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(54) YARN HEATER TRACK

(71) We, MONITOR COATINGS AND ENGINEERS LIMITED (formerly known as MONITOR COATINGS LIMITED), a British Company, of Monitor House, Coast Road, Wallsend, Tyne & Wear NE28 7RD, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a yarn track for a yarn heater.

Various yarns can be processed on draw-texturing machines to give the yarn improved qualities of "handle" and "feel". Electrical yarn heaters are employed in such machines to heat the yarn while it is being twisted and bulked. These heaters usually comprise a yarn track of steel or brass one-half to three metres in length, having yarn grooves through which the yarn passes. The yarn can induce considerable wear, the wear rate being dependent upon the speed of the yarn traversing the track, the level of twist being induced in the yarn, the temperature, and the type of yarn. Corrosion also occurs, since the yarn is often lubricated with a variety of chemicals which can be quite aggressive.

Yarn tracks have, in the past, been electroplated with a layer of nickel followed by a layer of chromium, in order to give improved wear and corrosion resistance. Electroless deposition of nickel was found to give a nickel layer which could, by heat treatment, be given a hardness substantially equivalent to that of electrodeposited chromium, and for about ten years it has been well known to plate yarn tracks with nickel by electroless deposition. However, as processsing speeds were increased by the adoption of advanced technology, it became clear about five years ago that the rate of wear of such deposits was unacceptable.

The tracks were then coated instead with chromium oxide or mixtures of aluminium oxide and titanium oxide. Since such ceramics are very much harder than chromium or nickel, it was expected that the wear resistance of the tracks could be increased by factors of up to 100. However, two or three years ago it was found that a high proportion of ceramic coated tracks failed in service. The mode of failure is usually "flaking" of the ceramic coating, but the mechanism of flaking has not yet been critically defined.

For at least two years, manufacturers of yarn tracks have been faced with the problem of protecting the tracks against wear and corrosion, and it has been generally thought that the answer to this problem lay neither with nickel coatings nor with ceramic coatings.

The present invention provides a yarn track for a yarn heater, comprising an elongate body having at least one longitudinal yarn groove having a rounded bottom, the surface layer of the body in and adjacent the groove(s) substantially consisting of nickel and/or chromium, and a ceramic coating on the surface layer at the bottom of the or each groove.

The invention also provides a method of making a yarn track for a yarn heater, comprising the sequential steps of providing an elongate body, having at least one longitudinal groove having a rounded bottom, with a surface layer substantially consisting of nickel and/or chromium in and adjacent the groove(s); and forming a ceramic coating on the surface layer at the bottom of the or each groove.

Tests which we have carried out have unexpectedly indicated that such a track should resist wear and corrosion much better than the known nickel plated and ceramic coated tracks.

The preferred method of making a yarn track will now be described in detail, starting with an elongate body of steel or brass having two symmetrically positioned longitudinal grooves of substantially U-shaped cross-section which has been formed by extrusion or rolling, followed by machining.

A surface layer of nickel with a substantially uniform thickness of 0.001 to 0.003 inch (preferably approximately 0.002 inch) is provided in and adjacent the grooves, over the while of the face of the body containing the grooves, by electroless deposition. It is

possible that a layer of chromium or of nickel and chromium would function equally satisfactorily in the finished track, but at present chromium cannot be deposited by electroless deposition and uniform plating of the grooves is very difficult to obtain by electrodeposition; furthermore, it is not possible to predict that a chromium layer will be as successful as a nickel layer in bonding to the ceramic coating.

The nickel surface layer is applied by a conventional electroless nickel/phosphide plating process. The body is plated by immersion in specific known solutions for specific times. The solution which contains nickel in ionic form is contained in a tank which is heated by a water jacket. The temperature of the solution is precisely controlled and the thickness of the nickel deposit is determined by the immersion time. A thickness of less than 0.001 inch, which might be satisfactory in handled carefully, would run the risk of being worn away unacceptably during subsequent treatment. Conversely, a thickness of more than 0.003 inch would be uneconomic, although satisfactory from the functional point of view.

The nickel surface layer may be hardened to substantially 1000 Vickers by conventional heat-treatment involving holding at approximately 400°C for 1 hour. The parts of the surface layer which are to be ceramic coated are then roughened by grit blasting. Other parts of the surface layer are attacked by the grit blasting, but this is not believed to be detrimental. It is important, however, to ensure that the nickel layer is not eroded away, and the grit blasting process is therefore adjusted so that a layer thickness of at least 0.001 inch is left. Immediately after (or not more than two hours after) grit blasting, the ceramic coating is applied.

Our research, including bend tests, has shown that the best bond strength of a ceramic coating is exhibited at the bottom of the yarn grooves, which is where the wear of uncoated yarn tracks actually take place. Accordingly, the upper portions of the side walls of the grooves (as well as the remainder of the nickel layer) preferably remain free of ceramic coating. Extension of the coating up to or beyond the edges of the grooves, while not preferred, is possible but brings the risk of premature failure of the coating extension causing damage to the yarn or irregular functioning of the yarn heater.

If it is to be ensured that the ceramic coating is only deposited in the grooves, the areas of the surface layer adjacent the grooves are masked before application of the coating. Masking can be accomplished by a mechanical mask which covers the areas not requiring coating, but it is preferable to apply a masking substance in the form of an organic film by means of a felt roller shaped to contact only those parts of the surface layer to which the ceramic coating is not to adhere. After coating, the film is removed by a solvent (organic or aqueous).

The ceramic coating may consist of chromium oxide and/or aluminium oxide and/or titanium oxide, for example, chromium oxide being preferred for its high wear-resistance. The chromium oxide coating is applied by a conventional plasma flame coating technique using a plasma gun whose head defines a chamber having gas inlets and a gas outlet and containing an internal electrode. The gun chamber gas outlet is also an electrode and the desired gas mixture is passed through the chamber and through a constrained internal d.c. electric arc between the live electrodes. The gas mixture is immediately ionised as it passes through the electric arc and the ionised gas (plasma) rapidly attains temperatures of the order of 18,000—20,000°C. Because of the rapid temperature rise the gas expands out of the chamber at supersonic velocities. The chromium oxide is fed into the high temperature stream as a fine power at precisely controlled flow rates. Each individual particular is transformed into a molten droplet and is projected towards the substrate at very high velocity. The coating is formed by the particles "flattening" and flowing around the surface irregularities of the grit blasted surface layer, and the bond strength is a function of the particle temperature and velocity.

The ceramic coating is then surface finished to the required smoothness. The thickness of the coating is preferably at least 0.001 inch. The maximum thickness permissible depends on the depth of the grooves, but increasing the thickness beyond 0.004 inch appears to be unnecessary. A thickness of approximately 0.002 inch is therefore preferred.

Two embodiments of the yarn track produced by the preferred method are described below, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a cross-section through a yarn track;

Figure 2 shows a detail of the cross-section of a yarn groove of the track of Figure 1, on an enlarged scale;

Figure 3 is a cross-section through another yarn track; and

Figure 4 shows a detail of the cross-section of a yarn groove of the track of Figure 3, on an enlarged scale.

The track shown in Figure 1 has a steel body 1 which is elongate normal to the plane of the drawing and which has two longitudinal yarn grooves 2 of U-shaped cross-section. A surface layer 3 (Figure 2) of nickel approximately 0.002 inch thick is provided in and adjacent the grooves 2, over the whole of

the face 4 of the body containing the grooves. A chromium oxide coating 5 approximately 0.002 inch thick is provided on the nickel layer 3 only at the bottom of each groove 2.

The track shown in Figures 3 and 4 is similar to that described above, except that the grooves 2 are of V-shaped cross-section with a rounded bottom.

WHAT WE CLAIM IS:—

1. A yarn track for a yarn heater, comprising an elongate body having at least one longitudinal yarn groove having a rounded bottom, the surface layer of the body in and adjacent the groove(s) substantially consisting of nickel and/or chromium, and a ceramic coating on the surface layer at the bottom of the or each groove.

2. A yarn track as claimed in claim 1, in which the surface layer is of substantially uniform thickness.

3. A yarn track as claimed in claim 1 or 2, in which the surface layer is at least 0.001 inch thick.

4. A yarn track as claimed in claim 3, in which the surface layer is 0.001 to 0.003 inch thick.

5. A yarn track as claimed in any of claims 1 to 4, in which the surface layer has a hardness of substantially 1000 Vickers.

6. A yarn track as claimed in any of claims 1 to 5, in which the ceramic coating is at least 0.001 inch thick.

7. A yarn track as claimed in claim 6, in which the ceramic coating is 0.001 to 0.004 inch thick.

8. A yarn track as claimed in any claims 1 to 7, in which the ceramic coating substantially consists of chromium oxide.

9. A method of making a yarn track for a yarn heater, comprising the sequential steps of providing an elongate body, having at least one longitudinal groove having a rounded bottom, with a surface layer substantially consisting of nickel and/or chromium in and adjacent to the groove(s); and forming a ceramic coating on the surface layer at the bottom of the or each groove.

10. A method as claimed in claim 9, in which the provision of the surface layer comprises electroless deposition of nickel.

11. A method as claimed in claim 10, in which the nickel deposit is hardened by heat treatment before the formation of the ceramic coating.

12. A method as claimed in any of claims 9 to 11, including roughening at least the part of the surface layer which is to be coated.

13. A method as claimed in claim 12, in which the roughening step comprises grit blasting.

14. A method as claimed in any of claims 9 to 13, in which the surface layer is of substantially uniform thickness.

15. A method as claimed in any of claims 9 to 14, in which the surface layer is at least 0.001 inch thick.

16. A method as claimed in claim 15, in which the surface layer is 0.001 to 0.003 inch thick.

17. A method as claimed in any of claims 9 to 16, in which the ceramic coating is formed by flame coating.

18. A method as claimed in claim 17, in which the ceramic coating is formed by plasma flame coating.

19. A method as claimed in any of claims 9 to 18, including applying a masking substance to the areas of the surface layer adjacent the groove(s) before formation of the ceramic coating, and removing the masking substance by means of a solvent after formation of the ceramic coating.

20. A method as claimed in any of claims 9 to 19, in which the ceramic coating substantially consists of chromium oxide.

21. A method as claimed in any of claims 9 to 20, in which the ceramic coating is 0.001 to 0.004 inch thick.

22. A method of making a yarn track, as claimed in claim 9, substantially as described herein.

23. A yarn track made by a method according to any of claims 9 to 22.

24. A yarn track as claimed in claim 1, substantially as described herein with reference to the accompanying drawings.

25. A yarn heater including a yarn track according to any of claims 1 to 8, claim 23, or claim 24.

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the face 4 of the body containing the grooves. A chromium oxide coating 5 approximately 0.002 inch thick is provided on the nickel layer 3 only at the bottom of each groove 2.

The track shown in Figures 3 and 4 is similar to that described above, except that the grooves 2 are of V-shaped cross-section with a rounded bottom.

WHAT WE CLAIM IS:—

1. A yarn track for a yarn heater, comprising an elongate body having at least one longitudinal yarn groove having a rounded bottom, the surface layer of the body in and adjacent the groove(s) substantially consisting of nickel and/or chromium, and a ceramic coating on the surface layer at the bottom of the or each groove.

2. A yarn track as claimed in claim 1, in which the surface layer is of substantially uniform thickness.

3. A yarn track as claimed in claim 1 or 2, in which the surface layer is at least 0.001 inch thick.

4. A yarn track as claimed in claim 3, in which the surface layer is 0.001 to 0.003 inch thick.

5. A yarn track as claimed in any of claims 1 to 4, in which the surface layer has a hardness of substantially 1000 Vickers.

6. A yarn track as claimed in any of claims 1 to 5, in which the ceramic coating is at least 0.001 inch thick.

7. A yarn track as claimed in claim 6, in which the ceramic coating is 0.001 to 0.004 inch thick.

8. A yarn track as claimed in any claims 1 to 7, in which the ceramic coating substantially consists of chromium oxide.

9. A method of making a yarn track for a yarn heater, comprising the sequential steps of providing an elongate body, having at least one longitudinal groove having a rounded bottom, with a surface layer substantially consisting of nickel and/or chromium in and adjacent to the groove(s); and forming a ceramic coating on the surface layer at the bottom of the or each groove.

10. A method as claimed in claim 9, in which the provision of the surface layer comprises electroless deposition of nickel.

11. A method as claimed in claim 10, in which the nickel deposit is hardened by heat treatment before the formation of the ceramic coating.

12. A method as claimed in any of claims 9 to 11, including roughening at least the part of the surface layer which is to be coated.

13. A method as claimed in claim 12, in which the roughening step comprises grit blasting.

14. A method as claimed in any of claims 9 to 13, in which the surface layer is of substantially uniform thickness.

15. A method as claimed in any of claims 9 to 14, in which the surface layer is at least 0.001 inch thick.

16. A method as claimed in claim 15, in which the surface layer is 0.001 to 0.003 inch thick.

17. A method as claimed in any of claims 9 to 16, in which the ceramic coating is formed by flame coating.

18. A method as claimed in claim 17, in which the ceramic coating is formed by plasma flame coating.

19. A method as claimed in any of claims 9 to 18, including applying a masking substance to the areas of the surface layer adjacent the groove(s) before formation of the ceramic coating, and removing the masking substance by means of a solvent after formation of the ceramic coating.

20. A method as claimed in any of claims 9 to 19, in which the ceramic coating substantially consists of chromium oxide.

21. A method as claimed in any of claims 9 to 20, in which the ceramic coating is 0.001 to 0.004 inch thick.

22. A method of making a yarn track, as claimed in claim 9, substantially as described herein.

23. A yarn track made by a method according to any of claims 9 to 22.

24. A yarn track as claimed in claim 1, substantially as described herein with reference to the accompanying drawings.

25. A yarn heater including a yarn track according to any of claims 1 to 8, claim 23, or claim 24.

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