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WEAR AND CORROSION RESISTANT COATING

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This invention relates to wear and corrosion resistant coatings.

There are many commercial applications in which the surfaces of mechanical elements need to be very wear resistant and at the same time corrosion and oxidation resistant. Boiler tubes, for example, must be wear resistant and at the same time be able to withstand the corrosive effects of the flue gases. Likewise, certain pump shafts, packing seals, and pump impellers need to be both wear resistant and corrosion or oxidation resistant where a corrosive abrasive fluid is used. In addition, some seals must also be self-mating in an environment of sandy mud and water.

It is therefore the main object of the present invention to provide a wear and corrosion resistant coating of general application to satisfy these requirements.

According to the present invention, the coating is formed from a mixture of from 20–60% ferrochrome by weight, the balance being tungsten carbide. In the preferred form of the invention, the coating consists of 40% ferrochrome. The term "ferrochrome" is here meant to mean an iron-chromium compound having about 67% by weight chromium.

The preferred method for applying the coating is the arc torch powder coating process described in U.S. Patent No. 3,016,447. Such process yields a coating that is highly dense with a lamellar, overlapping leaf structure. The coating may be applied to either metals or non-metals so long as the surface is cleaned and roughened sufficiently to grab the powder as it is applied. For example, the coatings could be applied to steel, aluminum, graphite, or a reinforced resin.

As previously stated, the amount of ferrochrome should be between 20 and 60% by weight, the balance being tungsten carbide. Pure ferrochrome will yield a good corrosion or oxidation resistant coating. However, its wear resistant qualities will be low. The addition of tungsten carbide will increase the hardness of the coating so as to make it wear resistant. However, if too much tungsten carbide is added, the coating becomes pitted which in itself is an indication of a lack of inherent strength. On the other hand, if an insufficient amount of tungsten carbide is added there will be no appreciable increase in the wear resistance of the coating.

Prior to mixing the powders and passing them through the torch, the ferrochrome and the tungsten carbide are ground to a range of powder sizes that have been found to be critical. Generally, for the ferrochrome, it has been found that the average particle diameter should be between 8 and 12 on the Fisher scale. If the size is less than 8, there will be a tendency for the coating to crack. On the other hand when the size gets much beyond 12, the coating becomes pitted. For the tungsten carbide, the average particles should be at least 4.5 on the Fisher scale otherwise deposition of the compound is prohibitive. The upper limit of the tungsten carbide, for the present, appears to be the commercial availability of these powders, the limit being 6.5.

Upon analysis of the ferrochrome, it has been found that it should contain at least 7% carbon otherwise the coating will have poor wear resistance.

The following examples illustrate the novel coating. In the examples, apparatus of the general type depicted in the previously mentioned U.S. Patent No. 3,016,447 was used. The torch had a thoriated tungsten stick electrode and a copper nozzle anode.

EXAMPLE I

Forty percent by weight ferrochrome was mixed with 60% by weight tungsten carbide (WC). The powder particle size of the ferrochrome was between 8–12 on the Fisher scale, and for the WC, about 5.7. This powder mixture was passed through the torch at a feed rate of 31–33 g./min. Argon was fed through the torch and nitrogen was used as a shield gas to protect the melted powder from oxidation. Torch amperage was 150 amps with a load voltage of 55–60 volts. Sufficient CO_2 (approx. 4.6 lbs./min.) was used to maintain the workpiece temperature at 90–170° F. Several test samples including cast iron and steel were coated with a torch standoff of 3/16 inch to a thickness of .007–.010 inch.

EXAMPLE II

Twenty percent by weight ferrochrome was mixed with 80% by weight tungsten carbide. Both powders had the same particle size as Example I. This powder mixture was passed through the torch at a feed rate of 31–36 g./min. The same torch parameters as Example I above were used (argon, nitrogen, amperage, voltage, CO_2 and standoff).

Steel samples and aluminum test seals were coated to a thickness of .008 to .022 inch.

The two above coatings were tested and found to have a hardness range of 750–1000 UPN with excellent wet abrasion wear resistance.

Other apparatus on which the coating has been used are a pump impeller and cover, cast iron shafts, carbon steel knife blades, steel wire drawing rolls, .003" copper shim guides, steel saw blades, steel grass cutting blades for tractors, and aluminum seals for tractors. In all of these applications, 40% ferrochrome and 60% tungsten carbide was used as the coating composition.

What is claimed is:

1. Wear and corrosion resistant article of manufacture comprising a base material and a refractory material adherently bonded thereto, said coating comprising from 20% to 60% by weight of ferrochrome and the remainder tungsten carbide.

2. Wear and corrosion resistant article of manufacture as claimed in claim 1, in which the particle size on the Fisher scale are ferrochrome between 8 and 12, and tungsten carbide between 4.5 and 6.5, and arc plated onto said base material.

3. Wear and corrosion resistant article of manufacture as claimed in claim 1, in which the particle size on the Fisher scale are ferrochrome between 8 and 12, and tungsten carbide between 4.5 and 6.5.

4. Wear and corrosion resistant article of manufacture as claimed in claim 1, in which said coating contains about 40% ferrochrome and about 60% tungsten carbide.

5. Wear and corrosion resistant article of manufacture as claimed in claim 1, in which the ferrochrome contains about 67% by weight of chromium, and at least 7% of carbon.

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