

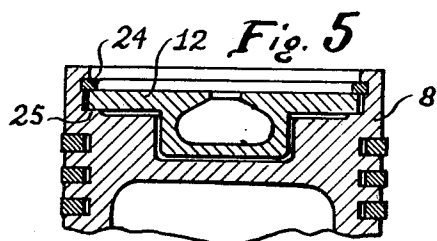
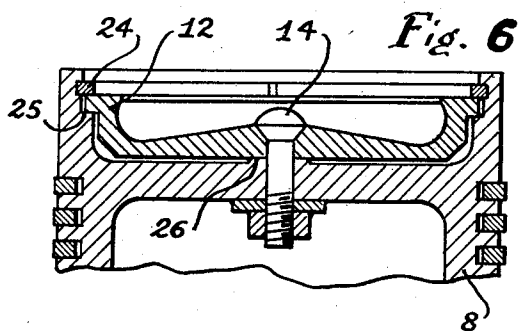
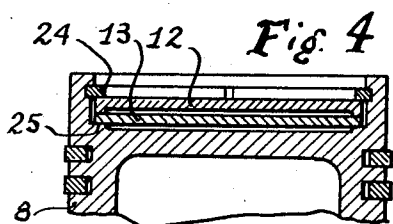
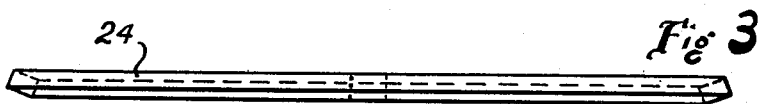
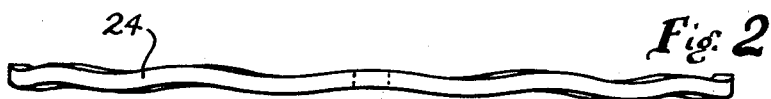
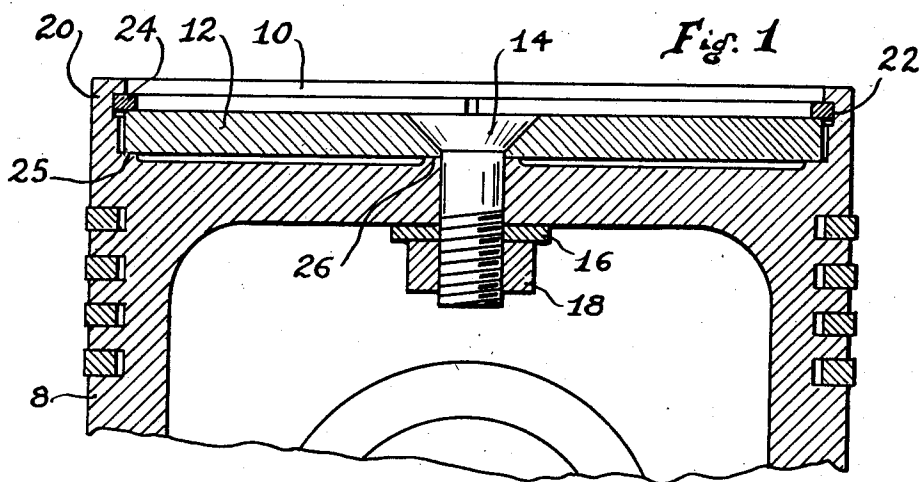
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PISTON

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## UNITED STATES PATENT OFFICE

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PISTON

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12 Claims. (Cl. 123—193)

This invention relates to pistons for internal combustion engines and more particularly to heat protecting plates for said pistons and means for attaching said plates. It is more particularly intended for compression-ignition, or Diesel, or heavy oil burning engines.

One of the objects of the invention is to provide means for reducing the amount of heat transmitted to the top of the piston.

Another object is to provide means for maintaining the temperature of the piston skirt and ring grooves at a comparatively low value.

Still another object is to provide means for attaching the heat protecting plate to the piston without interfering with the thermic dilation of said plate due to its high operating temperature.

A further object is to provide a resilient attachment of the plate.

A still further object is to provide annular means interposed between the heat protecting plate and the nearby cylinder wall, said means having a comparatively low temperature and operating as a heat screen for the cylinder wall.

The above and other objects of the invention will be apparent as the description proceeds; and while I have illustrated and described the preferred embodiments of the invention as they now appear to me, it will be understood that such changes may be made as fall within the scope of the appended claims. In the following description and in the claims various details will be identified by specific names for convenience, but they are intended to be as generic in the application as the art will permit.

Heat protecting plates attached to the piston head have long been used in internal combustion engines, and more particularly in compression-ignition engines of the two-cycle type having two opposed pistons per cylinder. Such plates are usually made of heat and corrosion resisting alloy steel or other suitable material, and their surface of contact with the piston is generally restricted to a small area, to reduce the heat flow by conduction from the plate to the piston under a given difference of temperature therebetween. The result is that in operation the temperature of the piston skirt and ring belt is appreciably lower, and the temperature of the piston top or plate is much higher than in a conventional piston. Accordingly, the amount of combustion heat lost to the piston, which is a function of the difference between the temperature in the combustion chamber and the temperature of the piston top, is substantially reduced.

A very well known type of heat protecting plate, that has been in use for years in high-speed two-cycle Diesel engines consists essentially of a flat disc of austenitic steel, whose center is solidly fastened to the piston crown by a bolt or equivalent means. Contact between plate and piston is limited to two narrow annular surface elements contained substantially in the same plane perpendicular to the piston axis, one near the bolt, and the other near the periphery of the plate. Both annular surface elements are concentric with the piston. It is important, in order to avoid overheating of the plate, that the contact along said two annular surface elements be maintained at all times, and it is equally important that the plate be free to expand and slide on the piston, without deforming the latter. To meet these requirements the plate is made in such a way that, when applied with little pressure against the piston head, only the outer annular surface elements of plate and piston are in contact, and a certain clearance exists between the inner annular surface elements thereof. A determined load has to be applied to the center of the plate, by tightening the bolt, in order to bring said inner surfaces into contact. Therefore when the bolt is blocked, forcing the inner annular surfaces against one another, the plate gets a certain amount of resilient deformation that maintains the outer annular surfaces in contact under a determined pressure, sufficient to secure good heat conduction but still permitting sliding motion of the plate relative to the piston when the former expands or contracts.

One of the drawbacks of said construction is that in operation the temperature of that side of the plate which is toward the combustion chamber, is higher than that of the side which is close to the piston. The plate therefore tends to assume a convex form, which increases the pressure of contact at its outer periphery and accordingly increases the stress in the plate. If the piston overheats, as it may happen when the engine is overloaded or is operating under poor combustion conditions, permanent deformation of the plate may occur, its contact with the piston near its periphery may come to an end, whereby the temperature of the plate is likely to attain destructive values. Another drawback is that a plate secured to the piston by a single centrally located bolt, has to be made of considerable thickness, thereby adding considerably to the weight of the reciprocating parts.

Further development, in connection with Diesel aircraft engine research, has led to an improved design of heat protecting plate in which a predetermined load is applied to the plate near its periphery, to maintain it in contact with the piston, by means of several long and resilient bolts parallel to the piston axis, and tightened by means of a clutch wrench adjusted to limit the torque applied to the serrating nuts, to a value that corresponds to said predetermined load. Said bolts are mounted in the piston with clearance, so that their end connected with the plate can move radially and does not interfere with the thermal expansion of the latter. This design appears to be quite satisfactory in operation, in that a very high engine specific power output may be obtained, and the plate may be made comparatively light, mounted without initial stress to withstand high temperature without permanent deformation. However the inclusion of a number of long bolts in the piston increases considerably the complication and the weight of the latter; and the number of bolts can hardly be made as large as it would be desirable, in order to evenly distribute the pressure on the plate.

The present invention concerns improvements to the heat protecting plate, as well as to the means for attaching the same to the piston, together with other improvements as it will appear from the following description in connection with the appended drawing.

In the drawing: Fig. 1 is a partial sectional elevation of a piston provided with heat protecting plate; Fig. 2 is a view of a retaining ring; Fig. 3 is a view of a retaining ring of different design; Fig. 4 is a partial section of a piston with a different form of plate; Fig. 5 is a partial section of a piston with another form of plate; Fig. 6 is a partial section of a piston provided with a heat protecting plate of still different design.

In Fig. 1 a piston 8 for internal combustion engine has at its top a cylindric cavity 10, adapted to receive a circular plate or disc 12, that may be fastened to piston 8 by means of a centrally located bolt 14, washer 16, and nut 18. The piston wall 20 that defines the cavity 10, extends beyond the plate 12, and is provided at its inner surface with an annular groove 22, in which can be mounted a split ring 24 that maintains the plate 12 tightly pressed against the bottom of cavity 10, which is machined so that the surface of contact between plate 12 and piston 8, is limited to two narrow annular portions 25, 26, thereby reducing to a very low value the amount of heat directly flowing therebetween under a given difference of temperature.

The radial clearance of plate 12 in the piston cavity, allows for thermic expansion of plate 12 owing to its high operating temperature, so that the external cylindrical surface of plate 12, does not come into contact with the inner surface of the piston cavity.

Direct transmission of heat from the combustion gases to the piston is thus almost entirely eliminated, while the heat transmitted to the piston from the high temperature plate, is reduced to a very low value owing to the limited area of contact therebetween. The temperature of the piston skirt and ring belt, is therefore maintained at a comparatively low value, and the piston clearance in the cylinder can be made very small. Furthermore the projecting piston

wall 20, acts as a heat screen between the plate 12 and the cylinder wall.

While the retaining ring 24 may be any conventional flat split ring made of suitable heat resisting material, in Figs. 2 and 3 are shown, free, two preferred forms of retaining rings that, when compressed to assume substantially flat parallel surfaces, and mounted in groove 22, are capable of exerting on plate 12 a predetermined load. The split ring shown in Fig. 2 has an undulated or corrugated form, so that when it is axially compressed and forced in the piston groove 22, between the upper surface defining said groove and the plate 12, it resiliently exerts on number of points near the periphery of the latter, a predetermined load, whose function is to maintain the plate 12 at all times in contact with the annular portion 25 of the piston, to secure heat conduction therebetween, said load being however not great enough to prevent sliding motion of plate 12 on the annular portion 25 of piston 8, when the former is expanding or contracting.

The split ring shown in Fig. 3 is an alternative form of retainer. It is preferably made of spring steel wire of high heat and corrosion resisting ability, preferably of square or rectangular cross section, and has conical surfaces. When axially compressed and assembled in groove 22 against the plate 12, it resiliently exerts a predetermined pressure uniformly distributed along the whole periphery of the latter. It is otherwise equivalent to the ring of Fig. 2.

In pistons of small diameter the bolt 14 may be omitted, as indicated in Fig. 4, and the operating temperature of plate 12 may be increased, without unduly reducing the width of the annular surface of contact 25, by inserting another plate 13, or several other plates, between plate 12 and piston 8. The area of contact between plates 12 and 13, can also be reduced to a narrow annular element as shown in Fig. 4.

Obviously, the heat protecting plate 12 is not necessarily a flat disc, but may assume various forms to suit the particular requirements of the type of engine for which it is designed. In Figs. 5 and 6, two different forms of heat protecting plates are shown.

These embodiments of the invention have been shown merely for purpose of illustration, and not as a limitation of the scope of the invention. It is, therefore, to be expressly understood that the invention is not limited to the specific embodiments shown, but may be used in various other ways, in connection with other devices or mechanisms, and various modifications may be made to suit different requirements, and that other changes, modifications, substitutions, additions and omissions may be made in the construction, arrangement and manner of operation of the parts within the limits of the invention, as defined in the following claims.

What I claim is:

1. A piston for an internal combustion engine, a cavity at the top of said piston, heat protecting means made of material resistant to high temperature mounted with radial clearance in said cavity, and having a restricted area of contact with said piston to limit the heat conduction between said means and said piston, a groove in said piston cavity, and a split ring in said groove resiliently exerting a predeterminable load on said means to hold the latter in contact with said piston without preventing sliding motion of

said means relative to said piston due to thermal expansion of the former.

2. A piston having a cavity at its top, a member made of heat resistant material mounted therein with radial clearance and having a surface of contact of limited extent with said piston to reduce the heat conduction to the latter, a groove in said piston cavity, a split ring in said groove to resiliently hold said member into contact with said piston with a moderate pressure, thereby permitting sliding motion of said member relative to said piston due to difference of thermal expansion therebetween.

3. A piston having a cavity at its top, a member made of heat resistant material mounted therein with radial clearance to allow for thermic expansion, means for keeping said member coaxial with said piston, a groove in said piston cavity, and a split ring in said groove to resiliently urge said member into contact with said piston with a predeterminable pressure, the surface of contact between said piston and said member having a very small area, whereby in operation the temperature of said member attains an unusually high value, and the walls of said piston cavity extending beyond said member and acting as a heat screen between said member and the contiguous portion of cylinder wall.

4. A combination as defined in claim 2, including means for attaching the central portion of said member to said piston whereby the radial clearance between said member and the walls of said piston cavity is maintained uniform.

5. A combination as defined in claim 2, wherein said surface of contact consists of a narrow annular element coaxial with said piston.

6. A combination as defined in claim 2, including means for fastening the central portion of said member to said piston, wherein said surface of contact consists of two narrow concentric annular elements located near the center and near the periphery of said member respectively.

7. A combination as defined in claim 1, wherein said heat protecting means consist of at least two superimposed members.

8. A piston for internal combustion engine having a cavity at its top, heat protecting means mounted with radial clearance in said cavity and having a surface of contact of limited area

with said piston, a groove in said piston cavity, and resilient annular means adapted to be mounted in said groove to yieldingly hold said heat protecting means into contact with said piston with a predeterminable pressure.

9. A piston for internal combustion engine having its top adapted to receive heat protecting means, a groove at the top of said piston, and axially yielding means mounted in said groove for resiliently urging said heat protecting means against said piston with a predeterminable load whose value is such that continuous contact between said piston and said heat protecting means is secured, irregular distortion of the latter due to high temperature is resisted, and sliding motion of said heat protecting means relative to said piston is not appreciably opposed, whereby thermal expansion of the former does not cause any deformation of the latter.

10. A piston for internal combustion engine having a cavity at its top, heat protecting means mounted with radial clearance in said cavity, a groove in said piston cavity, and a split ring having when free an undulated form and adapted to be resiliently flattened whereby when axially compressed, mounted in said groove and thereby maintained compressed against said heat protecting means, said split ring exerts on said means a predeterminable load to secure contact between said piston and said heat protecting means without preventing thermic expansion of the latter.

11. A piston for internal combustion engine having a cavity at its top, heat protecting means mounted with radial clearance in said cavity, a groove in said piston cavity, and a split ring having when free a substantially conic form and adapted to be resiliently flattened whereby when axially compressed, inserted in said groove and thereby maintained compressed against said heat protecting means, said split ring exerts on said means a predeterminable load to secure contact between said piston and said heat protecting means without preventing thermic expansion of the latter.

12. A combination as defined in claim 1, wherein the surface of said heat protecting means defining the combustion chamber is hollow.

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