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S. J. WALKER ET AL

2,731,313

INTERNAL COMBUSTION ENGINE PISTON

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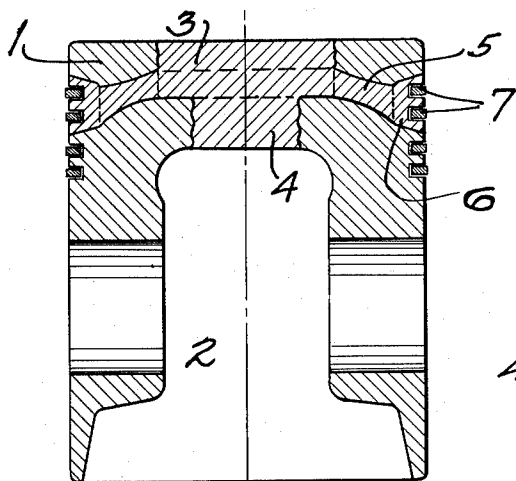


FIG. 1

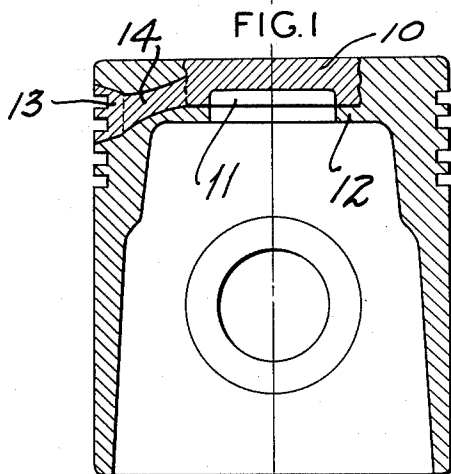


FIG. 3

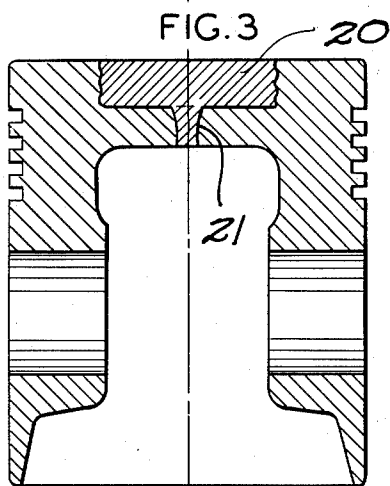


FIG. 5

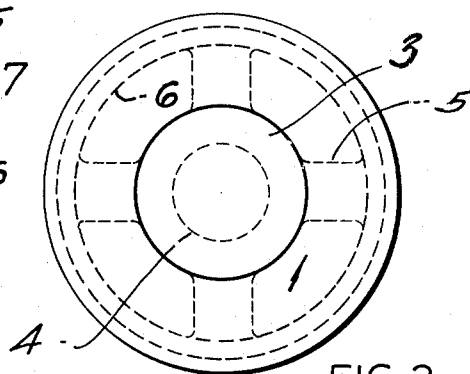


FIG. 2

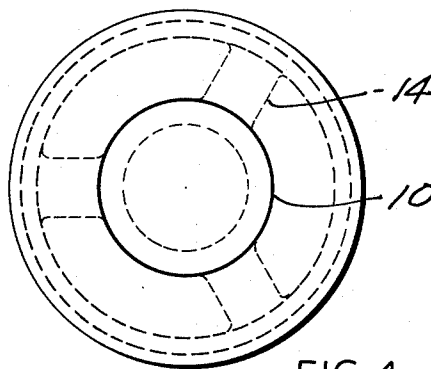


FIG. 4

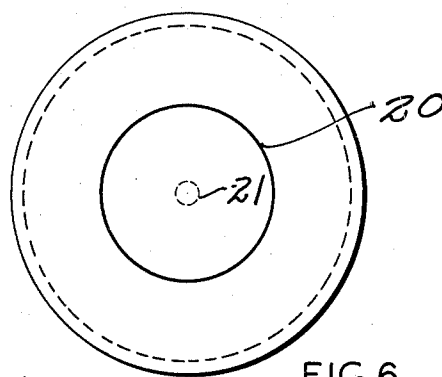


FIG. 6

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INTERNAL COMBUSTION ENGINE PISTON

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9 Claims. (Cl. 309—9)

The invention relates to pistons for internal combustion engines and more particularly to pistons of the type in which the major portion consists of a relatively lightweight, high thermal conductivity metal such as aluminum but restricted portions of the piston, subject to unusually heavy service conditions, may be formed of a relatively heavier, low thermal conductivity metal such as cast iron.

A piston embodying the invention is particularly adapted for use in diesel engines in which the top walls of the pistons are subject to deterioration because of direct exposure to the high temperature of the explosion which tends to soften and even burn the piston top wall if made of aluminum. The main object of the present invention is to avoid this undesirable result and this object is attained by forming a substantial portion of the piston head of a ferrous metal which may extend through the head. Preferably the ferrous metal portion of the piston head is of sufficient bulk to constitute a core of relatively high heat capacity which will function during periods of light duty of the engine to maintain a temperature of the piston head sufficiently high to insure a more prompt resumption of effective operation, when the engine is again under load, than would result if the entire head were of aluminum, which has a lower heat capacity, and would rapidly dissipate heat from the upper portion of the cylinder.

Another object of the invention is to combine such a piston head structure with a piston ring seat in the side wall of the head which will also be formed of ferrous metal and will better resist excessive wear of the piston ring holding grooves than would a seat of aluminum because of the softening of the aluminum due to high temperature adjacent the piston head.

It is essential that the bimetal structures form a permanent rigid unit and another object is to secure this result by molecularly bonding the interface of the metals and preferably by increasing the area of the interface by corrugating it.

Another object is to retain piston head high temperatures when the engine is working at less than capacity.

In the accompanying drawings illustrating selected embodiments of the invention.

Figure 1 is a vertical transverse section through a piston head which includes a center core or plate with a downward extension of substantial diameter and also includes a circular seat for one or more piston rings connected to the core by radial spokes.

Figure 2 is a top view of the piston shown in Figure 1.

Figure 3 is a section similar to Figure 1 but illustrating another form of the invention in which the center core or plate is recessed upwardly.

Figure 4 is a top view of the piston shown in Figure 3.

Figure 5 is a vertical section illustrating another form of the invention in which the center core or plate is more nearly enclosed in the aluminum body.

Figure 6 is a top view of the piston shown in Figure 5.

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In the piston shown in Figures 1 and 2, the outer portion of the piston head 1 and all of the piston skirt 2 is formed preferably of aluminum, or aluminum alloy, or metal having similar heat conductivity and specific heat.

This major portion of the piston is cast about a separately formed ferrous metal member comprising a central top disc 3 with a depending projection 4 of somewhat smaller diameter, radial arms 5 and a circular periphery 6 having grooves for seating one or more piston rings 7. Preferably the ferrous metal core 3, 4 extends from the top face of the head to the bottom face of the head and the volume of the ferrous metal portion of the head approximates half of the volume of the head.

The piston shown in Figures 3 and 4 is substantially lighter in weight than that shown in Figures 1 and 2 and the center ferrous metal core 10 is recessed upwardly at 11. The aluminum body includes ledges 12 underlying the annular portion of the core surrounding the recess. As in Figures 1 and 2, the ferrous metal core extends from top to bottom of the center portion of the head. The ring seat 13 and spider arms 14 correspond to those previously described.

In the piston shown in Figures 5 and 6, the upper portion 20 of the ferrous metal center core corresponds in diameter generally to those cores shown in Figures 1—4 but has a more extended surface in contact with the aluminum heat material. The central projection 21 is of restricted diameter and its main value is to facilitate molding and casting operations. While this piston does not include the ferrous metal seat for piston rings, this feature may be added if desired.

In each form of the invention, at least part of the interface between the ferrous metal and lighter metal is corrugated to provide increased interface area. Preferably the lighter metal is cast about the ferrous metal member in a manner which results in a molecular bond between the metals at the interface. Such a bond may be formed by placing the ferrous metal member in a bath of molten aluminum or aluminum base alloy long enough to reach the temperature at which the bath metal alloys with the ferrous metal, forming a thin layer thereon which will readily unite with the aluminum of the head when it is cast about the ferrous metal insert. This process may be as described in Whitfield et al. Patent No. 2,396,730 or by any other suitable process effecting the same general result of permanently uniting the different metals so that subsequent subjection to high temperatures, explosive forces and load thrusts cannot effect separation of the different metal parts. There is no possibility of the ferrous metal member separating from the body of the piston because of alternate heating of the piston, when the engine is under heavy load, and cooling of the piston when the engine is idling or not running. Even the slightest loosening of the different metal parts would be fatal to an effective piston life because subsequent operations could not fail to increase the looseness to the point to which the piston would become unusable. Hence, the necessity of the molecular bond at the interface. Any mere incasting of the ferrous metal part or other mechanical keying in or tie between the different metal parts would be ineffective. It would result first in the leakage of gas through the head under the high pressures encountered and second in the gradual increase of the play between the separated parts.

Aluminum or aluminum alloy and gray iron or a gray iron alloy are the preferred metals for use in the pistons as described above but other metals having the respective qualities of aluminum and gray iron base metals may be used if desired and other variations in the details of the construction may be used without departing from the spirit of the invention and the exclusive use

of these modifications coming within the scope of the claims is contemplated.

What is claimed is:

1. An internal combustion engine piston comprising a relatively thick head and a relatively thin depending skirt of aluminum, the head having a center core of ferrous metal extending from top to bottom of the head, the aluminum and ferrous metal parts being molecularly bonded together at their interface.

2. An internal combustion engine piston, the head and skirt of which is formed substantially of aluminum, there being a central core in the head formed of ferrous metal, the bottom of said core having a concavity extending substantially half the depth of the head and the aluminum metal underlining the lower annular periphery of the core, there being an aluminum-ferrous metal molecular bond between the ferrous metal core and the surrounding aluminum.

3. An internal combustion engine piston, the head and skirt of which is formed substantially of aluminum, there being a central core formed of ferrous metal and comprising a substantial portion of the top face of the head and provided with a projection of restricted diameter extending to the bottom of the head, said core being molecularly bonded to the surrounding aluminum throughout their interface.

4. An internal combustion engine piston, the head and skirt of which is formed substantially of aluminum, there being a central core in the head formed of ferrous metal, said core being approximately half the depth of the surrounding portion of the head and forming the top and bottom surface of the central portion of the head, said core being molecularly bonded to the surrounding aluminum throughout their interface.

5. An internal combustion engine piston comprising a head and depending skirt of aluminum, the head having a center core of ferrous metal extending from top to bottom of the head, the aluminum and ferrous metal parts being molecularly bonded together at their interface, the contiguous faces of the ferrous metal central core and of the surrounding aluminum metal part of the head being of wavy contour to increase the interface surface and an iron-aluminum alloy molecular bond between the interface metals.

6. An internal combustion engine piston comprising a

head and depending skirt of relatively high heat conductivity metal, the head having a central core of relatively low heat conductivity metal extending from top to bottom of the head, there being a film of an alloy of the two metals forming a molecular bond between the core and the surrounding portion of the head.

7. An internal combustion engine piston comprising a head having a peripheral portion and depending skirt of aluminum and having a central core portion of approximately one-half the volume of the head of ferrous metal and forming a heat reservoir of high capacity relative to that which would be formed by a corresponding core of aluminum, the aluminum and ferrous metal portions having a molecular bond between their interfaces and forming a head of solid metal section.

8. An internal combustion engine piston comprising a head and depending skirt, the head having a solid core of different metal than the remainder of the piston head and of corresponding volume and of relatively high heat capacity, said core being molecularly bonded to the remainder of the head.

9. An internal combustion engine piston comprising a head, including a cylinder-like periphery, and a skirt depending therefrom, said head and skirt being formed of metal having a high specific heat, a core-like insert in the center of the head and extending from top to bottom of the head, a piston ring seat insert in said periphery, and radial arms connecting said center insert and ring seat insert, said inserts and radial arms being of relatively low specific heat and being molecularly bonded to the metal of the head and skirt throughout their interfaces.

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