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PISTON

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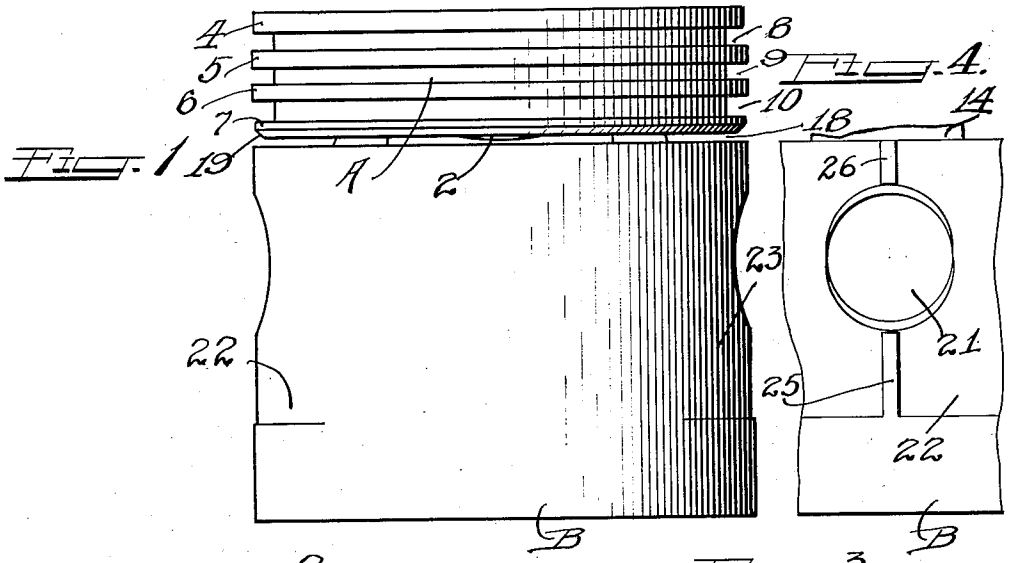
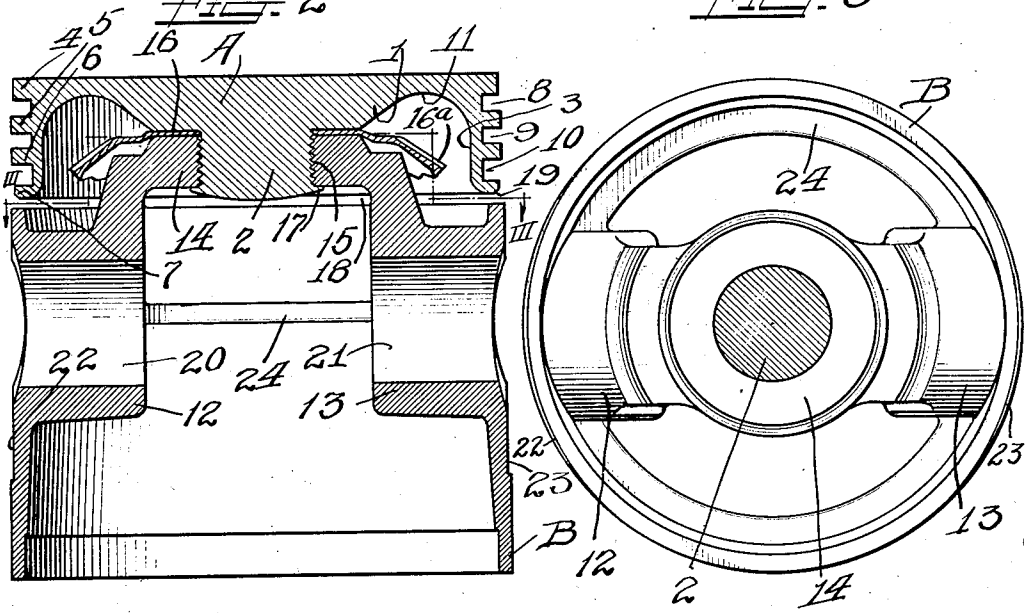


Fig. 1

Fig. 4.

Fig. 3

Fig. 2



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PISTON

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6 Claims. (Cl. 309—21)

The present invention relates to a piston and particularly to an aluminum or aluminum alloy piston for internal combustion engines so constructed and designed as to reduce its expansion characteristics due to heat to approximate the characteristics of cast iron.

The invention furthermore relates to a machine for making the pistons of the present invention.

Pistons as ordinarily constructed for use in internal combustion engines have head and skirt portion integral or continuous, i. e., the head and skirt are made of metal having the same thermal and mechanical characteristics. The head which is subjected to the maximum heat of the combustible gases transmits the heat to the skirt causing expansion of the skirt in service and causing the same to bind in the cylinders thus scoring or grooving the latter in time. In the event the skirt portions are made small enough not to bind then rattling or slap occurs, making a noisy engine.

Aluminum pistons have heretofore been constructed but in order to be practical it has been necessary to cut the skirt portion from top to bottom to allow for expansion of the same in service. This cutting of the skirt is disadvantageous particularly for the reason that the edges forming the cut portion are forced together under expansion and form ribs or protuberances which in time score the cylinder walls. Another disadvantage of the split skirt type of piston is that it increases oil consumption.

The present invention has for an object the provision of a piston made of aluminum or aluminum alloy having the head portion and a skirt portion separated axially to provide an uninterrupted gap between these parts for heat dissipation and so that the extreme expansion of the head is not transmitted to the skirt. The head is secured to the skirt centrally but is otherwise separated. This arrangement allows the head to change its shape and size without restriction, without warping the skirt and without causing undue expansion of the skirt in service. It will be understood that a manufacturing tolerance is contemplated and therefore the connection between the head and the skirt is not limited to the geometrical axis thereof but contemplates variations within the spirit of the invention.

Even though the rate of expansion of aluminum is greater than cast iron the rapidity of heat transference from the aluminum piston of the present invention to the cylinder walls is such as to prevent extreme expansion of the piston, making its expansion characteristics substantially the same as the expansion characteristics of cast iron pistons.

Another object of the invention is to provide an aluminum piston so constructed as to maintain its cylindrical form in spite of the expansibility of the head in service, thus providing a piston having the advantage of constant clearance and uniform bearing surface even at high operating temperatures.

A further object of the invention is to provide an aluminum piston of two parts so constructed and arranged that the excessive heat of combustion is dissipated in such manner as to prevent too wide a range of expansion under operating conditions.

A still further object of the invention is to provide a two part aluminum piston so constructed and arranged that the excessive heat to which the head is subjected is dissipated in a manner to prevent undue expansion of the skirt and in which the heat flow away from the head is accelerated by reason of the construction of the piston.

Another and yet further object of the invention is to provide a very light piston having a high degree of rigidity and wherein the heat transference from the piston to the cylinder walls is accelerated, thus reducing to a marked degree the expansion ordinarily experienced in aluminum pistons.

A still further object of the invention is to provide an aluminum piston having a head so constructed as to allow cantilever action thereof in service thus eliminating the detonation noises.

A still further object of the invention is to provide an aluminum piston construction having a head provided with a central portion of maximum thickness associated with a bridge integrally formed with the wrist or piston pin bosses so that rapid heat transference takes place between the head and the cylinder walls, the thickened central portion of the head and the bridge and pin bosses providing a path for ready dissipation of heat.

The above, other, and further objects of the invention will be apparent from the following description, accompanying drawing, and appended claims.

The views of the drawing are as follows:

Figure 1 is a side elevational view of a piston embodying principles of the present invention.

Figure 2 is a vertical central section through the piston of Figure 1.

Figure 3 is a sectional view taken substantially

on a plane of line III—III of Figure 2 and looking in the direction of the arrows.

Figure 4 is a fragmentary elevational view of a modified form of the invention.

The present invention contemplates a piston having a head and a skirt which are separately manufactured and then assembled together in permanent relation in such manner that there is provided an unobstructed continuous gap between the flange of the head and the skirt. The construction of the piston in this manner provides free ventilation for the head, thus preventing cracking of the oil and the deposit of carbon on the head.

It has been ascertained that under the force of combustion in an internal combustion engine, there is a tendency to force downwardly the peripheral portion of the piston head which causes the flange of the head to approach the skirt. The characteristics of the metal employed for the head are such as to return the head to normal position, that is with the closed end of the head substantially flat, after the forces of combustion have been spent. This results in what is herein termed as "cantilever action". This cantilever action, therefore, causes a movement of the flange of the head with respect to its axial support, resulting in a slight crowning of the normally flat exposed surface of the head under the force of and incident to the expansive action of the combustible fuel utilized in such engines. It is highly desirable that the piston be so constructed that at no time does the flange of the head contact the skirt, and it is further desirable that the heat generated by the combustion of the fuel be dissipated as rapidly as possible to the cylinder walls without expanding unduly the skirt portion of the piston, thereby preventing binding or sticking of the piston in the cylinder.

The cantilever action present in the instant invention is of such nature that the ring grooves are maintained in substantially horizontal position under expansion and do not cant, as is found in other pistons now on the market, thus preventing cocking of the rings in the ring grooves, thereby eliminating binding of the rings in the ring grooves because of this particular construction of the head. The free ring action resulting from the present invention therefore prolongs the life of the rings and hence, the particular construction of the piston as a whole results in no internal stresses or strains being set up in the head or skirt under working conditions.

The head and skirt are made as separate parts of different thermal and mechanical characteristics.

The drawing will now be explained.

The piston chosen to exemplify the present invention as illustrated includes a head A and a skirt B. The head and skirt are made of aluminum or aluminum alloy, the skirt being preferably a casting and continuous throughout except for the holes for the piston pins.

The head as illustrated has an enlarged central part 1 which is illustrated as having, as a part thereof, a threaded shank 2. The peripheral portion 3 of the head A is provided on its exterior with the usual lands 4, 5, 6, and 7 providing three piston ring grooves 8, 9, and 10. The wall of the peripheral portion is reduced in thickness. The diameter of the upper land 4 and of the lowermost land 7 is less than the diameters of the intermediate lands 5 and 6 for the purpose of allowing more rapid expansion of the uppermost land 4 without causing binding or scoring and for permitting proper oil circulation as will appear hereinafter.

The head A between the central part 1 and the peripheral portion 3 is reduced in thickness as at 11 thus providing a thin or weakened portion in the head so that cantilever action of the head may take place in service, which action has been found to eliminate the noises incidental to detonation. The head A in service under expansion of the combusted gases tends to move downwardly, that is, the peripheral portion 3 moves downwardly with respect to the central portion 1, causing a slight crowning of the exterior of the head A.

The skirt B is provided on its interior with diametrically oppositely disposed bosses 12 and 13 for receiving the wrist or piston pins. These bosses are of relatively heavy section, that is, greater in transverse dimension than the transverse dimension of the skirt. A bridge 14 connects the bosses 12 and 13 and is illustrated as projecting above the upper margin of the skirt B. The bridge 14 is illustrated as provided with a centrally disposed threaded aperture 15 for receiving the threaded shank 2 of the head A.

The head and skirt are made as separate parts and threaded together as herein described, a washer 16 is interposed between the central enlargement 1 of the head A and the upper surface of the bridge 14. This washer may be of copper or brass or other metal having resilient characteristics so that when the piston is in service any tendency for setting up relative movement between the head and skirt is absorbed by the washer, thus eliminating what otherwise would be objectionable noise.

The head A is secured to the skirt B by threading the shank 2 into the aperture 15 of the bridge with the washer 16 interposed between the same and when the shank has been screwed home what is then its outer end is spun or peened over to form a permanent connection as at 17 between the shank and bridge, thus for all practical purposes making the head and skirt integral.

The washer 16 is provided with a depending flange 16^a. The washer is assembled between the head and the bridge of the skirt. The washer 16 is made of materials having characteristics of high heat conductivity to dissipate heat from the head to the cylinder oil contacting the washer during working conditions of the piston. It has been found that pistons equipped with washers of this type and operated under service conditions maintain the viscosity of the oil for a longer period of time than pistons not so equipped.

When the head and skirt are connected in the manner described, that is, when permanently united, an unobstructed circumferential gap 18 is provided between the head and the skirt. This gap is of sufficient size so as to prevent contact of the peripheral portion of the head A with the skirt no matter how greatly the peripheral portion of the head expands or moves downwardly in service with respect to the skirt, thus affording at all times complete separation between the peripheral portion of the skirt and the peripheral portion of the head. This gap at the same time affords means for cooling the skirt and head and also allows passage of oil to and from the cylinder walls as the piston operates in service.

Preferably the lower surface of the lowermost land 7 is chamfered at 19 to enlarge the mouth of the gap 18 for easy oil entrance in the scavenging operation of the piston in its cylinder.

The exterior surface of the skirt B adjacent the

holes 20 and 21 formed respectively in the bosses 12 and 13 for the piston or wrist pin is flattened slightly as at 22 and 23 provide relief adjacent the pin holes, preventing scoring of the cylinder by the piston at these zones and also allowing greater expansion of the skirt without binding or scoring in the cylinder. The skirt expands to a greater degree in the direction of the axis of the piston pin than it does at right angles to this axis so that the provision of the flattened portions 22 and 23 allows for this increased expansion in the direction of the axis of the pin without binding or scoring.

The inner surface of the head A is machined for increasing the heat conductivity thereof as it has been found that a machined surface increases this conductivity over a surface resulting from the molding operation of the head without machining.

The provision of the central mass 1 of the head A and the bridge 14 allows unrestricted expansion of the head without warping or distorting the skirt thus eliminating the need for forming a split or cut in the skirt.

The provision of the support of the head at its axis allows the peripheral portion free expansion and movement with respect to the skirt as its edge does not come in contact with the skirt.

The sum of the area of the threads on the shank 2 and in the bridge 14 is substantially equal to the area of the end of the shank so as to make a union between the head and the skirt which is for all practical purposes integral and uniform in every respect.

Interiorly of the skirt a rib 24 is formed which rib lies in or adjacent the plane of the axis of the piston or wrist pin. This rib serves to strengthen the skirt and prevents deflection thereof under load in service and also aids in distributing heat to the skirt. The rib 24 is integrally cast with the skirt and also with the bosses 12 and 13.

The area of the threaded engagement between the shank 2 and the bridge 14 is sufficient to prevent separation of the parts in service and the utilization of the washer 16 is such as to prevent these parts from becoming loose.

The detonation noises are stopped by providing the heavy construction at the center of the head, the knocks being eliminated by the yielding cantilever action of the head in service.

It has been found that pistons constructed in accordance with the present invention may be made with slight clearances; in fact, substantially the clearances utilized with pistons of cast iron construction. Better results have been accomplished by use of pistons of the present invention as detonation and rattling are eliminated and oil consumption reduced.

A piston made in accordance with the present invention enables use of a solid aluminum skirt without excessive clearance.

The construction of the aluminum piston of the present invention eliminates detonation and rattle noises and allows decrease of clearance usually found necessary with aluminum pistons. The present invention eliminates a slotted skirt and takes care of expansion by reason of the construction of the piston.

There may, if desired, be provided ribs 25 and 26 in the depressed portions 22 and 23 of the exterior of the skirt adjacent the pin openings 20 and 21. The ribs 25 may be applied below these openings and the ribs 26 above the openings if desired. The utilization of these ribs is for guidance in squaring the piston as to both twist and cocking after connection to the connecting rod. The ribs 25 and 26 are narrow and in service would be worn off readily because of frictional engagement with the cylinder walls in service.

The piston has been described as having a head and skirt of aluminum or aluminum alloy. The head might, if desired, be made of duralumin in which event it would be secured to the aluminum skirt in the manner heretofore described.

In accordance with a further form of the invention, the washer may be provided with a depending annular flange disposed in the space between the cylindrical portion of the head and the bridge. The oil contacting both sides of the skirt will dissipate the heat at the central part of the head to a very substantial degree, so that the temperature of the skirt due to heat transfer from the bridge is considerably reduced. This reduction is sufficient to obviate the necessity for relieving the skirt at the wrist pin holes.

I am aware that many changes may be made, and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon, otherwise than necessitated by the prior art.

The invention is claimed as follows:

1. A piston having a head and a skirt which are separately manufactured and subsequently assembled together, the skirt having piston pin bosses integrally formed therewith and a bridge connecting said bosses, said head having a centrally disposed enlarged portion or shank for engaging with the central portion of the bridge for connecting the head to the bridge, and a dished washer of high heat conductivity characteristics on said shank interposed between the head and the bridge to dissipate heat from the head under working conditions of the piston and having a free depending flange adapted to contact with oil inside the piston, said central portion of the head and said bridge being permanently connected together.

2. A piston comprising a head and a skirt separated by an uninterrupted air gap, a centrally disposed connection between said head and skirt and including a washer positioned between said head and said skirt, said washer having a free depending flange for contacting oil inside the piston to thereby minimize passage of heat from the head to the skirt.

3. A piston comprising a head and a skirt which are manufactured separately and subsequently assembled together, the head having a marginal ring carrying flange and an axially positioned shank, said head being weakened between the flange and shank to permit movement of the flange with respect to the shank in service, the skirt having integral wrist pin bosses and a bridge member connected to and integral with said bosses, said bridge being centrally apertured to receive the head shank, the shank being rigidly and immovably fastened to said bridge when the parts are assembled, the construction of the parts being such that an uninterrupted gap is provided between the head flange and skirt for ventilation and to prevent contact of the flange with the skirt as said flange moves with respect to the shank under working conditions.

4. A piston comprising a head and a skirt separated by an uninterrupted air gap, a single connection between said head and skirt and including a washer having a free depending flange for contacting the oil inside the piston and having

the characteristics of high heat conductivity to thereby minimize passage of heat from the head to the skirt.

5. A piston comprising a head and a skirt separated by an uninterrupted air gap, a single connection between said head and skirt and including a washer having a free depending flange for contacting the oil inside the piston and having the characteristics of high heat conductivity to thereby minimize passage of heat from the head to the skirt, said washer also serving to maintain the gap between said head and skirt during working conditions of the piston.

6. A piston comprising a head and a skirt which are separately manufactured and subsequently assembled together, said head having a marginal ring carrying flange and a centrally positioned shank, said skirt having integral wrist pin bosses and a bridge member integral with and connecting said bosses, said bridge member being centrally apertured to receive the head shank, said shank being rigidly and immovably fastened to said bridge when the parts are assembled, and a washer having a free depending flange and having characteristics of high heat conductivity interposed between said bridge and head for contacting oil inside the piston for dissipating heat from the head, the flange of said washer lying between the head flange and the shank and in spaced relation to both, said washer maintaining the head flange spaced from the juxtaposed margin of the skirt to provide an uninterrupted air gap under working conditions.

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