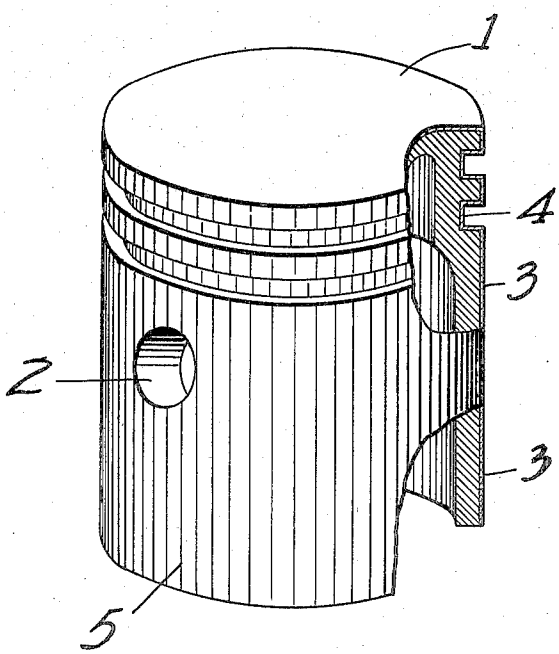
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COATED ALUMINUM PISTON

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COATED ALUMINUM PISTON

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Continuation of application Serial No. 541,521, June 1, 1931. This application October 6, 1932, Serial No. 636,536

3 Claims. (Cl. 309—14)

This invention relates to pistons made of aluminum base alloy, herein and in the appended claims conveniently referred to as aluminum pistons, and to a coated aluminum piston of new and unusual properties. This application is a continuation of my application for United States Patent Serial No. 541,621, filed June 1, 1931, and similarly entitled.

The aluminum pistons to which my invention refers are provided on their surfaces with an oxide coating, a term which, in the parlance of the art, denotes an artificially produced coating of appreciable thickness composed in substantial part of aluminum oxide.

I have discovered that when aluminum pistons are treated by one of the several known methods to produce on the wearing surfaces thereof a hard, minutely porous and adsorbent oxide coating of appreciable thickness, and the coated piston treated in such a manner as to cause lubricating oil to be adsorbed in the minute pores of the coating, the resultant product, in operation in a motor, has certain unexpected and highly useful properties not heretofore developed by aluminum pistons and not heretofore developed as properties of the oxide coating with which the piston is provided. I have further discovered that the combination of aluminum piston and coating offers, in connection with the operation of motors, a solution to many existing problems.

A coated aluminum piston, such as herein referred to, is shown in the accompanying drawing where there is illustrated, with certain wall sections cut away to show the coating, a conventional type of trunk type piston consisting of a head 1 and a skirt 5. Conventional wrist pin bosses, as at 2, and piston ring grooves, as at 4, are shown. The whole surface of the piston is provided with the oxide coating 3. While this coating is shown only on the outer or wearing parts of the piston, the entire inner and outer surface of the piston may be, if desired, provided with such a coating. It will be appreciated that, for illustrative purposes, the thickness of the coating as shown in the drawing is greatly exaggerated.

The wearing qualities of pistons and cylinders of any material are intimately related to lubrication of the engaging surfaces. Lubrication depends upon the formation and maintenance of films of lubricating oil between the surfaces, thus preventing direct metal-to-metal contact. The more evenly the oil films are distributed over the engaging surfaces the more nearly this result is obtained. Any imperfections in a surface lessening its affinity for oil may militate against evenness of film. I have found that when an aluminum piston is provided with an oxide coating of the type described and this coating is further provided with what may be termed resident oil adsorbed in and on its surface, several benefits of considerable magnitude are obtained when the piston is operated in a motor. For instance, a new motor is, as is well known, difficult to wear in. Pistons are liable to seize or scuff unless the motor is run with unusual care. By using oxide-coated pistons it is possible to fit the piston with only about one-half of the normal clearance with which aluminum pistons are normally fitted in new motors and to obtain a higher speed in new motors in a shorter time without seizing or scuffing of the piston. This result is a function of the peculiar method in which the oxide coating and its resident oil reacts to motor operating conditions. The small but effective amount of resident oil which is adsorbed or absorbed in the coating apparently does not, as might be expected, leave the coating during operation at motor temperatures, but it appears to assist in maintaining a film of oil between the oxide-coated walls of the piston and the cylinder walls. For instance, there may be cited the unusual case where, due to faulty motor lubrication, an oxide-coated aluminum piston made in accordance with this invention ran for several hours in a small high speed motor without lubrication other than that provided by the resident oil in the coating, and this without any of the usual signs of scuffing or seizing.

The manner of making the oxide-coated pistons and providing them with a thin, pervious and hard oxide coating containing resident oil will now be described. The aluminum piston may be made in any usual manner such as for instance by casting in permanent molds. The piston surfaces are then prepared for use as in the usual manner by machining and grinding so that they are perfectly smooth and uniform and fit the cylinder in which they are placed. The piston is then ready, any grease having been removed, as by washing in the usual organic solvent, for the coating operation. Oxide coatings may, as is known, be formed on aluminum surfaces by any one of several methods. For instance, one may make the aluminum the anode in an electrolytic cell the electrolyte of which is a solution of one of various substances, such as sulfuric acid, chromic acid, oxalic acid, etc., and the coating will be formed on the aluminum when external electrical energy is impressed upon the cell. Or

the coating may be formed by dipping the prepared aluminum surfaces into chemical solutions, such as solutions of alkali chromates and dichromates and alkali carbonates. Other solutions are also known to the art for this purpose. When providing an aluminum piston with an oxide coating, one of the several known methods may be used but preferably such methods as provide the coating with a very hard, a very adherent, and a minutely porous oxide coating. I prefer to use, for example, the anodic process and particularly the anodic processes which utilize, as an electrolyte, solutions of sulfuric acid. After the coating is formed, the coated piston may be rinsed in clear water and dried, and oil may then be adsorbed or absorbed in the coating, as by immersion of the piston in a bath of oil, or rubbing it with oil. If desired, the piston may be heated before immersion in the oil, to drive off water that may have been previously adsorbed by the coating.

An instance of a typical coating procedure is where an aluminum piston was made the anode in an electrolyte consisting of an aqueous solution containing 25 per cent by weight of sulfuric acid. A lead cathode was used and a voltage of about 12 volts was impressed upon the cell. The bath was agitated and circulated and kept at a temperature between 70 and 75° Fahrenheit and the piston treated under these conditions for about 40 minutes. The oxide coating having been formed by this treatment, the piston was removed from the cell and rinsed in clean water and was then ready for a treatment which would place in the coating the resident oil.

Besides the advantages which my novel piston has in connection with new motors, several other advantages accrue by the use thereof. Although the oxide coating which is provided on the piston surfaces is in itself comparatively brittle, I have found that its action in the piston ring grooves is unusual and very advantageous. This apparently brittle oxide coating prevents a substantial amount of the deformation of the ring groove metal which is normally caused by the pounding of the piston ring in the groove during motor operation, and this result is achieved without any material failure of the oxide coating itself although, as is readily apparent, the coating on the more or less sharp edges of the ring groove is exposed in such a way as to be susceptible to failure under the pounding action of the rings. The coating likewise eliminates a part of the frictional load on the wrist pin, resulting in maintaining a uniform wrist pin fit and therefore uniform heat distribution and less heating in the piston structure.

It has likewise been observed in certain motors that apparently the stray electrical excitations which, in conjunction with the acid present in motor lubricating oils, tend to pit or corrode the piston are largely overcome by the use of oxide-coated aluminum pistons. It has been observed that when the oxide-coated piston is used, the tendency towards pitting or corroding of the piston is substantially eliminated.

The oxide coatings which may be produced on aluminum pistons do not materially alter the dimension of the piston, and thus it is possible to completely prepare the piston for motor use by the usual grinding and machining methods prior to furnishing the piston with the oxide coating. The coating provided on the piston is relatively thin, usually of a thickness expressed in tenths of thousandths of an inch, but is nevertheless substantial. A coating having a thickness of about 0.0005 inch may have the desired properties, and usually the coatings do not exceed a thickness of about 0.0015 inch.

I claim:

1. As a new article of manufacture, an aluminum alloy piston provided on its skirt with a hard, adherent aluminum oxide coating.

2. As a new article of manufacture, an aluminum alloy piston having its cylindrical surface provided with a hard, integrally-united, oil-adsorptive, anodic aluminum oxide coating.

3. As a new article of manufacture, an aluminum alloy piston having its cylindrical surface and ring grooves provided with a hard, closely-adherent, minutely-porous, anodic aluminum oxide coating containing resident lubricating oil.

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