

Dec. 9, 1952

L. SULPRIZIO
MANUFACTURE OF PISTONS

2,620,530

Filed June 8, 1950

2 SHEETS—SHEET 1

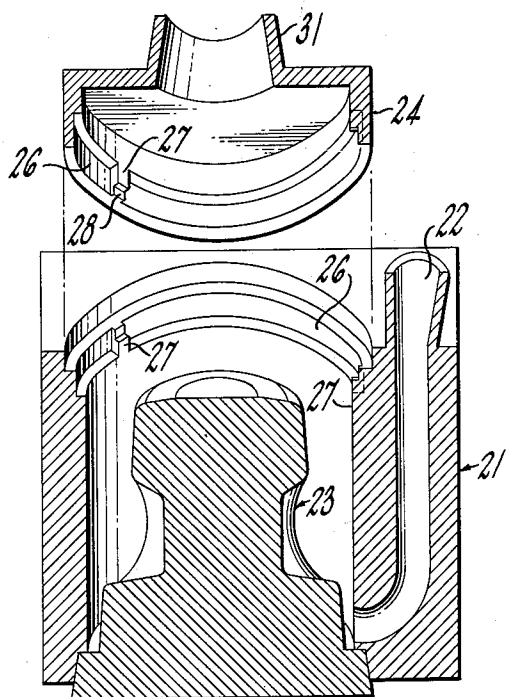


FIG. 1.

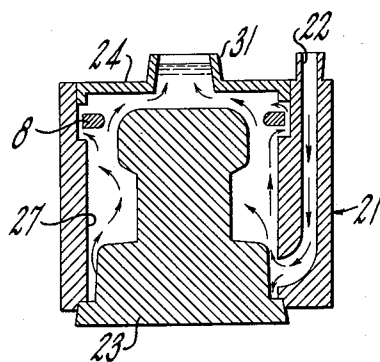


FIG. 2.

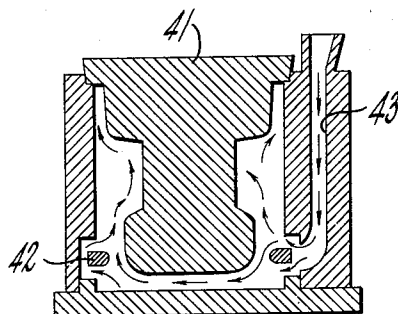


FIG. 3.

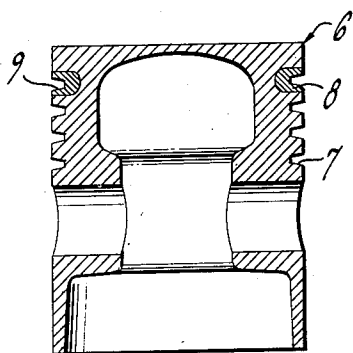


FIG. 4.

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2 SHEETS—SHEET 2

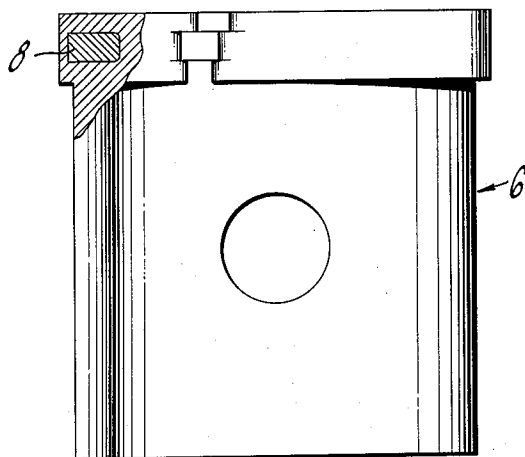


FIG. 5.

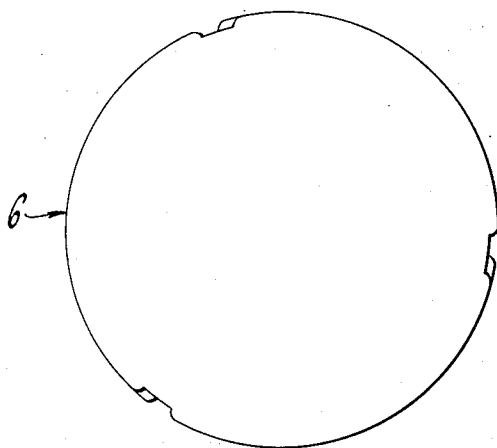


FIG. 6.

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MANUFACTURE OF PISTONS

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1 Claim. (Cl. 22-204)

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This invention relates to the manufacture of pistons and the like and particularly to pistons made of aluminum or an aluminum base alloy and which are employed in engines which operate, for example, on the Otto or diesel cycle. In accordance with this invention, such a piston is cast in a mold with a concentric metal ring which forms a portion of the working side wall of the piston. The ferrous metal ring is first coated with a thin iron-aluminum alloy as by immersion in a suitable bath at about 1525° to about 1625° F. for a short time, as is taught in the Whitfield et al. Patents 2,396,730 and 2,455,457. Immediately after the coating is applied and before the ring has cooled, the ring is transferred to a mold and the piston is cast; the ferrous metal ring is integrally bonded to the body of aluminum or aluminum alloy forming the piston. When the mass has cooled, the surfaces of the piston are suitably machined, a groove being cut in the ferrous metal ring to provide a support for a piston ring. If desired, the ferrous metal ring can be provided of such size as to carry several piston rings. If only one ring is provided, the groove is cut at the head end or top of the piston and is utilized to provide support for the top ring. The provision and maintenance of an adequate seal about the top of the piston has long been recognized as essential to long engine life and high operating efficiency; imperfect or worn grooves and lands enable combustion gases to destroy compression factors, shorten ring life, carbonize and freeze rings with resultant cylinder wear and fuel waste. Each of these is obviated or reduced by utilizing a piston embodying and made in accordance with this invention.

It is in general the broad object of the present invention to provide a novel and improved process for the manufacture of a piston including an integrally bonded ferrous metal in the peripheral surface of the piston.

A further object of the invention is to provide a novel mold for the casting of a piston having an integrally bonded concentric ferrous metal ring which forms a part of the side-wall working surface of the piston.

The invention includes other objects and features of advantage, some of which, together with the foregoing, will appear hereinafter wherein the preferred practice of the method and the preferred form of mold embodying this invention are disclosed.

In the drawing accompanying and forming a part hereof,

Figure 1 is a schematic side elevation of a mold

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and core, portions of the mold and core being cut away to illustrate their relation to one another in preparation for completion of the mold prior to the casting operation.

Figure 2 is a diagrammatic view illustrating the flow of metal in the form of mold shown in Figure 1.

Figure 3 is a diagrammatic view illustrating the flow of metal in another form of mold embodying the present invention.

Figure 4 is a sectional view illustrating the construction of one form of a machined piston produced in accordance with this invention.

Figure 5 is a side elevation of a piston, partially in section, as removed from the mold of this invention.

Figure 6 is a plan view of the piston in Figure 5.

Referring to the drawings, this invention particularly relates to the manufacture of a piston generally indicated at 6 and having one or more grooves 7 therein for the reception of suitable piston rings. It is preferred that at least one of these grooves, preferably the upper groove, include an integrally bonded annular ring 8 of ferrous metal in the piston side-wall working surface. To ensure good results, the aluminum or aluminum base alloy piston structure and the ferrous metal ring must be integrally bonded through a ferro-aluminum alloy. This is attained by first heating the surface of the ring to a temperature and for a time sufficient to form a ferro-aluminum alloy film on the surface of the article, after which, and without cooling, the coated ring is positioned in the mold and the piston is cast. The conditions for formation of the alloy film and the general process details are disclosed in the aforementioned patents.

In accordance with this invention, the aluminum coated ferrous metal ring is supported in such relation to the mold that it is completely embedded in the aluminum metal, as is shown in Figures 5 and 6, and excess metal must be removed as by machining to exhibit the ring and prior to formation of the groove 9 therein, as in Figure 4. Thus, referring particularly to Figure 1, I have indicated a mold generally at 21 and having a cylindrical mold cavity for formation of a piston; the mold has a conventional gate 22 through which the molten metal is admitted to the bottom of the mold. A suitable core, indicated generally at 23, is placed in the mold, cover 24 being adapted to fit the top of the mold and including a riser 31 completing the mold.

In accordance with this invention, the mold

and cover are each provided with an annular recess 26 having a diameter larger than that of the piston proper, the recess being at an elevation in the mold corresponding to that of the position of the ferrous metal ring in the piston. The recess is of a size to receive the ferrous metal ring and retain it in a spaced relation to the adjacent side wall of the completed mold. At spaced points about the annular recess 26 in each of the mold proper and the cover, the recess is discontinuous and the side wall is continued as is indicated at 27, a notch or recess 28 being provided in each such continuation 27 to provide a support for the aluminum coated ferrous metal ring. Preferably, at least three such supports are used to ensure centering of the ring. The notches in the cover and in the mold are preferably offset so that a minimum area of the ring is sealed against the wall on either side of the ring (see Figures 5 and 6). Thus, except at the places where the ring is engaged with the notches 28, it will be supported in a freely spaced relation to the wall 27 of the mold and metal can flow freely up and around the ring, as has been indicated in Figure 2. Slag and oxide are thus forced into the riser 31 and do not collect in and around the ring at its junction with the wall, as is the case when the ring is merely supported at the desired elevation within the mold with its outer surface in engagement with the cylindrical surface of the mold; the complete piston after casting is shown in Figures 5 and 6 and, when typically machined, in Figure 4.

The invention can be practiced with a mold of the type illustrated in Figure 3 wherein core 41 depends into the mold and the ferrous metal ring 42 is supported, as has been described, in the bottom portion of the mold. The metal then flows up and around the ring from gate 43, as is indicated by the arrow, the slag and oxide collecting in the upper portion of the piston about the skirt portion where its presence is not too undesirable.

A typical cast piston is shown in Figures 5 and 6, with the excess metal completely surrounding the ferrous metal ring except for those relatively small areas where the ring is supported in position in the mold. This excess metal is readily removed in the machining operation. In this manner, an improved piston structure is provided wherein the concentric ferrous metal

ring utilized as a piston ring support is adequately bonded by a ferro-aluminum bond to the piston. One can use any desired ferrous metal for the ring which is suited to the use of the piston.

Because of the very limited contact of the hot alloyed ring with the outer mold, the ring retains its heat and metal flowing over and around it does not cool appreciably. This same result can be achieved by providing three or more conical indentations in the surface of the ring and spaced equally about the periphery to receive the pointed end of a pin-like support which projects from the mold wall, one of the three pins being spring-biased to hold the ring against the other two pins which are fixed. Because of the small area of contact between the pins, the heat loss through the pins is negligible.

I claim:

In the casting of an aluminum piston having an annular iron ring supported concentrically thereon, the steps of coating an iron ring with an iron-aluminum alloy by immersing the ring for a short time in a molten bath of said alloy at a bath temperature of from about 1525° F. to about 1625° F. and immediately thereafter supporting the hot ring in a mold for the piston at a plurality of spaced points about the periphery of the ring with the ring outer wall spaced from and concentric with the mold to provide a free-passageway for metal flow between the mold and the ring outer wall, and then, while the ring is still hot, pouring a molten metal of the class consisting of aluminum and aluminum base alloys into the mold to fill the mold and embed said ring therein.

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