May 20, 1924. 1,494,483

J. M. HOWE

PISTON

Filed May 3, 1921 2 Sheets-Sheet 1

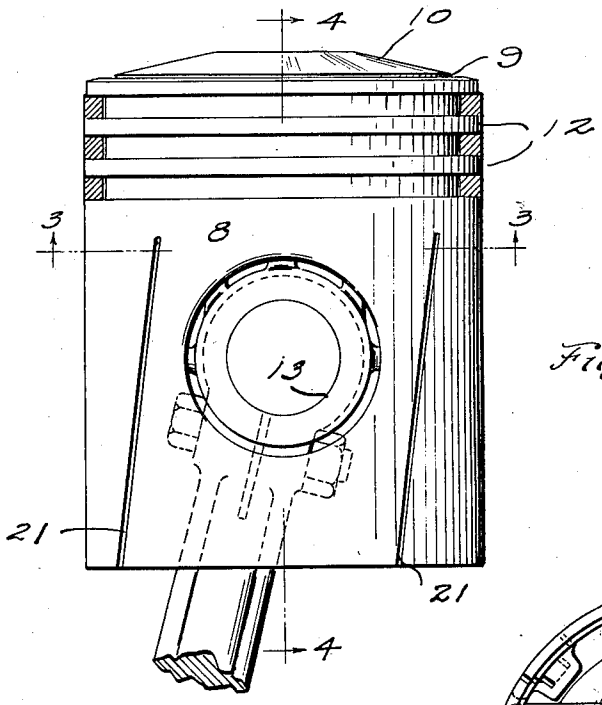


FIG. 1

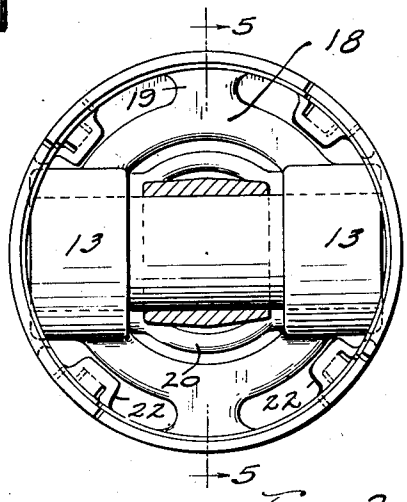
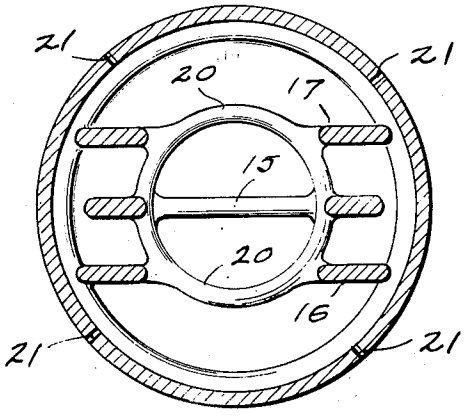


FIG. 2

FIG. 3



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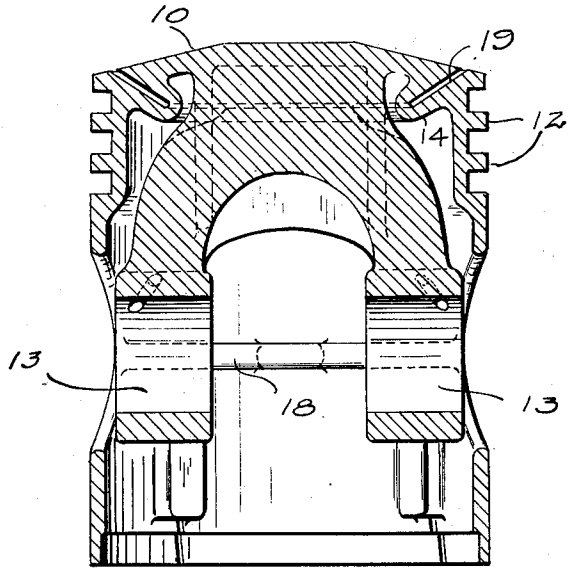

FIG. 4

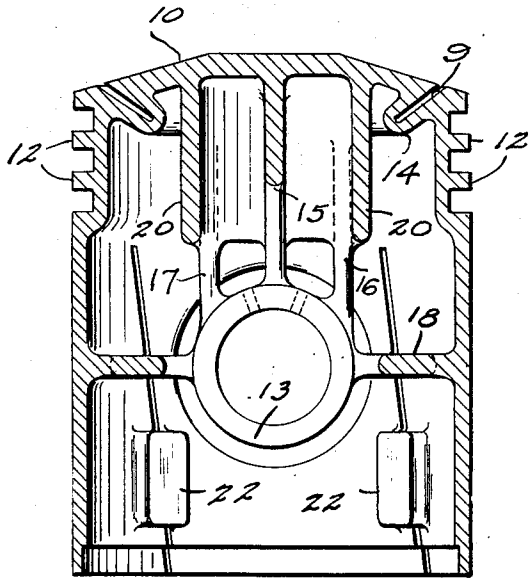

FIG. 5

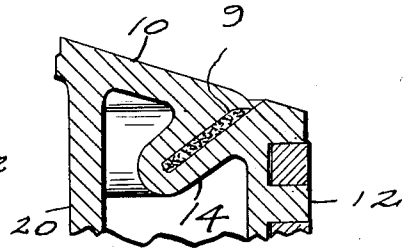

FIG. 6

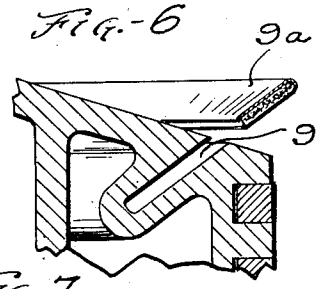

FIG. 7

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UNITED STATES PATENT OFFICE.

JAMES M. HOWE, OF CLEVELAND HEIGHTS, OHIO.

PISTON.

Application filed May 3, 1921. Serial No. 466,415.

To all whom it may concern:

Be it known that I, JAMES M. HOWE, a citizen of the United States, residing at Cleveland Heights, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Pistons, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention is concerned with the provision of a piston for an internal combustion engine, wherein certain novel features are embodied which are directed to increase the efficiency of the engine.

In internal combustion engines, particularly those of high speed, difficulties have been encountered from the unequal heating of the piston, and its consequent non-cylindrical expansion, and this is especially so with aluminum pistons, which are otherwise very desirable on account of their lightness. A number of aluminum pistons have been advocated within recent times, wherein various sectional contours have been provided for absorbing the heat and stresses exerted upon the piston head at the explosion period. During this period the heat developed is transmitted to the piston head, thence to the walls, lands and skirt of the piston by conduction.

The thermal conductivity of aluminum being about four times that of iron, the heat in the larger masses of the piston about the head thereof, has a tendency to cause such expansion of those parts that the piston ring grooves become loose longitudinally, while the lands between the grooves, expanding radially, tend to wear the cylinder wall.

The looseness of the grooves is disadvantageous as it results in the rings not being properly held and is liable to cause a knock in the operation of the engine. To overcome these difficulties it has been the custom to cut back the lands so that even when expanded they would be out of contact with the cylinder wall, the piston being made sufficiently long so that the skirt below the lands would of itself provide a sufficient bearing surface. This has somewhat remedied the difficulty but at the expense of lengthening the cylinder, and consequently increasing the size and cost of the engine.

Other pistons have been designed, wherein the sections are considerably greater than what is actually required to withstand the mechanical stresses set up within the piston, in the attempt to provide sufficient conductive area to carry the heat to the inside surfaces of the piston, and allow heat to be dissipated by radiation. These have been only partially successful because the bulk of the heat must be dissipated by the water in the cooling jacket or other cooling means on the outside of the cylinder.

I have found, however, that it is possible to construct an aluminum piston of minimum length and of minimum weight, which will have the requisite strength to meet the exacting conditions required in a high power motor and shall retain its cylindrical form irrespective of the expansion.

The general object of my invention, therefore, is the provision of means within the head for conducting the heat evenly to the skirt while obstructing the direct flow of heat from the head to the ring groove walls. The result is that the whole cylindrical wall remains cylindrical during expansion, and the lands may constitute part of the bearing surface of the piston and thus reduce the overall length thereof. I accordingly arrange the location of the wrist pin bearing center with relation to the bearing surface of the piston so that the bearing surface may be extended to include the lands, thereby shortening the length of the piston, without in any way affecting the efficient coaction between the piston rings and inner walls of the cylinder.

I make the internal construction of the piston such that the heat is carried directly from the head to the skirt to the wrist pin bearings and thence flows upwardly and downwardly in the skirt to give it an even expansion, while by reducing the metallic connection between the piston head and the upper end of the piston wall, I prevent the direct flow of any such amount of heat as would interfere with the cylindrical expansion. The piston wall preferably extends above the wrist pin connection a slightly greater distance than below it, and this excess of length and the size of the comparatively small metallic connection between the upper end of the wall and the head, are mutually proportioned to allow the direct flow

of only sufficient heat to maintain the expansion of this upper end of the skirt the same as that of its lower regions.

Not only do I, by the means described, cause such even heating of the piston wall that it remains cylindrical throughout at all times, but the reduced connection between the head and wall has the further advantage of making a slightly flexible relation between the skirt and head, thereby further decreasing the possibilities of the piston wall binding in the cylinder, notwithstanding I use the lands as part of the bearing surface.

An additional object of my invention is to provide radiation ribs rigidly connecting the piston head and the wrist pin bearings, which are of sufficient size to transmit the load from the piston head to the bearings, and which will also serve as a thermal conducting means for dissipating the heat from the head.

Other objects will become apparent in connection with the following description of the accompanying drawings, which illustrate a preferred embodiment of my invention. The essential characteristics will be summarized in the claims.

In the drawings, Fig. 1 is an illustration of my piston with the piston rings shown in cross section, while Fig. 2 is a bottom plan view showing the inner arrangement of the piston below the wrist pin bearing, while Fig. 3 is a cross section substantially along the line 3—3 of Fig. 1; Fig. 4 is a cross sectional elevation substantially along the line 4—4 of Fig. 1; while Fig. 5 is a similar section along the line 5—5 of Fig. 2; Figs. 6 and 7 are enlarged fragmentary sections of the upper edge of the piston.

In Fig. 1, I have shown a piston 8 having some of the general characteristics of the usual aluminum piston design, but in which I have incorporated heat insulating means located in the head adapted to deflect the flow of heat moving from the head to the ring grooves in an inward direction to or toward the inside of the piston. I also have arranged the rib construction in such a manner that the load stresses are exerted directly upon the wrist pin bearings.

I accordingly have provided the piston head 10 with an annular U-shaped rib 14, extending inwardly, which forms a coniform groove 9, terminating in the upper surface of the piston head. This groove may be positioned anywhere between the central portion of the piston head and the lands 12. I prefer, however, to have the groove walls extending a considerable distance from the piston head and at an angle to the piston walls, so that the inner surfaces of the walls may have sufficient air circulation to expedite the radiation of the heat, and permit slight flexibility of the groove wall relative to the head.

By positioning the groove near the outer edge of the piston head, the walls thereof may be compressed a slight amount, thus providing a semi-flexible relation between the piston head and the piston lands 12, the walls 14 surrounding the groove being of such shape and thickness as to permit of this flexibility. I thereby obtain a two fold advantage in this rib and groove arrangement, for, by filling the groove with any heat insulating means, such as asbestos, I may retard the flow of the heat toward the piston lands, with the consequence that the lands may be maintained at a temperature approximately the same as the skirt, which will permit of their being used as a part of the bearing surface. It will be apparent that as the heat is conducted through the distorted sections of the rib walls forming the groove, considerable radiation takes place from the inner surfaces of the walls, and radiates therefrom toward the underside of the piston head. This groove may also be filled by an insulating ring 9^a or the edge thereof may be turned over as shown in Fig. 9 to present a seal against the penetration of carbon.

By maintaining these piston ring grooves at a temperature considerably less than that of the piston head and conducting the heat independently thereof from the head to an intermediate region of the skirt, it is possible to utilize the lands as part of the skirt or bearing surface, and they therefore may be considered as an addition to the bearing surface in which the piston ring grooves are formed. Hence the over all length of the piston may be less than the length usually considered necessary, for it is an axiom of good practice in gas engine construction that the bearing surface of a piston be at least equal to the diameter of the piston, and that the wrist pin be located approximately at the mid-point of the bearing portion.

Moreover, by using these lands as a part of the skirt or bearing surface, the weight of the piston may be materially decreased, since in the usual piston the lands are always of less diameter than the diameter of the skirt, with the consequence that the portion of the wall above the bearing surface has no stabilizing effect upon the movement of the piston. This practice has prevailed, because no means have been known, heretofore, whereby the lands could be maintained at a temperature equal to that of the skirt.

Another advantage in this construction of the piston head is to be found in the fact that the mechanical load exerted upon the piston head during explosion and compression period may be transmitted directly to the wrist pin bearings through the vertical supporting ribs 15, 16 and 17, and not through the outer wall or skirt of the piston, the practice heretofore being to trans-

mit this load down through the ring groove walls of the piston and to the skirt to which the wrist pin bearings were integrally cast. I have found that a very light but rigid rib construction may be obtained, which will permit of the proper air circulation, by reinforcing the piston head with a cylindrical rib 20 extending around the piston center that will also be integral with the vertical wrist pin ribs 15, 16 and 17. All of these ribs are independent of the side wall of the piston.

By transmitting the load from the piston head directly to the wrist pin bearings without utilizing the side walls of the piston, I have eliminated the possibility of the top part of the piston being flattened out, when excessively overloaded, a condition which often occurs. In my construction the ring groove wear is greatly reduced and the danger of the piston rings freezing, scoring or digging into the walls of the cylinder is lessened. The scoring of the walls is further prevented by having the lands in bearing contact with the cylinder walls for by thus utilizing the lands as bearing surfaces the wrist pin bearings 13 may be located closer to the piston head.

Since I have arranged the piston to have the greater part of the load transmitted directly to the wrist pin bearing from the head, it is evident that the side walls of the piston serve merely as guide or bearing surfaces. Any rib construction connecting the wrist pin bearing to the skirt or side walls need not be of any greater strength than is required to maintain the wrist pin bearings in proper relation to the piston skirt and to conduct the heat to the skirt. A convenient manner of supporting the piston skirt is to provide a transverse concentric rib 18 extending inside of the skirt wall, and terminating in the wrist pin bearing bosses 13. This rib may be arranged to support the split portions of the skirt by the connecting integral portions 19, which are positioned approximately 90° from the wrist pin bearings. Hence the skirt of the piston may be parted in the usual manner through the provision of slots 21, extending from the end of the skirt toward the piston head in an angular direction. I have found it convenient, however, to have connecting portions 22 positioned to straddle these slots, whereby the piston skirt may have the requisite flexible qualities desired to permit expansion and contraction under the various working conditions. These connecting portions also serve to maintain the cylindrical relation of these separated skirt portions. This greatly facilitates the assembling of the piston and prevents flapping or so called clattering at high speeds.

In the use of a piston designed to embody the features herein set forth, excessive ring groove wear will not take place, and the piston rings will be properly held in the ring grooves and will maintain their proper engagement with the cylinder walls. Furthermore, as the inertia forces are in direct proportion to the reciprocating mass, the decrease I effect in the piston weight decreases the resulting pressures upon the connecting rod, wrist pin and shaft bearings. It is also evident that by transmitting the piston head load directly to the wrist pin bearings the danger of mushrooming or flattening of the piston head is reduced.

Having thus described my invention, I claim:

1. A piston having a head, internal ribs connected therewith, wrist pin bearings connected with the ribs, a skirt connected with the bearings approximately at its mid region, and a heat retarding connection between the upper end of the skirt and the head.

2. A cast piston having the following parts integral with each other, namely, a head, internal ribs connected with the head and independent of the skirt, wrist pin bearings connected with the ribs and skirt, a skirt connected with the wrist pin bearings, and a comparatively small metallic connection between the upper end of the skirt and the outer region of the head.

3. A piston having a head, wrist pin bearings internally connected with the head, a skirt connected with the bearings in a manner to allow heat to flow to the skirt and in the skirt from an intermediate region toward each end thereof, and a heat retarding connection between the upper end of the skirt and the head, the upper region of the skirt being annularly grooved and the land between the grooves being of the same external diameter as the skirt.

4. An internal combustion motor comprised substantially of a piston head, an annular U-shaped rib extending about the under side of the piston head and connecting the head to ring groove walls of the piston, and a series of vertical ribs independent of said ring groove walls connecting the piston head to the wrist pin bearings, and a transverse rib extending within the piston connecting the skirt thereof with said wrist pin bearings.

5. A piston for an internal combustion motor having a coniform groove between the head and the ring groove walls of the piston, internal portions rigidly connecting the wrist pin bearings of the piston with the piston head, and means connecting the wrist pin bearings with an intermediate region of the skirt.

6. A piston for an internal combustion motor having a semi-flexible connection between the head and ring groove walls there-

of, and an integral connection between said head and the wrist pin bearings of the piston whereby the head and bearings may have semi-flexible relation to the ring groove walls and skirt of said piston.

7. A piston for an internal combustion motor having an interruption between the head and the ring groove walls of the piston, and integral portions rigidly connecting the wrist pin bearings of the piston with the piston head whereby a force exerted on said head may be directly transmitted to said bearings independent of said ring groove walls.

8. A piston for an internal combustion motor having a coniform groove between the head and the ring groove walls of the piston, and portions rigidly connecting the wrist pin bearings of the piston with the piston head.

9. A piston for an internal combustion motor comprising a head connected to the piston ring groove walls by a U-shaped annual rib and connecting ribs rigidly securing the wrist pin bearings of the piston to its head whereby heat absorbed by the head during the explosion period of the engine may be directed away from said groove walls and into said connecting ribs.

10. A piston for an internal combustion motor having a groove between the head and the ring groove walls of the piston, an insulating filling in said groove, and portions rigidly connecting the wrist pin bearings of the piston with the piston head.

11. A hollow piston having a head and skirt, a series of ring grooves formed in the skirt near said head, heat insulating means incorporated within the head positioned intermediate of the head and said grooves, and heat radiating means composed of a series of vertical ribs rigidly securing said head to the wrist pin bearings of the piston.

12. An internal combustion motor comprised substantially of a piston head, an annular U-shaped rib extending about the under side of the piston head and connecting the head to ring groove walls of the piston, and a series of vertical ribs independent of said ring groove walls connecting the piston head to the wrist pin bearings.

13. A piston for an internal combustion motor having a head rigidly connected to the wrist pin bearings and semi-flexibly connected to the ring groove walls thereof, means intermediate of the head and ring groove walls adapted to impair the thermal conductivity of the metallic portion connecting said head to said ring groove walls and a series of heat radiation ribs connecting the piston head and wrist pin bearings whereby the heat in said head may be conducted inwardly, thereby partially dissipated therefrom by radiation, and means for conducting the heat from the wrist pin bearings to the skirt, whence it may pass to the cylinder wall and jacket.

14. A cast piston comprising a head, a wall having a ring groove formed therein near said head, and heat radiating means composed of ribs rigidly securing said head to the wrist pin bearings of the piston independently of the bearing walls of the piston, a longitudinally split skirt, and annular means within the skirt connected with the wrist pin bearings and connected with the skirt sections in isolated regions each a considerable distance from the line of separation of the sections.

15. In a cast piston, the combination of a head, a wall having a series of ring grooves formed therein near said head, the lands between the grooves constituting part of the bearing surface, and heat radiating and conducting means composed of a series of vertical ribs rigidly securing said head to the wrist pin bearings of the piston independently of the bearing walls of the piston.

16. A cast piston comprised substantially of a head, a skirt having a series of ring grooves formed in the wall thereof near said head, internal heat radiating means composed of a vertical tubular rib and a series of vertical ribs integral with the tubular rib and out of contact with the skirt, said ribs rigidly securing said head to the wrist pin bearings of the piston independently of the bearing walls of the piston, and a connection located in the horizontal plane of the wrist pin between the wrist pin bearings and the skirt.

17. A cast piston comprising a head, a wall having ring grooves formed therein near said head, means for retarding the passage of heat from the head to the ring grooves, and heat radiating means composed of ribs rigidly securing said head to the wrist pin bearings of the piston independently of the bearing walls of the piston.

18. A cast piston for an internal combustion motor having an internal rib construction adapted to transmit mechanical stresses exerted upon the head thereof directly to the wrist pin bearings through connecting rib portions integral with the piston head and the bearings, said connecting ribs being independent of the bearing walls of the piston, the skirt of the piston being integrally connected with the head by an inwardly doubled portion adapted to retard the passage of heat from the head to the skirt and permit flexibility.

In testimony whereof, I hereunto affix my signature.

JAMES M. HOWE.