

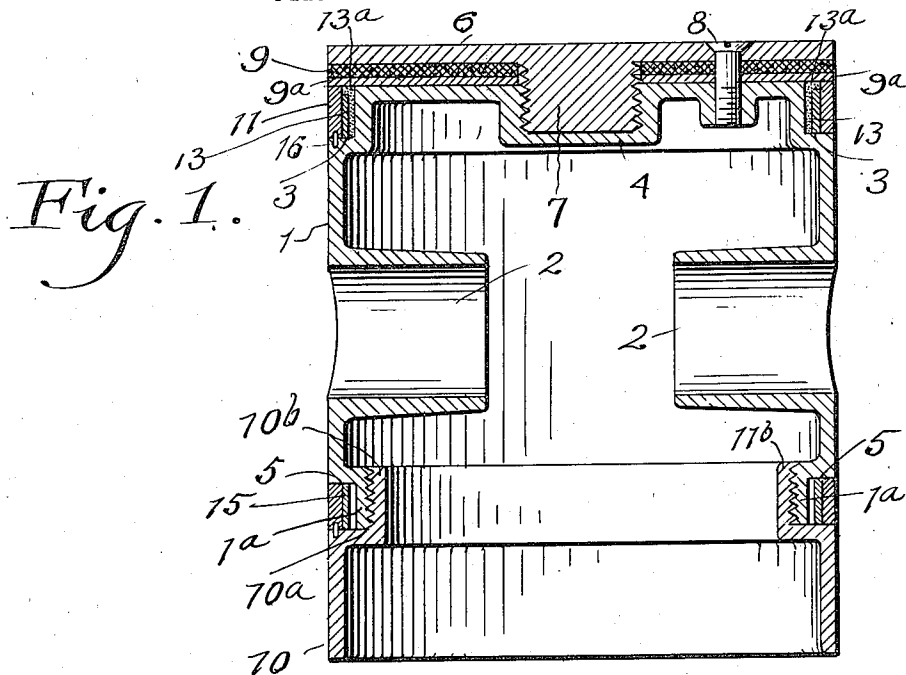
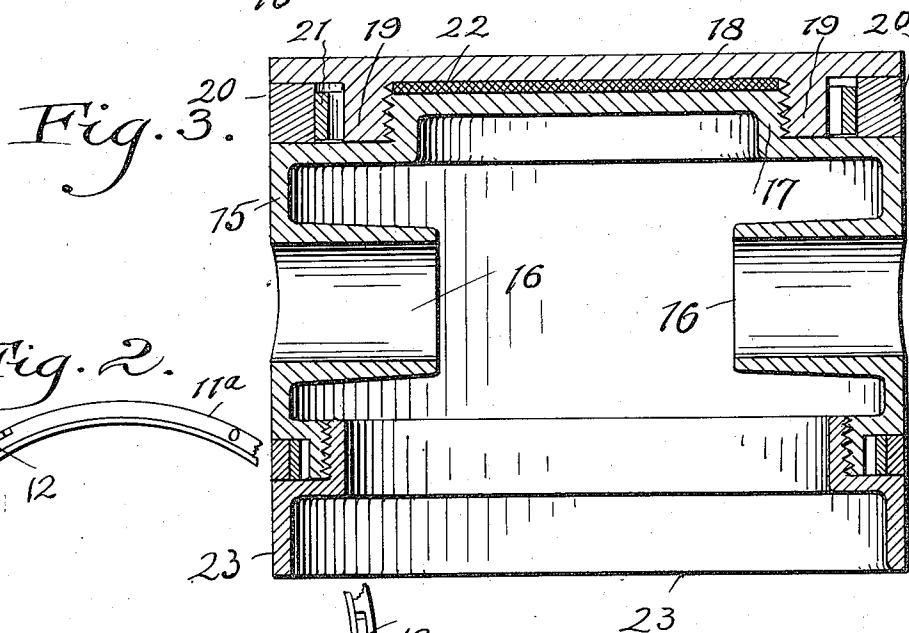
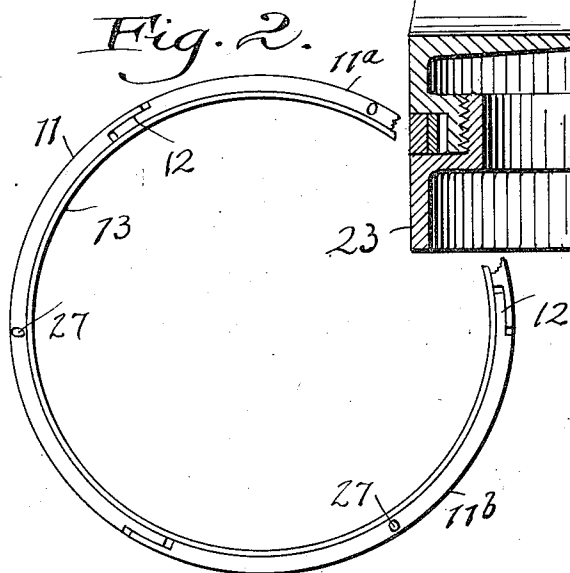
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E. M. WILLIAMS

PISTON

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UNITED STATES PATENT OFFICE.

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PISTON.

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The present invention relates to a piston for use in cylinders and is more particularly intended for use in the cylinders of internal combustion engines.

Experiment has demonstrated that when a piston of usual construction such as a cast iron piston is in actual operation in a cylinder of an internal combustion engine, the temperature at the top end or head of the piston is greatest and decreases toward the inner end or skirt of the cylinder where the temperature is the lowest. This will be evident because the head of the piston is exposed directly to the heat incident to the repeated explosions of the fuel mixture. The piston being an integral body, the heat which is imparted to the head of the piston is in part transferred to the body of the piston in accordance with the laws of the conduction of heat.

Such being the case, the greatest expansion of the usual type of piston occurs at the head end of the piston while the least expansion occurs at the skirt of the piston. This makes it necessary to provide a variation of clearance allowance from the top to the skirt of a piston in installing the same in a cylinder and this is usually taken care of by machining a piston so that it is of slightly tapering form.

The difficulties and disadvantages which are incident to the usual type of cast iron pistons and the leakage of oil around the pistons into the combustion chamber of the engine, or conversely, the leaking of gasoline past a piston into the crank case, and additionally, the excessive weight of cast iron pistons and the disadvantage of moving the large mass of iron, are all too well known to require comment.

It is the purpose of this invention to provide a piston which is so constructed that by far the greater portion of the heat which is imparted to the piston incident to its operation is retained in the head portion of the piston and only a small fraction of that heat is permitted to pass to the central portion of the body of the piston and to the skirt of the piston. Additionally, provision is also made so that heat which may be transmitted to the body of the piston is only transmitted in diminishing degree to the skirt portion of the piston.

This construction enables a piston to be fitted much closer within the walls of a cylinder and results directly in eliminating the

usual sloppy fit of a piston and on the other hand enables that the skirt portion of the piston particularly may be fitted rather exactly and have a much closer working fit within the walls of the cylinder than can possibly be attained with the types of pistons with which I am familiar.

The cylinder also provides a construction wherein the compression rings may be assembled on the piston without the necessity of removing the piston from the cylinder in which it may be placed.

Reference should be had to the accompanying drawings forming a part of this specification, in which Fig. 1 is a sectional elevation of a piston embodying my invention; Fig. 2 is a top plan view showing the compression rings; Fig. 3 is a sectional elevation of a modified form of the invention.

Referring to the drawings, 1 indicates what may be termed the body of the piston and it is provided with the inwardly extended sleeves such as indicated at 2 for the reception of a wrist pin the same as in usual practice. The upper end of the body 1 is provided with an external recess or groove which is indicated at 3, this groove being indicated for the reception of the compression ring as will be later described.

At the central portion at the top of the body portion 1 there is a boss 4 into which is threaded the member which holds the head of the piston in its attached relationship to the body portion, as will be later described.

At the lower or inner end of the body portion there is also an inwardly extending groove or recess as indicated at 5, this groove or recess being for the reception of the usual oil rings.

The body portion 1 is made hollow according to usual practice.

The head of the piston is indicated at 6 and it is provided with a central retaining screw 7 which is threaded into a suitable opening in the boss 4 thus serving as a retaining means for the head. There are also provided one or more auxiliary screws such as indicated at 8 which prevent relative turning between the body of the piston 1 and the head member 6. These various threaded members are made to have only a fairly close fit so that when the head of the piston becomes heated and expansion takes place, the expansion of the threaded members will be possible.

Means is also provided for preventing at least to a very large degree the transfer of heat between the head 6 and the body of the piston. As one means for accomplishing this general result which has been mentioned, I provide a gasket 9 which is made of any suitable composition or material which is efficient from the standpoint of the non-conduction of heat. Asbestos is a material from which such a gasket may be made. This gasket is retained between the top of the body portion 1 and the underside of the head when the head is secured on the body portion as before stated.

For the purpose of more effectively retaining the gasket 9, I may provide a plate 9^a which underlies the gasket and is secured upon the stem 7. This plate with the gasket 9 and piston head 6 may be removed from the body portion as a unit. The provision of the plate 9^a is not absolutely necessary but is desirable.

The skirt member of the piston is made as a separate element and secured to the body of the piston at the lower or open side thereof. In the present instance this is accomplished by providing the lower portion of the body 1 with an inwardly extending shoulder 1^a which is threaded upon its interior surface. The skirt member proper which is represented at 10 has at one end a shoulder 10^a and an upstanding neck 10^b, which on its outer surface is threaded and may be attached to the lower portion of the piston body 1 by the screw thread engagement which is suggested. This particular method of securing the two parts together is but suggestive of any desired method. The width of the shoulder 10^a is such that when assembling with the body 1 the outer surface of the body 6 is substantially in the same cylindrical plane as the outer surface of the body 1 of the piston.

It will thus be seen that the piston which has been described is made up of three parts which may be described as the head, the body portion and the skirt portion. The head is preferably made of a metal which has a low co-efficient of expansion and one which is nonwarping under the action of the high heat to which it is subjected when in use. The middle section or body portion of the piston is preferably made of a much lighter metal than the other portions and for this purpose aluminum or aluminum alloy has been found to be suitable. The lower or skirt portion of the piston is made of a material having a low co-efficient of expansion, which metal at the same time has the properties of resistance to wear.

The head member 6 is made of such a diameter with respect to a given cylinder into which it is to be fitted so that when within the cylinder and under working conditions, the expansion of the head under

the temperatures to which it is subjected to use, will cause sufficient expansion so that the head portion will have a nice working fit within the cylinder.

The central part or body portion of the piston being made of material of low specific gravity will materially reduce the weight of the combined portions of the piston so that the total weight of the three portions may be less than the weight of the usual cast iron piston of light dimensions. The body portion is made of such diameter with respect to a given cylinder into which it is to be housed, so that under expansion the body portion of the piston will have a nice working fit within the cylinder.

The skirt portion is made to have a diameter and clearance with respect to a given cylinder so that when in use and expanded by such heat as it receives, it will have a nice working fit against the wall of the piston.

When such a piston as has been described is used, in an internal combustion engine, the first application of heat incident to the running of the engine comes upon the head of the piston and very quickly the head of the piston expands to its ultimate amount.

The conduction of heat from the head to the body portion is materially reduced due to the provision of the heat insulating means between the body portion and the head so that the body portion of the cylinder can never become as highly heated as would be the case if the body portion and head of the piston were integral. From the foregoing it will be readily deduced that the heat which the skirt portion of the piston receives, is very much less than would be the case were the piston made as an integral structure, and experiment has demonstrated as a fact that the transfer of heat from the head of the piston to the skirt portion is so reduced over what would be the case in a solid piston, that the temperature which is attained by the skirt portion will never be so high as to affect the lubricating qualities of the oil used in crank case lubrication, whereas with the solid types of pistons now in use the breaking down of the lubricating oil in the crank case and destroying its lubricating properties is the usual occurrence unless a very good grade of oil be used, which is of course relatively expensive.

By making the piston in the three parts as above suggested, the head may be constructed so that it will expand in accordance with the heat which it receives and when so heated provide a nice fit within the cylinder, also the body portion may be so made and machined that it will when expanded by the heat which it receives, have a good

working fit in the cylinder, and the same is true with respect to the skirt portion.

Therefore with each of these parts of the piston being particularly constructed so as to take care of the temperatures to which they are individually subjected and at the same time provide a nice fit in the cylinder when in heated condition, insures that the piston under working conditions will at all portions of its engagement with the walls of the cylinder have a proper fit and not a loose or sloppy fit, and thereby the passage of oil beyond the piston into the combustion chamber is minimized.

Due to the fact that the skirt portion 10 may be so nicely fitted within the cylinder due to the construction of the piston as before explained, the skirt portion of the piston will always be in bearing relationship with the wall of the cylinder and so serve as a sort of a cross-head, and eliminate any other movement of the piston than a true reciprocating movement.

In the groove or recess 3 there is located the compression ring which is shown in plan view in Fig. 2 and comprises the three sections which are indicated at 11, 11^a and 11^b. The ends of each of these sections are provided with notched extensions such as indicated at 12, which extensions overlap and engage each other in the manner shown in Fig. 2. When these sections are inserted in the groove or recess 3 a spring member 13 is placed behind them, thus constantly urging the ring sections outwardly and against the wall of the cylinder. Attention is called to the fact that by the ring construction which has been shown and described, the various sections move out evenly so that the diameter of the assembled segments remains constant. This is not the case where a ring with a single split or division is used, because in such a construction the portions of the ring adjacent the split are somewhat more resilient than the portion of the ring which is 180° removed from the split.

Additionally it will be seen that by the construction of piston which has been described, the compression ring may be inserted after the piston is within the cylinder or where after the piston has been in use and it is desired to place a new compression ring in the same, the compression ring may be placed, without removing the piston from the cylinder. This may be accomplished by removing the head of the engine and reciprocating the piston until the head of the piston is at the top of its stroke. The head 6 may then be removed, thus exposing the groove 3 and permitting the removal or placement of the segments of the compression ring.

When a new compression ring is placed in a piston it is possible to use a rather stiff

spring behind the segments of the ring, and by this I mean a spring which is much stiffer than would be necessary in the actual operation of the piston. This will cause the segments of the ring to exert a rather heavy outward pressure against the inner wall of the cylinder. The head may then be placed and the engine mechanically turned over for a desired period of time, thereby wearing in the rings. After this wearing action has been permitted for a sufficient length of time, the head of the piston may be removed and a lighter spring substituted for the heavy spring which had heretofore been used behind the compression ring. Then the head of the piston may be replaced and the head of the ring assembled on the block thereof.

By the procedure which has just been outlined it is possible to give the rings a preliminary wearing in, which in the usual types of piston can only be accomplished by actually wearing the rings in by use. This wearing in action makes the engine very stiff and all this may be to a large extent obviated with the type of piston herein proposed in the manner which has just been described.

In the groove or recess 5 is positioned the oil ring as indicated at 14. This oil ring is constructed with segments the same as explained with respect to the compression ring and the segments of the oil ring are pushed outwardly by means of a spring 15 in precisely the same manner as has before been described.

Each of the segments of the oil ring and the compression ring are retained against undue radial movement by means of pins, one of which is indicated at 16 in Fig. 1, one end of the pin being secured with a driving fit in an opening in the body member 1, while the other end of the pin extends into a slot such as indicated at 27, which slot is formed in the under side of a ring segment. The slot is slightly elliptical in shape so as to permit a limited radial movement of the ring sections.

It is my preference to place behind the spring 13 which holds the ring segments expanded, a packing which is indicated at 13^a. This packing may be of any suitable substance which is resistant to charring or carbonization or heat, such for instance as asbestos or similar substance, and the packing is inserted so as to quite completely fill the space behind the spring 13 and the inside wall of the groove in which the ring is located.

This packing will effectually prevent the ring segments from working in and out at least to any appreciable extent. And this is desirable because the working of the rings, in an in and out direction, as the piston reciprocates in its cylinder, acts quite like a pump, and under the action of the spring,

oil sucked in around the ring, and working in back of the ring, finds exit at the top of the ring.

By placing the packing as indicated, the passage of the oil is obstructed, and even if at the beginning a small amount of oil lodges in the packing, the heat which the packing will receive will tend to carbonize the oil, and so make the packing more impervious and a better barrier against the passage of oil.

Additionally, by placing packing behind the ring segments they are quite positively held in outward position and in contact with the walls of the cylinder. This has what may be termed a bull ring effect, and provides a bearing for the top of the piston which is of material assistance in insuring a true rectangular movement of the piston within its cylinder.

In Fig. 3 there is shown a slightly modified form of construction which is particularly intended for use where the piston is of larger size than the usual automobile piston, as for instance, in compressors, pumps, or devices of analogous character. In the form illustrated the body of the piston is indicated at 15, having the usual wrist pin arms 16. The upper portion of the body 15 has an outwardly extending boss 17 which is threaded on its exterior surface. The head of the piston which is indicated at 18 has an inwardly extending flange 19. This flange on its inner surface is threaded to co-operate with the threaded boss or extension 17. The head of the piston 18 extends outwardly beyond the flange 19, as indicated, and this outwardly extending portion in connection with the body 15 forms a groove for the reception of a ring 20, which ring may be the same as that illustrated in Fig. 2, or of any desired construction. The ring is pressed outwardly by means of a spring 21. Between the inner surface of the piston head and the body portion of the piston is a gasket 22 which is similar in its functions to that which is shown in Fig. 1. As shown in Fig. 3 the gasket 22 merely engages with the boss 17 of the body of the piston, but if desired the gasket may be extended so as to lie above the ring 20.

However, it may be remarked that in pis-

tons used for compressors and similar purposes the heat to which the piston is subjected is not anywhere near so great as is the case with pistons used in internal combustion engines, and hence the requirement for heat insulation is not so great as in an internal combustion engine.

It will be noted that the ring 20 may be assembled or replaced with respect to the piston by removal of the head 18 the same as is the case with the showing in Fig. 1.

The lower portion of the piston, that is to say, the skirt 23, may be attached to the lower end of the body portion of the piston in the same manner as described with respect to the construction shown in Fig. 1.

Having described my invention, I claim:—

1. A piston comprising a body portion, a head portion, which head portion is separate from but secured to the body portion, and a skirt portion associated with the body portion which is made separate from but attached to the lower part of the body portion, the said head and skirt portion being made of metal which has a lower co-efficient of expansion than the body portion and being of the same external diameter.

2. A piston comprising a body portion, a head portion, which head portion is separate from but secured to the body portion, heat insulating means co-operating with the head and body portion and a skirt portion associated with the body portion which is made separate from but attached to the lower part of the body portion, the said head portion and the said skirt portion being made of metal which has a low co-efficient of expansion.

3. A piston comprising a body portion, a head portion detachably secured to the upper end thereof, a skirt portion detachably secured to the lower end thereof, said body portion having upper and lower portions of reduced diameter forming ring receiving recesses, and said head and skirt portions overlying said recesses, and expansible rings retained in said recesses by said head and skirt portions of the piston.

In testimony whereof, I hereunto affix my signature.

EDWARD M. WILLIAMS.