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PROVIDING CAST-IRON ARTICLES WITH A
CELL-LIKE SURFACE

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This invention relates to the treatment of articles formed of cast iron, the object being to provide the article with a honeycombed or cell-like surface which can retain lubricant when subjected to friction at high temperatures and/or high pressures.

Piston-rings, particularly for internal-combustion engines, are found to give very satisfactory results when treated in this way. Not only do they quickly bed themselves in but they also prevent roughening of the cylinder bore in the early stages.

According to the invention, a piston-ring or other article is formed of a cast iron containing more than 0.15% of phosphorus and is chemically treated so that the material, within the polygonal network formed by the phosphorus-rich constituent, is removed to some extent, leaving the phosphorus-rich constituent in relief.

A preferred method according to the invention involves subjecting the article:—

(a) To a neutral or acid solution of a copper salt until it is coated with a layer of copper;
(b) After rinsing and drying, to an acid solution which will dissolve the copper coating, and then

(c) To an alkaline solution which will neutralize the acid adhering to the article.

Thereafter the article is washed to remove traces of the alkali.

The invention particularly involves a piston-ring provided with a cell-like surface by treatment in this manner.

In a simple method of carrying out the invention, as applied to a piston-ring of a cast iron containing the necessary content of phosphorus, the piston-ring is de-greased in the first instance and then placed in a neutral or acid solution of copper chloride for a predetermined time until a layer of copper forms over the piston-ring. Alternatively, use may be made of other copper salts, such as copper sulphate, which will deposit copper when iron is placed in the solution. Other salts may be present as long as their presence does not prevent deposition of the copper. Furthermore, the piston-ring may, if desired, be placed in a neutral solution of the copper salt in the first instance and then immersed in an acid solution of the salt. Moreover, the deposition may be accelerated by electrolytic methods.

After the piston-ring has been coated with copper in this way it is rinsed in water, alcohol or other liquid and then dried. It is then placed in a copper-dissolving acid; and for this purpose concentrated nitric acid is very satisfactory as

it dissolves the copper without attacking the iron. Thereafter the piston-ring is immersed in an alkaline solution which will neutralize the acid adhering to the ring. When concentrated nitric acid has been used a solution of sodium carbonate in water is very satisfactory for this purpose. Thereafter the ring is washed in water, alcohol, or other liquid to remove the traces of alkali.

A microscopic examination of the surface of an article thus treated shows that the surface has become cell-like. The reason for this is believed to be that the phosphorus-rich constituent of the cast iron exists as a polygonal network varying in amount with the quantity of phosphorus present, and it is the remaining constituents of the cast iron within this network which are removed to some extent. The extent to which they are removed may be controlled as desired by variation of the solution concentrations, of the time during which the article is in the solutions, and of the temperature of the solutions. Finally the phosphorus-rich constituent stands out to a greater or less extent in relief to the mass.

The minute superficial cavities formed in piston-rings in this manner will hold the lubricant in conditions of high temperature and external pressure which would remove oil from between polished surfaces not so treated.

In the past it has been common practice in internal-combustion engines and in steam engines to have cast-iron piston-rings working in cylinders or cylinder liners made of cast iron or steel. To prevent wear of the piston rings and of the cylinders or cylinder liners and to reduce power loss by friction it is necessary that there should always be a film of oil or lubricant between the piston rings and the cylinder wall. Recent improvements in the hardness and strength of cylinder wall material to cope with increased working pressures, higher speeds and higher working temperatures permit and have led to the use of piston-rings and cylinder walls in a highly polished state. It is also necessary to finish piston-rings and cylinder walls by fine turning or grinding or lapping to produce components to required dimensions and it may be taken that, the closer the working tolerances, so the higher degree of polish is attained. But highly polished surfaces in opposition are not conducive to the maintenance of an oil film. Provided that an oil film can be maintained between the opposed metals such as between piston-rings and cylinder wall, wear cannot take place to any appreciable degree and by means of the process hereinbefore described the surface of cast iron

can be prepared in such a manner as to provide, as stated, minute superficial cavities which hold oil in conditions of high temperature and external pressure which would remove oil from between polished surfaces not so treated.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A method of treating an article formed of cast iron containing more than 0.15% of phosphorus, to provide it with a cell-like surface which can retain lubricant when subjected to friction at high temperatures or at high pressures, which involves the following steps:—degreasing the article, subjecting it to a solution of copper chloride until it is coated with a layer of copper, rinsing and drying it, subjecting it to nitric acid until the copper has been dissolved, subjecting it to an alkaline solution which will neutralize the acid adhering to it, and then washing it to remove traces of the alkali.

2. A method of treating an article formed of cast iron containing more than 0.15% of phosphorus, to provide it with a cell-like surface which can retain lubricant when subjected to friction at high temperatures or at high pressures, which involves the following steps:—subjecting the article to a solution of a copper salt until it is coated with a layer of copper, then to an acid solution which will dissolve the copper, and then to an alkaline solution which will neutralize the acid adhering to it.

3. A method of treating an article formed of cast iron containing more than 0.15% of phosphorus, to provide it with a cell-like surface which can retain lubricant when subjected to friction at high temperatures or at high pressures, which involves the following steps:—subjecting the article to a solution of copper chloride until it is coated with a layer of copper, and then subjecting it to an acid solution which will dissolve the copper.

4. A method of treating an article formed of cast iron containing more than 0.15% of phosphorus,

to provide it with a cell-like surface which can retain lubricant when subjected to friction at high temperatures or at high pressures, which involves the following steps:—subjecting the article to a solution of a copper salt until it is coated with a layer of copper, and then subjecting it to a solution of nitric acid until the copper has been dissolved.

5. A method of treating an article formed of cast iron containing more than 0.15% of phosphorus, to provide it with a cell-like surface which can retain lubricant when subjected to friction at high temperatures or at high pressures, which involves the following steps:—subjecting the article to a solution of a copper salt until it is coated with a layer of copper, then to a solution of nitric acid until the copper has been dissolved, and then to an aqueous solution of sodium carbonate.

6. A piston-ring formed of cast iron containing more than 0.15% of phosphorus and having a polygonal network formed by the phosphorus rich constituent, said ring having a cell-like surface formed by the ring being treated chemically by the ring being subjected to a solution of a copper salt until it is coated with a layer of copper and then subjected to an acid solution which will dissolve copper so that the material within the polygonal network, formed by the phosphorus-rich constituent, will be removed to some extent to leave the phosphorus-rich constituent in relief.

7. A piston-ring formed of cast iron containing more than 0.15% of phosphorus and having a polygonal network formed by the phosphorus rich constituent, said ring being treated chemically as specified in claim 2 so that the material within the polygonal network formed by the phosphorus-rich constituent will be removed to some extent to leave the phosphorus-rich constituent in relief, thus providing a cell-like surface.

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