Nov. 12, 1940. O. C. BERRY 2,221,535

PISTON

Filed Nov. 20, 1937 2 Sheets-Sheet 1

Fig. 1.

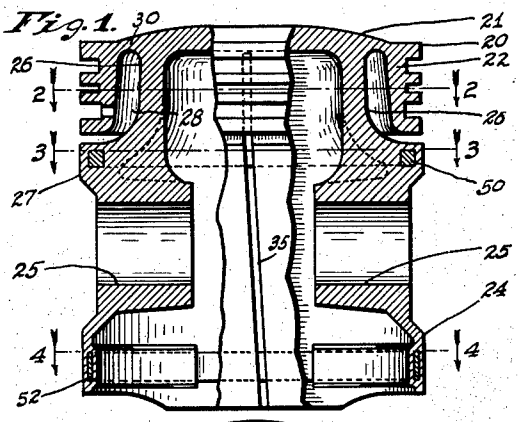


Fig. 2.

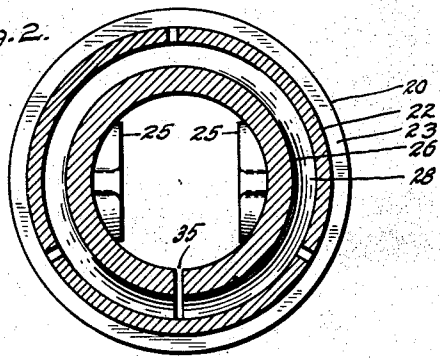


Fig. 3.

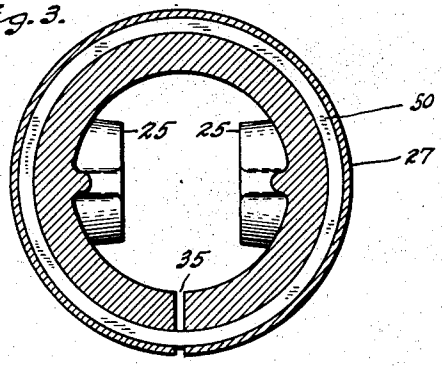


Fig. 4.

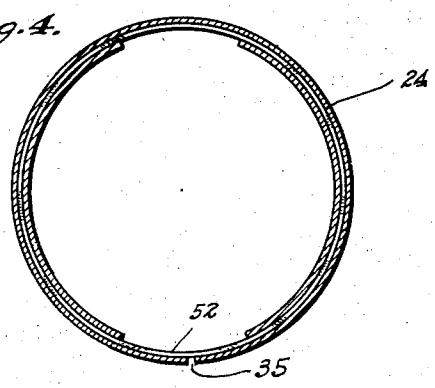


Fig. 5.

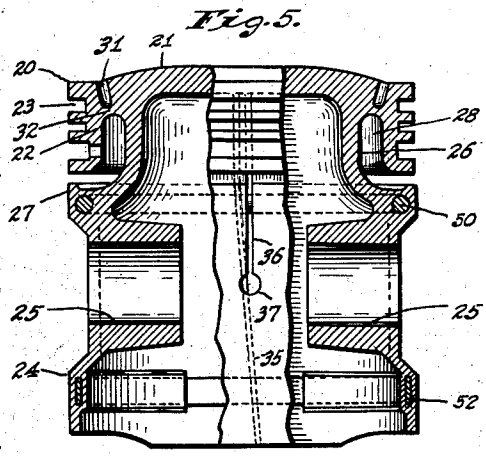


Fig. 6.

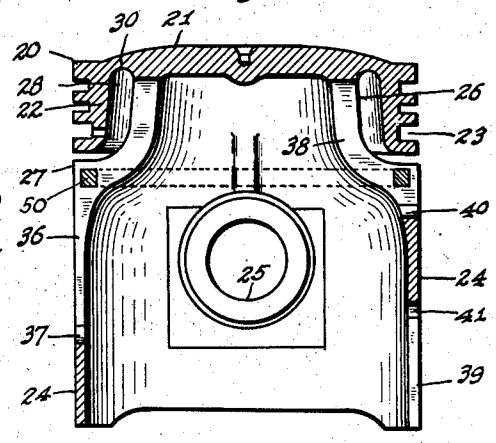
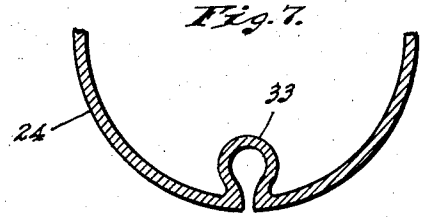


Fig. 7.



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PISTON

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Fig. 8.

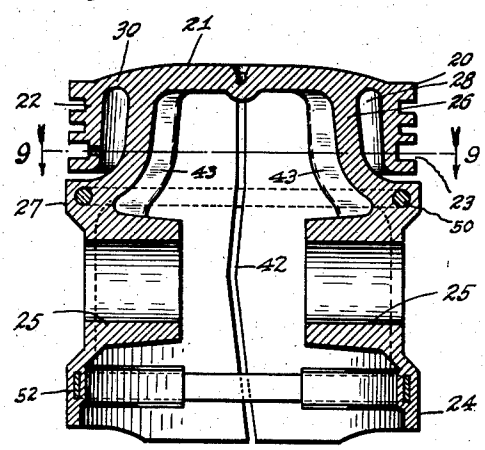


Fig. 11.

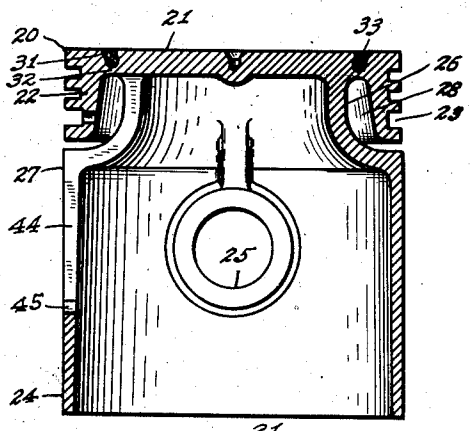


Fig. 9.

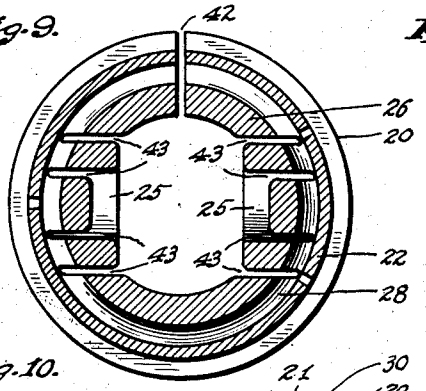


Fig. 12.

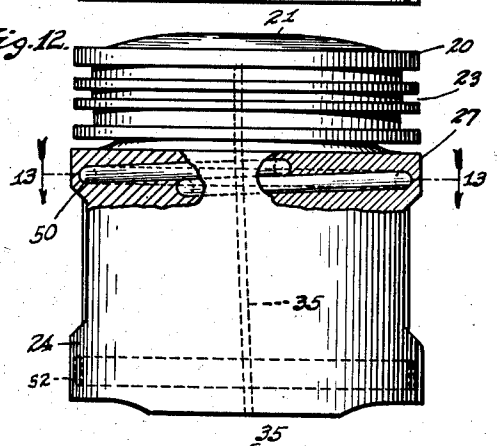


Fig. 10.

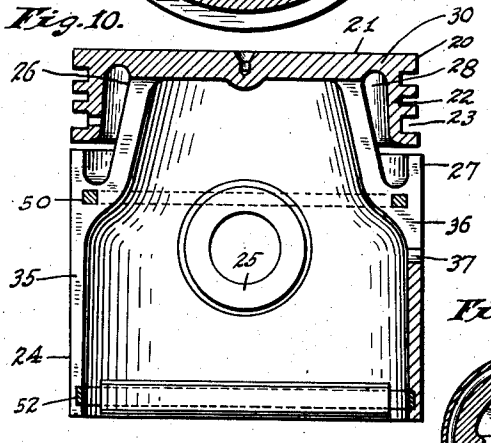


Fig. 13.

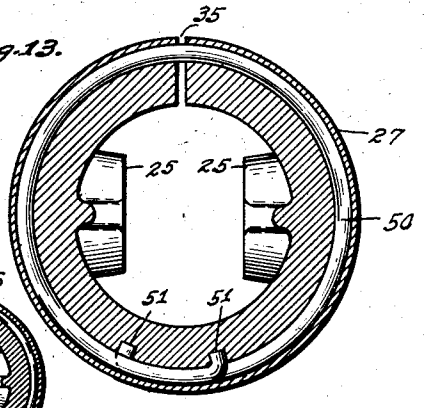
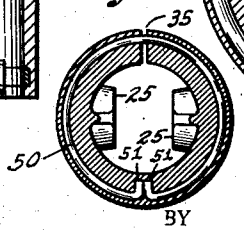


Fig. 14.



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2,221,535

UNITED STATES PATENT OFFICE

2,221,535

PISTON

Otto Carter Berry, Ann Arbor, Mich.

Application November 20, 1937, Serial No. 175,635

5 Claims. (Cl. 309—9)

This invention relates to pistons for internal combustion engines, and more especially to those made of aluminum or of an alloy in which the principal ingredient is aluminum.

The main objects of this invention are the following:

a. To keep the piston rings cooler than is possible under the same operating conditions in the aluminum pistons now in common use.

b. To keep the piston head as cool as is practical in an aluminum piston under the required operating conditions.

c. To improve the control by the piston of the amount of oil used by the engine.

In carrying out these main objectives, the following have taken form as auxiliary objects of the invention:

d. To divide the heat-flow from the piston head into two parallel paths, leading to the piston skirt and to the piston-ring flange respectively, and to control that division so that the heat-flow to the piston-ring flange can not become excessive.

e. To provide a piston skirt which is able to receive a large amount of heat from the head and dissipate that heat, but which nevertheless is of a size such that said piston skirt may be made a close fit in the cylinder of the engine with complete assurance that it will never become too tight.

f. To provide in the skirt of an aluminum piston control bands on which the aluminum will slip easily while still fitting closely on the control bands; and to provide a method for ensuring that capability of easy slipping.

g. To provide between the piston head and the piston skirt a connection of such nature that the skirt will remain round whether the head be hot or cold.

h. To provide a piston that in addition to having the preceding characteristics is strong and rugged.

As a result of the combined efforts of a number of inventors, aided by the experience of the automotive industry through the years, it is possible to produce aluminum-alloy pistons which may be made a close fit in the cylinders, and which will maintain their clearance from the cylinders substantially unchanged throughout the temperature changes met in practice, without slapping, binding, scoring, or undue wear. In all these pistons this result is obtained by partially separating the piston skirt from the piston head, thus reducing the amount of heat that can flow from the piston head to the piston skirt, and by providing a skirt that will not become too tight under these conditions that are highly favorable for the skirt. It is characteristic of these pistons, however, that the rings tend to become too hot when the engine is running at high speed, and that when the engine becomes somewhat worn the pistons allow it to use too much oil. These faults will be discussed separately.

The overheating of the piston rings and piston heads comes about as follows: In all the aluminum pistons now in use that do not slap when cold nor get too tight when hot, it is a common characteristic, as already stated, that the piston heads are partially separated from the skirts. This reduces the amount of heat that can flow from the head to the skirt. The skirts are usually ground oval, or "cam-ground" as the automotive engineer expresses it, so that the skirt is spaced away from the cylinder in the line of the piston-pin bosses. Besides the cam-grinding, the pistons are usually cast with a relief around the piston-pin bosses that is often more than ninety degrees wide at the head end of the skirt. Very little heat can flow from the piston to the cylinder walls through these relieved areas. Yet the only place where the piston heads are joined to the skirts is in the region of the piston-pin bosses. The heat flowing from the piston head to the skirt is therefore not only limited by having a restricted path to follow, but it must also travel a long distance before it finally reaches the cylinder walls of the engine. Thus in the present modern aluminum pistons the head from the head passes to the cylinder walls largely through the ring-flange of the piston, and mostly through the rings themselves. The capacity of the rings for handling heat is limited, however, and under extreme conditions they and the piston heads become very hot.

The overheating of the piston rings and heads has become worse during the past few years. Engine designers have been studying how to shape combustion chambers so that they can use higher compressions without detonation. Petroleum refiners have also made marked improvements in their fuels, so that they will stand higher compressions. This situation has resulted in the common use of compression ratios in modern engines that are much higher than were formerly thought possible, and accounts for the fact that much higher flame temperatures are being met now than ever before.

Engines are also being run much faster than formerly. The oiling systems have been improved, bearings made larger and better, reciprocating parts lighter, and valves more heat-re-

sistant; and all of these things have combined to make the higher speeds possible. These high speeds, together with the high compressions and high flame temperatures, mean that heat is being poured into the piston heads in modern automotive engines at a tremendously high rate. In the best of these engines, those giving the most power per cubic inch of piston displacement, it often happens that the oil reaching the top rings not only becomes too thin to be a good lubricant, but is actually destroyed by the heat. This results in undue friction, rapid wearing of the cylinder walls, and scoring of the rings. One of the main objects of this invention, as previously stated, is to correct this over-heating of the piston head and more especially of the rings, so that the latter may be properly lubricated at all times.

Now for the fault of imperfect oil control on the part of a somewhat worn automotive engine. This is often accounted for as follows: It is now almost the uniform practice in these engines to supply oil to the main and connecting-rod bearings at a high pressure. When the engine is new and these bearings are a snug fit, only a reasonable amount of oil can flow through them and get on to the cylinder walls. The oil-control rings on the pistons can take care of this amount of oil, and the oil economy of the engine is good. When these bearings become worn and loose, however, the cylinder walls are flooded with oil. As previously stated, modern aluminum pistons have cam-ground skirts, and/or large relieved areas which surround the piston-pin bosses and extend to the upper end of the piston-skirt. A portion of this excess oil often gets past these skirts where the cam-grinding or the relief spaces them from the cylinders. This overloads the oil-control rings on the pistons and causes the engine to use too much oil. One of the main objects of this invention is to correct this situation. I provide the piston with a skirt that can safely be made round and a close fit in the cylinder of the engine. When this skirt is properly fitted into a good cylinder, it will help keep any excess of oil from ever reaching the oil control rings. This helps an engine avoid using too much oil even when its bearings are loose and the cylinders are being flooded with oil.

My invention is fundamentally directed toward preventing overheating of the piston rings and its consequences; and at the same time toward controlling the piston skirt so that it not only may be and will remain round or substantially so but expands and contracts with such a lower thermal coefficient of expansion with respect to that of aluminum and its alloys that proper clearance between the piston skirt and the cylinder is maintained at all temperatures.

Other objects of my invention will appear hereinafter.

My invention is illustrated in the following drawings, which show such invention in certain preferred forms. In such drawings, Fig. 1 is a longitudinal section, with parts in elevation, of a piston embodying a form of my invention in which two expansion-control bands are used in the skirt, the skirt is provided with a single slot, and the heat-flow to the piston-ring belt is controlled without requiring any groove in the piston-head surface; Figs. 2, 3, and 4 are transverse sections substantially on the lines 2—2, 3—3, and 4—4 of Fig. 1; Fig. 5 is a longitudinal section, with parts in elevation, generally similar to Fig. 1, of a piston embodying a form of my invention in which there are two expansion-control bands, and two slots in the piston skirt, and an annular groove in the piston head to reduce the cross-section of the heat-flow path to the piston-ring flange; Fig. 6 is a longitudinal section generally similar to Figs. 1 and 5 of a piston embodying a form of my invention in which there is only one expansion-control band and in which the piston skirt has three slots; Fig. 7 is a fragmental cross-section, illustrating a modification in which the two sides of a slot in the piston may be interconnected by a flexible connection; Fig. 8 is another longitudinal section and partial elevation generally similar to Fig. 1, of a piston embodying a form of my invention in which there are two expansion-control bands, and the upward extension of the piston skirt is divided into segments by groups of slots; Fig. 9 is a section on the line 9—9 of Fig. 7; Figs. 10 and 11 are longitudinal sections, and Fig. 12 an elevation partly in section, generally similar to Fig. 1, but of pistons embodying various modifications of my invention; Fig. 13 is a transverse section on the line 13—13 of Fig. 12; and Fig. 14 is a transverse section generally similar to Fig. 13 but on a smaller scale, to illustrate a modification in which a split expansion-control band with non-overlapping ends is used.

A piston embodying my invention, as illustrated in the various figures of the drawings, has a piston head 20, the top portion 21 of which is joined at its edge to a depending peripheral piston-ring flange 22 provided with piston-ring grooves 23, a piston skirt 24, and piston-pin bosses 25 which are desirably provided in and carried by the skirt. Both the head and the skirt are made of aluminum or aluminum-alloy, (collectively referred to simply as aluminum,) cast as one piece.

The piston skirt 24 has an upward extension 26, which extends upward from the cylinder-engaging portion 27 from a point at or near the upper end of the latter and lies radially inside of the piston-ring flange 22. The cylinder-engaging portion 27 of the skirt is preferably ground substantially round externally, especially in the region of the expansion-control bands hereinafter described, save that at and in the immediate vicinity of the piston-pin bosses 25 there may be relief which desirably does not extend to either the top or the bottom of that cylinder-bearing portion 27. The upward skirt-extension 26, in the preferred embodiments of my invention, is in general annular in cross-section, as is clear from Fig. 2, and generally cylindrical or slightly conical; and it forms an integral and homogeneous connection between the top portion 21 of the piston head 20 and the cylinder-engaging skirt-portion 27 by being cast in one piece therewith. The lower edge of the piston-ring flange 22 is spaced longitudinally from the upper end of the main or cylinder-engaging skirt-portion 27, and is spaced radially from the upward skirt-extension 26, to provide a generally annular open space 28 which communicates with the exterior just below the edge of the piston-ring flange 22 and is readily formed by the use of a sand core.

The upward skirt-extension 26 may join the main or cylinder-engaging skirt portion 27 in various ways. For instance, it may spring inwardly directly from the upper end of that cylinder-engaging portion 27 and swing upward in a smooth curve into the annular portion that joins the piston head, as is illustrated in Figs. 1, 6, 8, and 11; or it may spring inwardly directly from

the upper end of that cylinder-engaging portion 27, but dip slightly downward first before swinging upward in a curve into the annular portion that joins the piston head, as is illustrated in Fig. 5; or it may spring inwardly from a point slightly below the upper edge of the cylinder-engaging portion 27 and swing upward into the annular portion that joins the piston head, as is illustrated in Fig. 10.

The piston head 20 is composed of two sections, the more or less flat disk 21 forming the top portion, and the depending ring flange 22. The metal joining these two sections is made of constricted cross-section, markedly thinner than is either the top portion 21 or the upward skirt-extension 26, to make smaller the cross-section of the metal path for heat flowing from the top portion 21 to the piston-ring flange 22. This constriction may be provided by extending the open space 28 up fairly close to the upper surface of the piston head, to leave a constricted portion 30 to limit that heat-flow to the piston-ring flange 22, as is illustrated in Figs. 1, 6, 8, and 10. Or, if it is desired that the annular space shall not extend so close to the top surface of the piston, that top surface may be provided with an annular groove 31, preferably slightly oblique to the piston axis, as is shown in Figs. 5 and 11, which annular groove lies generally above the upper end of the annular space 28 to leave between it and that annular space the desired constricted portion 32. By controlling the depth of the groove 31, which is commonly provided by machining, the size of the constricted portion 32 is readily controlled. If desired, the annular groove 31 may be filled with some suitable heat-insulating filling 33, such as asbestos, as is illustrated in Fig. 11; but that filling is not always necessary.

By reason of this construction, the heat which the piston head receives from the explosion may flow from that piston head in two paths in parallel. One path is by way of the constriction 30 or 32 (Figs. 1 and 5 respectively) to the ring flange 22, and therefrom through the piston rings into the cylinder and the cooling water in the water jacket. The other path is by way of the upward skirt-extension 26 into the main or cylinder-engaging skirt-extension 27, and hence across the oil film into the cylinder and the cooling water. By properly controlling the size of the skirt-extension 26 and of the constriction 30 or 32, a large part of this heat may be compelled to flow into the piston skirt, and the amount which flows into the ring flange 22 may be kept sufficiently small to prevent undue heating of that piston-ring flange and the disadvantages attendant thereupon. The pin bosses 25, however, remain fairly cool, because they are not in the heat-flow path from the piston head to the cylinder-engaging portion 27 of the piston skirt.

The piston head expands and contracts upon changes in temperature in accordance with the thermal expansivity (thermal coefficient of expansion) of the aluminum alloy of which it is made. It is prevented from ever becoming too tight in the cylinder by being given an initial clearance larger than any expansion it can make. This is possible for the reason that the rings form the seal for this part of the piston, and it is not necessary that the ring-lands ever come close to the cylinder walls.

The problem in connection with the skirt is a different one. The cylinder of the engine is ordinarily made of cast iron, and is water-cooled. That cast iron has about half the thermal expansivity of the aluminum piston alloys, and never reaches a very high temperature. The piston skirts, on the other hand, are made of aluminum (or aluminum alloys), and in pistons after my design they handle a large amount of heat. This makes it necessary for them to become quite hot, especially at the upper or head end of the cylinder-bearing portion. A comparatively small increase in the temperature of the skirt would cause the aluminum in it, if uncontrolled, to expand more than the allowable clearance between the cylinder and the piston of a cold engine. The expansion of the piston skirt upon increase in temperature must therefore be restricted to less than the expansion which would be produced by the thermal expansivity of aluminum alloy if proper clearance between the piston skirt and the cylinder is to be preserved at all temperatures; and more especially so as the piston skirt is preferably machined substantially round, with clearance at the piston-pin bosses only, instead of being ground oval.

To permit this, whenever substantially constant skirt clearance is desired, the piston skirt is provided with one or more generally longitudinal slots, which can be closed to a greater or less extent by various expansion-restraining forces as the temperature of the piston skirt increases, thus making the skirt compressible in relation to its diameter. The slot or slots may be variously arranged, but there is at least one slot in this upward skirt-extension 26 and in at least the upper part of the main or cylinder-engaging portion 27. The slots can be and preferably are completely open, as illustrated in many of the figures of the drawings; but they may have their opposite edges interconnected, usually for only a portion of the slot-length, by a flexible connection 33, as is illustrated in Fig. 7.

In the embodiments of my invention shown in Figs. 1 to 4 inclusive, and Figs. 12, 13, and 14, there is a single slot 35 which extends throughout the entire length of the piston skirt, from the bottom thereof to substantially the point where the piston skirt joins the piston head 21. This slot 35 is desirably slightly oblique, at least in the cylinder-engaging portion 27 of the skirt, to prevent the production of a ridge in the cylinder wall.

In the embodiments of my invention shown in Figs. 5 and 10, there are two slots, one being the oblique slot 35 (of Figs. 1 to 4) extending the full length of the piston skirt, and the other being a slot 36 which is located approximately opposite the slot 35 and extends from the upper end of the skirt-extension 26 downward through that skirt-extension and part way through the cylinder-engaging skirt-portion 27 to an intermediate point in the length of the latter, to end in a round hole 37. By having two slots the skirt is made less stiff.

In the embodiment of my invention shown in Fig. 6, there are three slots, one being a slot 36 ending in a round hole 37, substantially as in the modification shown in Figs. 5 and 10, and the other two slots 38 and 39 being about opposite that slot 36 or in the same general location circumferentially as is the slot 35 of Figs. 1 and 5. Neither slot 38 nor slot 39, nor the two of them together, extends the full length of the piston skirt; but the slot 38 extends downward from the top of the upward skirt-extension 26 through that skirt-extension and only a short distance downward into the main or cylinder-engaging

skirt-portion 27 to end in a round hole 40, and the slot 39 extends upward from the bottom of the skirt a comparatively short distance to end in a round hole 41. This arrangement of the slots gives a fairly flexible skirt construction.

In the embodiment of my invention shown in Figs. 8 and 9, a slot 42 extends the full length of the piston skirt, as does the slot 35 in Figs. 1, 5, and 10; but it differs from the slot 35 in that it has two oppositely oblique portions, which is sometimes desirable. In addition to the slot 42, shown in this embodiment of my invention, there may be a number of slots 43 extending longitudinally at least in the region where the two skirt-portions 26 and 27 join each other, and desirably extending upward to or substantially to the top of the upward skirt-extension 26 and downward into the main or cylinder-engaging skirt-portion 27 to the vicinity of the piston-pin bosses 25. The slots 43 are often conveniently all in planes parallel to the axis of the piston pin, to make it possible to withdraw the cores when metal cores are used to form the open interior of the piston; which metal cores are conveniently of the three-piece type.

In the embodiment of my invention shown in Fig. 11, a single slot 44 extends downward from the top of the skirt-extension 26 through that skirt-extension and through a large part of the length of the main or cylinder-engaging skirt-portion 27, to terminate in a round hole 45 located below the transverse plane of the piston-pin axis.

By the provision of these slots 35, 36, 38, 39, 42, 43, and 44, or various combinations of them, the main or cylinder-engaging skirt-portion 26 is made compressible, either at its upper end or throughout its length as the case may be, so that by the closing of those slots when the piston is heated the expansion of the skirt-diameter may be made independent of the expansion of the piston head and of the thermal coefficient of expansion of aluminum and aluminum-alloy, and made less than those things would require if they controlled. If no slot extends to the lower end of the skirt, that lower end is preferably ground oval.

The compression of the main or cylinder-engaging skirt-portion 27, or at least of its upper end, from the diametral size called for by the thermal coefficient of expansion of aluminum or aluminum-alloy, may if desired be merely by the reaction of the encircling cylinder wall; and that is the case in the embodiment of my invention shown in Fig. 11.

However, in the preferred forms of my invention I control that expansion of the main or cylinder-engaging skirt-portion 27, or at least of the upper end thereof, by means independent of the cylinder wall, and embodied in and forming part of the piston itself; as is illustrated in the other figures of the drawings. To this end I provide in the upper end of the main or cylinder-engaging skirt-portion 27 an expansion-control band 50. This expansion-control band may be an endless band, as is illustrated in Figs. 1 to 10 inclusive, or it may be a split band having its two ends either overlapping as in Figs. 12 and 13 or non-overlapping (and desirably abutting) as in Fig. 14, with those ends provided in either case with inturned fingers 51 which grip the aluminum of the piston-body. If there is a split in this expansion-control band, as in Figs. 12, 13, and 14, it is desirably remote from any of the longitudinal slots above described, as by being opposite the slot 35 as illustrated.

This expansion-control band 50 is made of some strong metal with a lower thermal expansivity (thermal coefficient of expansion) than that of the skirt-metal, aluminum or aluminum alloy; such as steel or nickel steel of a desired thermal expansivity. It is of material of uniform cross-section, and desirably has smooth surfaces, so that the aluminum may slide circumferentially on it; and to that end its parts at and near any longitudinal slots which it crosses are in a plane perpendicular to the piston axis.

By reason of the expansion-control band 50, the piston skirt in the plane of such expansion-control band is prevented from increasing in diameter too greatly upon increase in temperature. It is held down to the increase which is permitted by the thermal coefficient of expansion of the expansion-control band. The excess expansion of the aluminum is taken up by circumferential movement of it on the expansion-control band to produce a greater or less closing of the slot or slots 35, 36, 38, 42, and/or 43 which cross the plane of that expansion-control band. This control is effected without material distortion of the circular form of the piston skirt by having the various parts of the piston designed to that end, and especially by reason of the annular form of the upward skirt-extension 26.

The expansion-control band 50 at the upper end of the main or cylinder-engaging skirt portion 27 may be the only expansion-control band, as is the case in that form of my invention which is illustrated in Fig. 6. However, I deem it preferable to have a second expansion-control band 52 near the bottom of the piston skirt, as is illustrated in Figs. 1 and 4, 5, 8, 10, and 12. This is shown as an endless band, although it is not necessarily so. The lower expansion-control band 52 may be of steel or nickel steel, with a thermal expansivity less than that of aluminum or aluminum alloy; but the thermal expansivity of the lower expansion-control band 52 may be and desirably is greater than that of the upper expansion-control band 50 because the lower part of the piston skirt does not get so hot as the upper part.

The expansion-control bands 50 and 52 may be of any desired cross-section. I consider it best to have the upper expansion-control band 50 rather sturdy in the radius of the piston, as by being of a round or square cross-section, for it is this expansion-control band which exerts most of the control. The lower expansion-control band 52, because the load on it is less, may be made of a steel strip which is fairly wide in the direction of the piston length and relatively thin in the direction of the piston radius. Both expansion-control bands 50 and 52 are cast in place—by which I mean that they are prefabricated and set in proper position in the mold into which the molten aluminum-alloy is poured to form the aluminum-alloy body of the piston.

To insure the best control, the expansion-control bands should meet two requirements. They should be cast in place in the skirt in such a way that the aluminum will slide over them easily, and they should be a close fit in the aluminum. Untreated steel bands cast in place directly in the aluminum will not allow the latter to slip as readily as is desirable; for the aluminum gets too powerful a pinching grip on the steel bands. To prevent this I provide the steel bands with a slip-promoting coating; for which I use an ex-

tremely fine, soft, unctuous, amorphous, powdered graphite, such as is frequently used as a coating on dry sand cores or on the surfaces of metal molds. I heat the bands well above the boiling temperature of water, and then apply to the bands, with a spray gun, a water suspension of that graphite. In this way I produce a thin but fairly hard coating of the graphite that is baked on to the bands and is hard enough so that the band may be handled without material danger of removing such coating. In fact, the coated bands will stand considerable handling without having the coatings come off. This coating can be made thick enough so that as the aluminum casting contracts in cooling, the graphite will be compressed without allowing the aluminum to grip the band too strongly, and yet thin enough so that the band will be a close fit in the casting. The graphite not only prevents the casting from obtaining too powerful a grip on the band, but also serves as an excellent lubricant to facilitate the sliding of the aluminum over the bands.

Other coatings may be used instead of the graphite, but care must be exercised to avoid the use of any substance that will form a gas and produce blow-holes in the casting. Dry graphite is likely not to cling to the bands in large enough quantities to prevent the gripping of the aluminum. A graphite paste is likely to form too thick a coating and so to make the aluminum too loose on the bands. Moreover, either dry graphite or graphite paste may often be rubbed off fairly easily, and may thus allow the aluminum to grip the bands too strongly at various points. I therefore prefer the coating of baked graphite applied as described.

Because a piston according to this invention can be ground round, instead of being ground oval, it provides an unusually fine oil control. By reason of the expansion-control band or bands, this grinding round may be made with confidence that it will not result in too tight a fit of the piston in the cylinder, no matter how hot the engine gets.

I claim as my invention:

1. A piston, comprising a skirt, piston-pin bosses, a head made up of a top portion and a ring flange, connecting means of large heat-carrying capacity that passes inside of said ring flange and joins said skirt to said top portion, said ring flange being joined to said top portion by a section of metal markedly thinner than is the metal in said connecting means to keep small the heat-flow to the ring flange, and an expansion-control band that is of lower thermal expansivity than is the skirt-metal and that is cast into the upper part of said skirt in the region where it joins said connecting means, said skirt being provided with a plurality of longitudinal slots which extend across the plane of said expansion-control band and which include slots which approach close to the piston head and slots which extend below the transverse plane in which the axis of the piston-pin bosses lies.

2. A piston comprising a skirt, pin bosses, a head composed of a top portion and a ring flange, and expansion-control bands having lower thermal expansivity than the skirt metal and mounted in the upper and lower parts of the cylinder-engaging portion of said skirt, said skirt being separated from said ring flange and being connected to the top portion of said head by an annular skirt-extension passing inside of said ring flange and being longitudinally slotted across the planes of said expansion-control bands, the upper expansion-control band having a lower thermal expansivity than has the lower expansion-control band.

3. A piston, comprising a head, pin bosses, and a skirt, said skirt being slotted longitudinally and having two expansion-control bands cast in place in it near the upper and lower ends of its cylinder-engaging portion, both of said expansion-control bands having a lower thermal expansivity than the skirt metal, and the upper one having a lower thermal expansivity than the lower.

4. A piston, comprising a skirt, pin bosses, a head made up of a top portion and a ring flange, said skirt having an annular skirt-extension of large heat-carrying capacity that passes inside of said ring flange and joins said skirt to said top portion, said skirt and its skirt-extension being spaced from said ring flange to leave an open space, said ring flange being joined to said top portion by a section of metal that is markedly thinner than said top portion to keep small the heat-flow to the ring flange, and said skirt being slotted longitudinally, and expansion-control bands cast in place in the upper and lower portions of the cylinder-engaging part of said skirt to control the skirt diameter, said expansion-control bands having a lower thermal expansivity than the skirt metal and the upper one having a lower thermal expansivity than the lower one, and both of said expansion-control bands being coated with a material that facilitates the sliding of the skirt-metal on them.

5. A piston as set forth in claim 4, with the addition that said skirt-extension and the upper part of the cylinder-engaging part of the skirt are provided with a plurality of longitudinal slots.

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