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Schedler

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[54] **FALSE TWIST CRIMPER FOR TEXTURING SYNTHETIC FIBERS**

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[51] **Int. Cl.** **D02g 1/06,** B22f 1/00

[58] **Field of Search** 57/77.3–77.45; 29/182.7; 75/203

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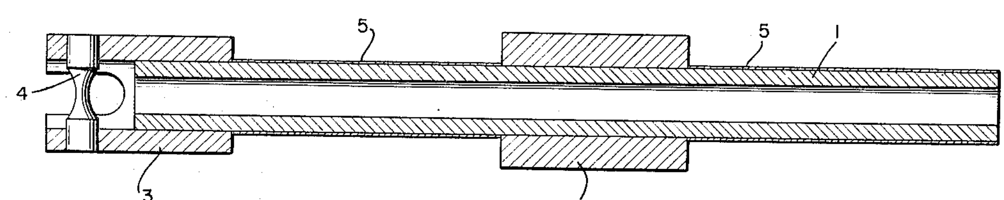
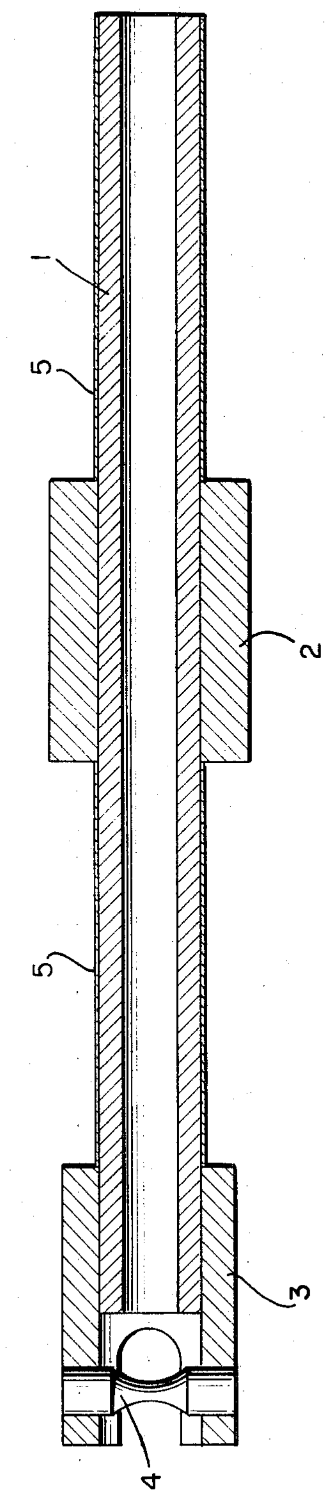
[57] **ABSTRACT**

The bodies of twist tubes for crimping synthetic textile yarns are constructed of sintered alloys of mixed carbides of titanium and specified other metals cemented by iron group binder metals for resistance to vibration and other stresses at extremely high speeds of rotation.

12 Claims, 1 Drawing Figure

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FALSE TWIST CRIMPER FOR TEXTURING SYNTHETIC FIBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the construction materials and method for fabricating improved twist tubes for texturing synthetic textile yarns.

2. Prior Art

Synthetic yarns are now made mainly by the so-called false twist method which consists in leading the fibers through a twist tube rotating at high velocity and equipped with a cross peg which functions as the twisting element. This element usually consists of a ceramic oxide material, e.g., a sapphire, around which the yarn passes through the twist tube. The fiber is softened to the plastic state by heating and, following the crimping by the twisting element, the crimp is set or fixed by cooling the fiber.

The economic production of yarns by the false twist method depends on the rate of rotation of the twist tube which determines the degree of crimping of the yarn; hence the requirements for the cross peg and the twist tube materials are very high. Although the twist tubes currently used with two spindles are already operated at speeds up to 600,000 rpm., it is desirable to substantially increase the rate of rotation in order to improve the productivity of the process.

Cemented carbide alloys or dispersions based on tungsten carbide, e.g., alloys containing 90–95 percent tungsten carbide and 5–10 percent cobalt have proven very suitable as materials for these twist tubes on account of their great wear resistance and large Young's modulus. However, the rate of rotation of these twist tubes cannot be increased much beyond 600,000 rpm. because intense radial vibrations destroy the tubes.

SUMMARY OF THE INVENTION

Surprisingly, however, it has been found that the rate of rotation can be increased further when the twist tubes are made of certain sintered titanium carbide alloys. Accordingly, the present invention relates to an improvement which comprises a cemented carbide twist tube constructed principally of a sintered alloy comprising between about 43 and 89 parts by weight of a first metal carbide component having at least a major proportion of titanium carbide; between about 1 and 45 parts by weight of a second metal carbide component containig at least a substantial proportion of material of the group consisting of molybdenum carbides, vanadium carbide and mixtures thereof; and between about 6 and 30 parts by weight of a binder metal component containing at least a substantial proportion of material of the group consisting of iron, nickel, cobalt and mixtures thereof for cementing said carbide components.

Alloys within the above ranges of proportions have previously been employed for tools and special wear-resistant parts, e.g., spikes. However, it was unexpected to discover that such alloys provide improved resistance to such different and little understood stresses as are encountered in the false twist tubes. Using these new twist tubes, it is possible to increase the rate of rotation to 1,000,000 rpm.

DESCRIPTION OF THE DRAWING

The FIGURE is a central longitudinal section view of

one embodiment of a crimping tube according to the invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The present alloys contain three essential components, two different metal carbide components and a third binder metal component. Each of these components may be composed of a single substance or a mixture of substances as described hereinafter, for it has been found that the substitution of similar substances for at least part of the primary constitutent of any of these components can provide twist tubes of similarly improved performance. Unless otherwise specified, all proportions herein are expressed in terms of weight.

Titanium carbide is an essential constitutent of the first metal carbide component which amounts to 43 to 89 percent of the weight of the entire alloy. Titanium carbide may constitute the entire first component, or the first component may contain a total of from 0 to 30 percent by weight of zirconium carbide and/or hafnium carbide with titanium carbide making up the remainder of this component. Thus, the titanium carbide is present in major proportion and amounts to at least 70 percent of this first metal carbide component.

The second metal carbide component forms 1 to 45 percent of the alloy composition. This component may be made up of a molybdenum carbide alone (i.e., Mo_2C or MoC) or vanadium carbide alone or a mixture of carbides of molybdenum and vanadium. Alternatively, certain other carbides may be substituted for a part of the content of either of the two primary constitutents. When molybdenum carbide is present, up to 50 percent of its content may be replaced by an equal amount of tungsten carbide and up to 25 percent of a chromium carbide (i.e., Cr_3C_2 or Cr_5C_2). Expressed otherwise, if the second metal carbide component contains a molybdenum carbide, it may also contain an amount of tungsten carbide of up to about 100 parts by weight and/or an amount of a chromium carbide of up to about 33 parts by weight, per 100 parts by weight of molybdenum carbide present. If the second metal carbide component contains vanadium carbide, it may also contain up to an equal amount by weight of niobium carbide and/or tantalum carbide, i.e., the total quantities of niobium and tantalum carbides may range from 0 to about 100 percent of the weight of any vanadium carbide actually used in the second metal carbide component.

The third component of the alloy is a binder metal component and is present in an amount of from about 6 to 30 percent of the total alloy composition. At least about 45 percent, up to 100 percent of the binder metal is an iron group metal, i.e., iron, nickel or cobalt and mixtures thereof. This binder metal serves to bond the aforesaid carbide components in the alloy. The binder metal component of the iron group can also contain one or more of chromium, molybdenum, tungsten and mixtures thereof to the extent of about 40 percent of the total wieght of the binder metal composition. The binder metal compositions can also contain up to an aggregate of 15 percent by weight of the composition of titanium, zirconium, hafnium, vanadium, niobium and/or tantalum and mixtures thereof.

Preferred alloy compositions contain 70–80 percent titanium carbide, 10–15 percent dimolybdenum carbide, 6–18 percent nickel, 1–5 percent molybdenum and 0–1.5 percent zirconium.

One embodiment of a twist tube in accordance with the present invention is shown as an example in the figure. The basic tubular body **1** of the twist tube consists of an alloy of 76 percent titanium carbide, 10 percent dimolybdenum carbide, 12 percent nickel and 2 percent molybdenum. The rotor **2** made of a soft magnetic material (e.g., an iron alloy containing 3 percent silicon) is installed at the middle of the length of the twist tube and the head **3** made of an aluminium alloy, at one end.

The cross peg **4** is a sapphire cemented into a slot in the head **3**. The outside of the body of the twist tube can be coated with a wear-resistant layer **5** of pure titanium carbide with a thickness of a few microns. This provides additional wear resistance for the surfaces subjected to wear by the friction discs which impart the rotation to the tube. In addition to other carbides, carbonitrides, nitrides and wear-resistant borides of certain metals may also be employed as wear-resistant coatings which may be deposited from the gas phase by known methods. These are compounds of the metals of Groups IVB Vb and VIB of the Periodic Table of Elements having atomic numbers of 22 to 74, namely compounds of titanium, vanadium, chromium zirconium, niobium, molybdenum, hafnium, tantalum and tungsten.

Known powder metallurgy conditions and techniques are employed in fabricating the twist tubes of this invention. All of the substances to be incorporated into the alloy are introduced in powdered form in any order and thoroughly mixed together. That is, the aforementioned first metal carbide component (titanium carbide) may be added to the mixer last and one or more metals of the binder metal component may be introduced first. Also, when any of said components are composed of two or more substances (carbides or metals), there is no necessity for premixing such substances before their addition to the general alloy mixture or for the simultaneous addition of such substances. After mixing, the powdered material is compacted into tubes of the desired dimensions and the shaped tubes are sintered by heating.

Particularly good mechanical properties are obtained when the structure of the aforementioned alloys is very fine-grained and when the sintered material is in a labile to metastable condition as may be accomplished by the use of moderate sintering temperatures and short sintering times. Desirably, the carbide particles in the sintered cemented carbide are smaller than 5 microns, and at least 90 percent of the volume of the carbide particles are preferably smaller than 3 microns. The structure should largely retain the serrated edges and typical grain forms of the finest carbide powder particles. In order to obtain dense sintered materials, the activity of the powders is desirably protected against oxidation during grinding and further processing. For example, it has been found advantageous to carry out the wet grinding in an inert gas atmosphere.

I claim:

1. In a false twist crimping device for texturing synthetic textile fibers, the improvement which comprises a cemented carbide twist tube constructed principally of a sintered alloy comprising between about 43 and 89 parts by weight of a first metal carbide component having at least a major proportion of titanium carbide; between about 1 and 45 parts by weight of a second metal carbide component containing at least a substantial proportion of material of the group consisting of molybdenum carbides, vanadium carbide and mixtures thereof; and between about 6 and 30 parts by weight of a binder metal component containing at least a substantial proportion of material of the group consisting of iron, nickel, cobalt and mixtures thereof for cementing said carbide components.

2. A crimping device according to claim **1** wherein said first metal carbide component consists of 70–100 percent titanium carbide, 0–30 percent zirconium carbide and 0–30 percent hafnium carbide.

3. A crimping device according to claim **1** wherein said second metal carbide component comprises a molybdenum carbide and a quantity of tungsten carbide between 0 and about 100 percent of the weight of molybdenum carbide present.

4. A crimping device according to claim **1** in which said second carbide component comprises a molybdenum carbide and a quantity of a chromium carbide between 0 and about 33 percent of the weight of molybdenum carbide present.

5. A crimping device according to claim **1** in which a binder metal constituent of the group consisting of chromium, molybdenum, tungsten and mixtures thereof is present in an amount not exceeding about 40 percent of the total weight of said binder metal component.

6. A crimping device according to claim **1** in which a binder metal constituent of the group consisting of titanium, zirconium, hafnium, vanadium niobium, tantalum and mixtures thereof is present in an amount not exceeding about 15 percent of the total weight of said binder metal component.

7. A crimping device according to claim **1** in which said alloy has the following composition:

titanium carbide	70–80%
dimolybdenum carbide	10–15%
nickel	6–18%
molybdenum	1–5%
zirconium	0–1.5%.

8. A crimping device according to claim **1** in which said alloy has the following approximate composition:

titanium carbide	76%
dimolybdenum carbide	10%
nickel	12%
molybdenum	2%.

9. A crimping device according to claim **1** in which the exterior surface of said tube is coated with a wear-resistant compound of the group consisting of the carbides, carbonitrides, nitrides and borides of metals of Groups IVB, VB and VIB of the Periodic Table with atomic numbers of from 22 to 74.

10. A crimping device according to claim **1** in which said carbide components employed in the construction of said tube have an average particle size smaller than 5 microns and at least 90 percent of the volume thereof are particles smaller than 3 microns, and the sintered alloy structure essentially retains the typical grain form and serrated grain edges of said particles.

11. In a false twist crimping device for texturing synthetic textile fibers, the improvement which comprises a cemented carbide twist tube constructed principally of a sintered alloy consisting of between 43 and 89 percent of a first metal carbide component consisting of 70–100 percent titanium carbide, 0–30 percent zirconium carbide and 0–30 percent hafnium carbide based on the total weight of said component; between 1 and 45 percent of a second metal carbide component consisting of at least one carbide of the group consisting of molybdenum carbides and vanadium carbide, 0–100 percent tungsten carbide based on the weight of molybdenum carbide present, 0–33 percent of a chromium carbide based on the weight of molybdenum carbide present, and a total content of niobium and tantalum carbides of 0–100 percent based on the weight of vanadium carbide present; and between 6 and 30 percent of a binder metal component composed of 45–100 percent of material of the group consisting of iron, cobalt, nickel and mixtures thereof, not more than a total of 40 percent of material of the group consisting of chromium, molybdenum, tungsten and mixtures thereof, and not more than a total of 15 percent of material of the group consisting of titanium, zirconium, hafnium, vanadium, niobium, tantalum and mixtures thereof.

12. A method of fabricating a cemented carbide twist tube for crimping synthetic textile fibers which comprises mixing powders comprising between about 43 and 89 parts by weight of a first metal carbide component having at least a major proportion of titanium carbide; between about 1 and 45 parts by weight of a second metal carbide component containing at least a substantial proportion of material of the group consisting of molybdenum carbides, vanadium carbide and mixtures thereof; and between about 6 and 30 parts by weight of a binder metal component containing at least a substantial proportion of material of the group consisting of iron, nickel, cobalt and mixtures thereof, compacting said powdered mixture in tubular shape and heating the shaped tube at a sintering temperature.

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