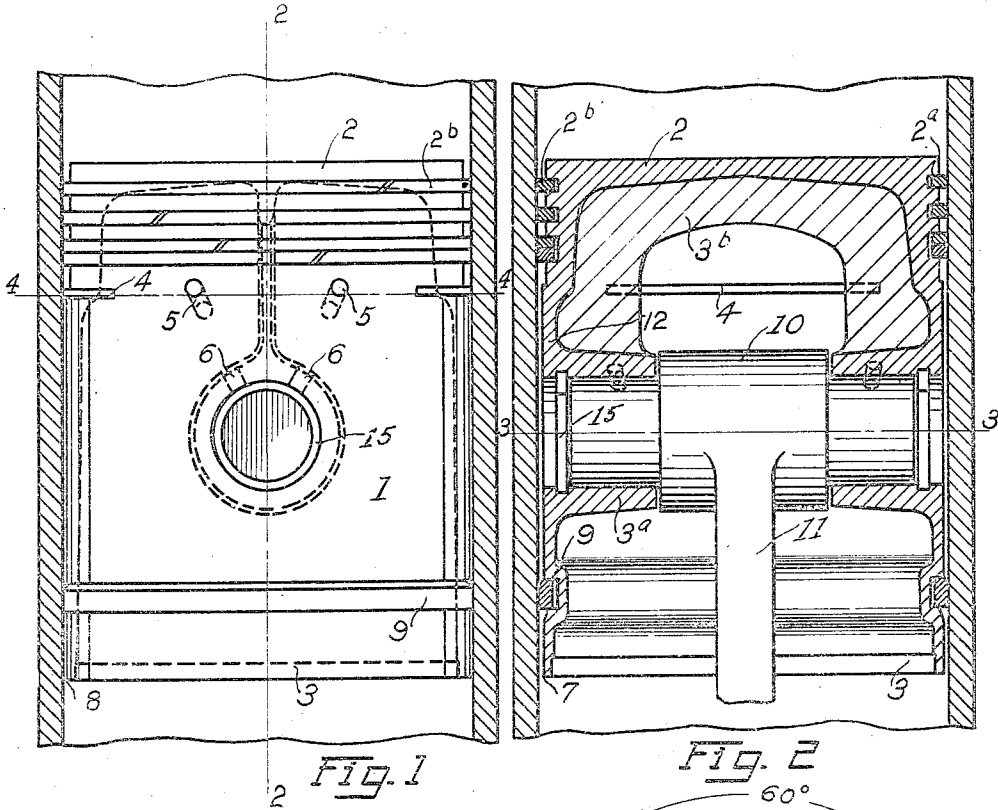
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PISTON

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634

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UNITED STATES PATENT OFFICE

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PISTON

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This invention relates to pistons for internal combustion engines. It is especially concerned with pistons composed of a material the coefficient of expansion of which is greater than that of the material composing the walls of the engine cylinder.

One object of the invention is to provide a piston capable of operation in an engine cylinder at various temperatures with a very small initial clearance.

Another object is to provide an aluminum alloy piston capable of operating in an iron cylinder at various temperatures with a very small initial clearance.

Another object is to provide an internal combustion engine piston having substantially constant maximum diameter across the thrust faces of the skirt at all temperatures.

Another object is to provide an internal combustion engine piston adapted to maintain a uniform clearance between the thrust faces of the skirt and the engine cylinder walls at all temperatures.

Another object of the invention is to provide a piston having a skirt adapted automatically to adjust its shape and size to the confining cylinder walls.

Other objects will be pointed out in the following specification in which my invention is set forth.

Many efforts have been made to design pistons for internal combustion engines which could be fitted into the engine cylinder with a relatively small clearance or space between the walls of the piston and cylinder at ordinary temperatures and which would not "seize" or "stick" in the cylinder when they became highly heated. When the materials composing the piston and cylinder have substantially the same coefficients of expansion it is not extremely difficult to realize these aims in part, although in use the piston becomes more highly heated than the cylinder, since the latter is artificially cooled by water jackets, heat radiating fins, etc. There are limits of clearance, however, below which pistons will seize in cylinders of the same material. For instance iron pistons fitted into iron cylinders

with a very small clearance, say .002" in a 3" piston will seize in the cylinder when heated.

When aluminum pistons are used in an iron cylinder, much more difficulty is experienced since the coefficient of expansion of aluminum is approximately three times as great as that of cast iron.

In order that pistons having high coefficients of expansion, as compared with iron, may have ample clearance in an iron cylinder when heated and in use it is necessary to provide them with excessive clearance when cold. This large clearance permits lateral movement of the piston in the cylinder when the engine is first started producing noises, commonly known as "slap" or "knock."

Various expedients have been resorted to in an effort to overcome these difficulties, but so far as I am aware, up to this time no satisfactory solution has been found. By my invention, however, I provide a piston which is capable of operating in an engine cylinder at all working temperatures with a very small initial clearance, regardless of the temperatures of the piston and cylinder and also regardless of the coefficients of expansion of the materials comprising the piston and the cylinder. Furthermore, the piston is automatic in adjusting itself to the cylinder during changes incident to temperatures, speeds, rates and amounts of expansion, etc., thereby maintaining substantially the same clearance between the thrust faces of the piston and the cylinder walls at all times.

One embodiment of my invention is disclosed in the drawings attached to this specification and forming a part hereof, in which;

Fig. 1 is a side elevation of a piston mounted in an internal combustion engine cylinder.

Fig. 2 is a sectional view taken on line 2-2 of Fig. 1 looking in the directions indicated and showing the clearance at the sides of the piston greatly exaggerated.

Fig. 3 is a cross sectional view taken on line 3-3 of Fig. 2 and;

Fig. 4 is a cross sectional view taken on line 4-4 of Fig. 1.

In carrying out my invention I provide a piston 1 of the trunk type comprising a head 2 and a skirt 3. The head 2 comprises a disc from the periphery of which depends a ring flange provided with ring grooves 2a for receiving packing rings 2b. The skirt 3 may be integral with or otherwise suitably secured to the head 2. In the modification shown the two parts are integral and comprise a piston of the general "trunk" type in which the skirt is a continuous substantially circular shell. The ordinary bosses 3a are integral with the inner surface of the skirt and are attached to and supported from the head 2 by a web 3b which also serves to connect the head and skirt and to make them function as a rigid unitary structure.

Horizontal slots 4 cut entirely through the skirt 3 at its upper end completely separate portions of the skirt from the ring flange of the head. These slots are preferably formed in diametrically opposite sides of the skirt and are symmetrical with respect to a line drawn at right angles to the center line of the bosses. Obviously the length of the slots may vary but a minimum of 60° and a maximum of 90° has been found satisfactory.

Relief ducts 5 suitably spaced in the skirt 3 permit the escape of oil from the cylinder walls to the interior of the piston while ducts 6 conduct oil from the interior of the piston to the bosses and wrist pin.

The outer surface of the skirt is substantially cylindrical throughout its length but has diametrically opposite parts 7 which are slightly relieved or depressed below the true cylindrical contour thereof thus making the outer surface slightly oval when the skirt is viewed in cross section. These relieved surfaces 7 preferably extend for about 60° on either side of the center of each boss and join the two remaining surfaces 8 which constitute parts of the true cylindrical surface of the piston.

Since the surfaces 8 are located on a line drawn at right angles to the center line of the bosses they constitute the "thrust" faces of the piston, namely those faces which take the lateral pressure of the piston caused by the angularity of the connecting rod with respect to the piston. These surfaces extend for the full length of the skirt and, being formed with a radius of curvature substantially the same as that of the inner surface of the cylinder in which the piston is to reciprocate, afford relatively wide bearing surfaces extending for the full length of the skirt.

If desired a wiper ring 9 may be provided near the lower end of the skirt to remove excess oil from the cylinder walls.

10 and 11 indicate respectively a wrist pin

and connecting rod, the former being mounted in the bosses 3a with an easy sliding fit when cold so as not to hinder expansion and contraction of the skirt and being retained in position in the bosses by spring rings 15 or otherwise.

In practise the piston here disclosed may be made by suitably machining an ordinary trunk type piston. After the outer surface of the skirt has been made substantially cylindrical and of a diameter only very slightly less than that of the cylinder in which the piston is to operate, the surfaces on the sides adjacent the bosses are relieved to form surfaces 7. This may be done by a turning operation the piston being mounted slightly off center for each surface with the result that the surfaces 7 are then eccentric with respect to the inner surface of the skirt and the skirt wall is thinnest at the center line thru the bosses and of uniformly varying cross section from that line to the lines where surfaces 6 and 7 unite.

If the surfaces 7 are formed by grinding the piston need not be mounted off center and then those surfaces are concentric with the inner surface of the skirt and the skirt walls are of approximately uniform thickness thruout the extent of surfaces 7 and of less thickness than the skirt walls defined by surfaces 8.

The slots 4 may be formed in the piston in various ways. They may, for example, be formed in the piston by the mold at the time the piston is being cast as is well known in the art. When the slots are to be sawed or similarly formed in the piston the operation of forming them may advantageously be performed after the piston has been more or less completely machined.

As an example of dimensions which have been found satisfactory the following figures are given.

Diameter of cylinder, 3.500"; diameter of piston across surfaces 8, 3.498"-3.499"; diameter of piston across surfaces 7, 3.480"-3.485".

It is difficult to determine the exact manner in which the various parts of this piston perform but my theory of their operation is as follows: The head 2 expands radially outward in all directions when the piston becomes heated. As its diameter increases it carries radially outward with it the portions of the skirt 3 to which it is connected, namely the longitudinal wall portion 12 adjacent the bosses, this outward movement being permitted in the cylinder by the space or clearance between the cylinder wall and the surfaces 7 of the piston. The thrust face wall portions 13, however, being separated from the head, are not carried radially outward when the head expands. Probably the only increase in the diameter of these wall portions is due to the expansion

of the skirt as a whole, as its temperature increases by the transfer of heat from the head 2 and cylinder to skirt 3. The outward movement of the wall portions 12 in conjunction with the head is resisted by the thicker wall portions 13, but when the connections between the head and these portions are sufficiently rigid the portions 12 will be distorted circumferentially and the portions 13 will move inwardly substantially without distortion thus preserving at all times their large bearing surface for contact with the cylinder walls. This distortion of the skirt brings the surfaces 7 into increasingly closer contact with the cylinder walls as the temperature of the piston is raised while, coincident therewith, the surfaces 8 tend to recede from the cylinder walls.

It will be noted that I have provided a piston the skirt of which is adapted to permit expansion thereof at a faster rate and to a greater amount than that of the cylinder without undue decrease in the clearance between the parts of the piston which are initially in close contact with the cylinder wall.

It will further be noted that I have provided a design of piston especially suited to aluminum alloys since the difference in the coefficients of expansion of the aluminum piston and the iron cylinder are taken care of without noticeable decrease in the amount of clearance between the thrust faces of the piston and the cylinder.

It will also be noted that I have provided a piston which may be fitted into the cylinder so closely that no disagreeable slapping or knocking noises will take place at ordinary temperatures and that all danger of seizure is avoided when heated.

Altho I have described one modification of my invention in detail I have done so merely for the purpose of illustration and not with the desire to be limited thereto, since it is obvious that many variations in the modification described could be made by those skilled in the art without departing from the scope of my invention. I wish to be limited only by what is claimed.

What is claimed:

1. In an internal combustion engine piston a circular head disc having a ring flange depending therefrom and a substantially cylindrical skirt the said skirt having longitudinal portions of different thicknesses, the said head being connected to the thinner longitudinal portions and separated from the thicker longitudinal portions by narrow air gaps of greater circumferential length than the said thicker portions, the thinner portions being relieved exteriorly throughout their entire length, and a rib extending across the said head disc and integral with the said head and thinner skirt portions.

2. In a piston for an internal combustion engine, a head comprising a circular disc with a ring flange depending from the periphery thereof, a skirt having opposite, longitudinally extending bearing wall portions and other opposite longitudinally extending boss carrying wall portions having their outer surfaces relieved throughout substantially the entire length thereof, and being thinner than the said bearing wall portions, the said boss carrying wall portions being integrally connected to the head, and a rib extending across the head disc and formed integrally with the said disc and boss carrying wall portions.

3. In a piston for an internal combustion engine a head comprising a circular disc and a depending ring flange, a skirt having longitudinally extending relatively rigid portions separated from the said head and other longitudinally extending relatively distortable portions having their outer surfaces relieved throughout their length and secured to the head, and reinforcing means extending across the said head disc and longitudinally of the said distortable portions.

4. A hollow piston for internal combustion engines including a head and a body integral therewith and formed from a metal lighter than iron, said body being non-compressible circumferentially and having internal aligned wrist pin bosses and also having external bearing areas of considerably less than 90 degrees curvature located between said bosses, the head portion having a plurality of piston ring grooves and the piston having transverse slots between said bosses and on the side of said grooves nearest said bosses and separating part of the head from said bearing areas, the head having an internal rib extending across from one of said bosses to the other, the piston being externally relieved except for said bearing areas, whereby heat from the head is conducted rapidly to said bosses.

5. A piston for an internal combustion engine comprising a head having a depending ring flange, a skirt relieved on opposite sides thereof and a rigid connection between the relieved sides of the skirt and the said piston head, the piston being adapted automatically to maintain the maximum initial diameter across the thrust faces of the skirt substantially constant at various temperatures.

6. A piston for an internal combustion engine comprising a head disc and integral ring flange a skirt exteriorly relieved on opposite sides thereof and a rigid connection between the said relieved sides of the skirt and the head, the maximum initial diameter of the skirt being from about .0005" to .002" smaller than the diameter of the cylinder in which it is to operate the skirt being adapted automatically to maintain substan-

tially constant, under varying operating conditions, the initial difference between the maximum diameter across the thrust faces of the skirt and the inside diameter of the cylinder in which it operates.

6 7. In an internal combustion engine piston a circular head disc having a ring flange depending therefrom and a substantially cylindrical skirt the said skirt having longitudinal portions of different thicknesses, the
10 said head being connected to the thinner longitudinal portions and separated from the thicker longitudinal portions by narrow air gaps of greater circumferential length
15 than the said thicker portions, the thinner portions being relieved exteriorly throughout their entire length.

8. In a piston for an internal combustion engine a head comprising a circular disc and
20 a depending ring flange, a skirt having longitudinally extending relatively rigid portions separated from the said head and other longitudinally extending relatively distortable portions having their outer surfaces re-
25 lieved throughout their length and secured to the head, and reinforcing means extending longitudinally of the same distortable portions.

9. In an internal combustion engine piston, a head and a continuous skirt that is non-compressible circumferentially having integrally connected longitudinal portions of different thicknesses, said head being connected to the thinner longitudinal portions
35 and separated from the thicker longitudinal portions by narrow air gaps, the thinner portions being exteriorly relieved throughout their entire length, and reinforcing ribs integral with the head and extending longitudinally of the thinner skirt portions.
40

10. A piston for an internal combustion engine comprising a head, a skirt relieved on opposite sides thereof and provided with opposed integral wrist pin bosses and a
45 rigid connection between the opposite relieved sides of the skirt including a rib member that connects each wrist pin boss with a substantial part of the head, the piston being adapted automatically to maintain the
50 maximum initial diameter across the thrust faces of the skirt substantially constant at various temperatures.

In testimony whereof, I hereunto affix my signature.

55 MARTIN B. COVERT.