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APPLICATION OF COBALT-BASE ALLOYS TO METAL PARTS

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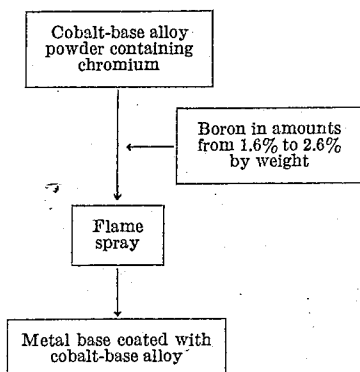
This invention relates generally to improvements in the application of cobalt-base alloys to metal parts, but more particularly to parts made of stainless steel, and especially stainless steels containing aluminum and/or titanium.

Cobalt-base alloys, such as those of the Stellite type, are difficult to apply as a coating to surfaces of metal parts because of their relatively high melting points. The Stellite alloys are a group of alloys which are well known in the metallurgical art. They consist of 40-80% cobalt, 20-35% chromium, 0-25% tungsten, 0-2.5% carbon, 0-9% iron, 0-11% nickel, 0-6% molybdenum and other incidental elements. These alloys are disclosed in Engineering Alloys by Norman E. Woldman, published by American Society for Metals (3rd edition, 1954), pages 208, 232, 545, 605, 629 and 644. These alloys are also found in Lange's Handbook of Chemistry, ninth edition (1956), on page 854. One of the well-recognized compositions of this type contains 1.5% carbon, 48% cobalt, 30% chromium, 14% tungsten, and small amounts of other elements, such as iron, manganese, silicon, etc. The melting point of this alloy is above 2500° F., and the alloy is normally used, for the purposes of coating, in the form of weld rods, which are melted by an oxy-acetylene flame, by Heliarc welding, or by some other suitable method.

In many instances, the base metal which is to be coated, is a stainless steel containing aluminum and/or titanium, and any undue increase in temperature of the base metal results in porosity, the formation of cracks, and other serious defects, in both the base metal and the coating. The present application is concerned with the problem of duplicating through the use of alloy powders, the application, in melted form, of the coatings which were formerly and normally applied by melting weld rods made of cobalt-base alloys.

By employing these cobalt-base alloys in the form of powders, and by applying these powders to a metal surface through a gun, in the manner disclosed, for example, in the co-pending application of Cape and Cirello, Serial No. 406,918, filed January 29, 1954, now abandoned, it is possible to reduce the temperature at which the application is made, but not to the extent necessary to eliminate the foregoing defects.

A simplified flow diagram of the present invention is as follows:



It has been found that by adding to the cobalt-base

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alloy powders a powder of a cobalt-boron (a boron alloy containing about 18% boron), the temperature of application is markedly reduced. However, it has also been found that if, in addition to the cobalt-boron powder, a quantity of tungsten powder, is added to the cobalt-base alloy powders, the melting point is reduced very substantially, with an increase in the wetting characteristics.

For example, if, to a cobalt-base alloy powder of the composition referred to above, there are added cobalt-boron powder in an amount of about 5% by weight of the total, and tungsten powder, in an amount of about 5% by weight of the total, the melting point is reduced to approximately 2100° F., and the application by means of a powder gun is enormously facilitated.

The amount of cobalt-boron powder must not be less than 2.5% of the total, and may be as high as 10% of the total. With amounts over 10%, there is no marked improvement, and with additions over 20%, the melting point tends to increase.

The amount of tungsten powder may be as low as 1% of the total, and may be as high as 10% of the total. With amounts over 10%, the melting point tends to increase.

In addition to the cobalt-base alloys of the type disclosed, the invention is applicable also to cobalt-base alloys such as disclosed in the co-pending application of Baldwin and Sheets, Serial No. 537,876, filed September 30, 1955, now Patent No. 2,801,165, dated July 30, 1957, as well as to cobalt-base alloys such as disclosed in the co-pending application of Cape, Snider and Zampieri, Serial No. 561,036, filed January 24, 1956, now abandoned, and to other cobalt-base alloys of this type.

In the abandoned Cape-Cirello application it was disclosed that in the use of the powder spray gun described in that application the combustible gas mixture is ignited and after the surface to be coated has been heated to a temperature approaching its melting point the flow of alloy powder is started into the flame formed by the ignition of the combustible gas mixture and the alloy powder is carried onto the surface to be coated by means of the flaming gases of combustion. The powder is melted by the flame and is deposited as molten globules onto the surface to be coated. Deposits thus made are homogeneous, free from porosity, and are firmly bonded to the metal base.

With the present powder gun and method, the powder is sprayed and melted immediately, essentially in a single operation and is thus to be differentiated from what takes place with an ordinary or conventional powder gun, in which powder is sprayed onto a part to be coated and melted afterwards. It is apparent that when spraying powder onto a vertical surface with a conventional powder gun it is difficult after the powder has been sprayed onto such vertical surface to remelt the powder in a vertical position, since the remelting must be extensive and the metal flows off.

The present method may also be used as a means of spraying powder and then remelting by any of several different methods. In this way, it is used conventionally and there are occasions when it is desirable to do so. In 99% of the cases, however, the great advantage lies in spraying and melting at the same time. For example, a poppet valve, when coated by hand, using a welding rod, takes ten minutes. The same valve, when coated by means of the present powder melting gun, takes four minutes. With a conventional spray gun, the time taken equals that of using a welding rod.

It will be understood that various changes may be made in the invention without departing from the spirit of the invention or the scope of the appended claims.

Having thus described my invention, I claim:

1. The method which comprises providing a mixture of powders, consisting of a cobalt-base alloy in powder form, consisting of 40-80% cobalt, 20-35% chromium, up to 25% tungsten, up to 2.5% carbon, up to 9% iron, up to 11% nickel, up to 6% molybdenum and incidental impurities, a cobalt-boron alloy powder, containing about 18% boron, in an amount of from about 2.5% to about 10% by weight of the mixture, and tungsten powder, in an amount of from about 1% to about 10% by weight of the mixture, applying the mixture to the surface of a metal part, and melting the mixture to cause it to become bonded to said surface.

2. The method, as recited in claim 1, in which the mixture is applied through a powder gun which melts the powder.

3. The method, as recited in claim 2, in which the metal surface to which the mixture is applied is a stainless steel containing aluminum.

4. The method, as recited in claim 2, in which the metal surface to which the mixture is applied is a stainless steel containing titanium.

5. The method, as recited in claim 1, in which the cobalt-boron alloy powder is in an amount of about 5% by weight of the mixture, and the tungsten powder is in an amount of about 5% by weight of the mixture.

6. A powder mixture for application to metal surfaces of stainless steel, said mixture containing a cobalt-base alloy powder consisting of 40-80% cobalt, 20-35% chromium, up to 25% tungsten, up to 2.5% carbon, up to 9% iron, up to 11% nickel, up to 6% molybdenum and incidental impurities, from about 2.5% to about 10% of cobalt-boron alloy powder containing about 18% boron, and from about 1% to about 10% of tungsten powder.

7. A powder mixture for application to metal surfaces of stainless steel, said mixture containing a cobalt-base alloy powder consisting of 40-80% cobalt, 20-35% chromium, up to 25% tungsten, up to 2.5% carbon, up to 9% iron, up to 11% nickel, up to 6% molybdenum and

incidental impurities, about 5% of cobalt-boron alloy powder containing about 18% boron, and about 5% of tungsten powder.

8. In the method of flame spraying particles of a cobalt base alloy containing substantial amounts of chromium onto a metal article surface having a melting point in excess of the melting point of said alloy, to thereby deposit on said surface a coating and heating the coating to a temperature above its fusion temperature but below the softening temperature of said article to cause it to become bonded to the surface thereof, the improvement which comprises adding boron in amounts of about 1.75% by weight to said alloy prior to flame spraying said alloy to thereby provide a flame sprayable composition of controlled fluidity.

9. In a method of flame spraying particles of a cobalt base alloy containing substantial amounts of chromium onto a metal article surface having a melting point in excess of the melting point of said alloy, to thereby deposit on said surface a coating and heating the coating to a temperature above its fusion temperature but below the softening temperature of said article to cause it to become bonded to the surface thereof, the improvement which comprises adding boron in amounts of from 1.6 to 2.6% by weight to said alloy prior to flame spraying said alloy to thereby provide a flame sprayable composition of controlled fluidity.

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