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(54) **Copper alloy for slide fasteners having excellent continuous castability**

(57) The object of the present invention is to provide a copper alloy for slide fasteners which has excellent whiteness, does not contain nickel and hence does not have the problem of nickel allergy, and has excellent continuous castability and casting quality.

The composition of the alloy for slide fasteners is represented by the general formula $Cu_aZn_bMn_c$, where-

in regarding a, b and c, in mass%, $10 \leq b \leq 20$, $8 \leq c \leq 15$, and a is a remainder, with unavoidable impurities being contained. Moreover, the structure of the alloy is preferably made to be a single α phase at room temperature, and the surface of the alloy is plated.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a copper alloy for slide fasteners, which is used for slide fastener constituent members such as slide fastener elements and stops. More specifically, the present invention relates to a copper alloy for slide fasteners having excellent continuous castability and casting quality.

2. Description of the Prior Art

[0002] Hitherto, as copper alloys for slide fasteners as mentioned above, for example, coppernickel-zinc alloys such as nickel silver, which has a white alloy color tone, copper-zinc alloys such as red brass and brass, and so on have been used. Nickel silver contains nickel as an alloying element, and thus has excellent corrosion resistance. But, if it used for a slide fastener or the like, then the problem of nickel allergy may arise because the fastener will often come into contact with the skin. Moreover, copper-zinc alloys such as red brass and brass do not contain nickel and hence the problem of nickel allergy does not arise, but the color tone thereof is yellowish, and hence a white alloy cannot be obtained.

[0003] To solve the above problems, the present applicants thus developed and filed patent applications for nickel-free white copper alloys as disclosed in Japanese Patent Publication Nos. 11-124644, 2000-303129, 2000-303130 and 2001-3125. The nickel-free white copper alloys disclosed in the above Patent Publications are Cu-Zn-Mn type alloys that have been made to contain Al, Sn or the like; they have excellent strength, hardness, workability and corrosion resistance, and do not contain nickel, and hence the problem of nickel allergy does not arise. Moreover, external appearance of the alloys maintains an attractive degree of whiteness, and hence the alloys are highly valuable for ornaments.

[0004] An attachment having constituent members such as a slide fastener is manufactured by following steps: manufacturing wires through continuous casting of the above-described alloy at the start; making the cross-sectional shape of each wire into a prescribed cross-sectional shape; cutting the wires into the individual constituent members; and then mounting the constituent members obtained onto an attachment.

However, the alloys disclosed in the above-mentioned patent publications do not have as good a continuous castability as the previously mentioned nickel silver, red brass and brass, and hence the wire is prone to break during the continuous casting process. Such breaking leads to a drop in productivity, and thus causes an increase in cost. Moreover, the wires manufactured through the continuous casting may have portions where die components are attached thereto. The mate-

rial properties of such portions are different from those of the other portions, and this is not good from the perspective of casting quality.

5 SUMMARY OF THE INVENTION

[0005] In view of the problems described above, an object of the present invention is to provide a copper alloy for slide fasteners which has excellent whiteness, does not have the problem of nickel allergy, and has excellent continuous castability and casting quality.

[0006] The present inventors assiduously studied toward solving the above problems, and resulted in the following findings.

1) Breakage of the wire during the continuous casting process occurs due to the compounds formed in a die. The compound acts as a resistance to casting, whereupon the wire becomes prone to breaking.

2) Dropping of the quality of the continuously cast wire is due to the compounds, formed in a die, becoming attached to the wire surface.

3) The compounds formed in a die cause the cooling efficiency of the alloy to drop and thus internal defects in the alloy to arise. The defects deteriorate the properties of the alloy.

4) The compounds formed in the die are formed by combining readily oxidizable elements that are components of the alloy such as Al, Sn, Ti, Si and Cr with die components.

[0007] Based on these findings, the present inventors discovered that if readily oxidizable elements such as Al, Sn, Ti, Si and Cr are not added as alloy components, then an alloy can be manufactured for which there is no change in the continuous castability or the casting surface of a cast article and there is no local change in properties, because such elements adversely affect on the continuous castability of the alloy and cause a drop in the casting quality. The present inventors thus attained the invention of the present application grounded on the discoveries.

[0008] Specifically, the present invention is constituted as follows.

(1) A copper alloy for slide fasteners having excellent continuous castability, having a composition represented by a general formula $\text{Cu}_a\text{Zn}_b\text{Mn}_c$, wherein regarding a, b and c, in mass%, $10 \leq b \leq 20$, $8 \leq c \leq 15$, and a is a remainder, with unavoidable impurities being contained.

(2) A copper alloy for slide fasteners according to (1) above, wherein a color tone is such that a^* and b^* , which represent a color tone as stipulated in JIS Z 8729, satisfy $0 < a^* < 2$ and $7 < b^* < 16$.

(3) A copper alloy for slide fasteners according to (1) or (2) above, being a single α phase at room

temperature.

(4) A copper alloy for slide fasteners according to any of (1) through (3) above, a surface thereof being plated.

(5) An element being a constituent member of a slide fastener, comprising the copper alloy for slide fasteners according to any of (1) through (4).

(6) A stop being a constituent member of a slide fastener, comprising the copper alloy for slide fasteners according to any of (1) through (4).

[0009] Following is a description of the copper alloy for slide fasteners of the present invention.

With the copper alloy for slide fasteners of the present invention, the object of the present invention can be attained by making the alloy be a composition represented by the following general formula:



wherein, regarding a, b and c, in mass%, $10 \leq b \leq 20$, $8 \leq c \leq 15$, and a is a remainder, with unavoidable impurities being contained.

[0010] The element Zn, which is a component of the alloy of the present invention, has an effect of improving the mechanical properties and the workhardening properties of the alloy through solid solution strengthening, a deoxidation effect during melt casting, and an effect of reducing the cost of the alloy. If the Zn proportion is below the numerical range defined above, then the reduction in the cost of the alloy will be insufficient, the strength of the alloy will decrease, and the castability will worsen, because the melt will become prone to oxidation and hence oxides will grow in the alloy. On the other hand, if the Zn proportion is above the numerical range stipulated above, then the crystalline structure will become $\alpha + \beta$, and hence the alloy will no longer exhibit sufficient cold workability.

The proportion b of Zn is preferably such that $10 < b < 20$, more preferably such that $13 < b < 17$.

[0011] The element Mn, which is another component of the alloy of the present invention, has an effect of improving the mechanical properties of the alloy through solid solution strengthening, and an effect of reducing the cost of the alloy. By adding Mn instead of Zn, the season cracking resistance is improved, and the color tone of the copper alloy is prevented from becoming too yellow. Mn reduces the melting point of the alloy, and hence Mn acts to improve the castability and also suppress vaporization of zinc from the melt. If the Mn proportion is below the numerical range stipulated above, the color tone will become yellowish. Whereas, if the Mn proportion is above the same range, oxides will increase during melt casting and hence the castability will worsen, and the crystalline structure will become $\alpha + \beta$, thereby, the alloy will no longer keep sufficient cold workability

and the castability will worsen.

The proportion c of Mn is preferably such that $8 < c < 14$, more preferably such that $8 < c < 12$.

[0012] In the present invention, it is important that readily oxidizable elements such as Al, Sn, Ti, Si and Cr are not added, because these elements damage the continuous castability and cause a drop in the casting quality.

[0013] The alloy of the present invention displays the color in ranges of $0 < a^* < 2$ and $7 < b^* < 16$ based on the chromaticity diagram of the L^* , a^* , b^* color system stipulated in JIS Z 8729. Note that the 'color tone' mentioned in the present specification is expressed using the method for indicating the color of objects stipulated in JIS Z 8729, and is represented by the values of the lightness index L^* (lightness: L star) and the chromaticity indexes a^* (greenness to redness: a star) and b^* (blueness to yellowness: b star).

[0014] By making the structure of the alloy of the present invention be a single α phase, an alloy having improved cold workability can be provided. Furthermore, by plating the surface of the alloy, an alloy having excellent corrosion resistance and discoloration resistance can be provided.

[0015] Following is a detailed description, with reference to the drawings, of a slide fastener, which is a usage of the alloy of the present invention.

Fig. 1 is a conceptual drawing of a slide fastener. As shown in Fig. 1, the slide fastener comprises a pair of fastener tapes 1 each of which has a core part 2 formed at a side edge thereof, elements 3 that are crimped (mounted) onto the core part 2 of each fastener tape 1 at a prescribed interval, a top stop 4 and a bottom stop 5 that are crimped onto the core part 2 of each fastener tape 1 at the top and bottom ends respectively of the elements 3, and a slider 6 that is disposed between facing pairs of elements 3 and can be freely slid in an up/down direction to engage or separate the elements 3. In the above, a slide fastener chain 7 is an article obtained by mounting elements 3 onto the core part 2 of a fastener tape 1.

[0016] Although not shown in the drawings, slider 6 as shown in Fig. 1 is manufactured by the following steps: pressing a long plate-shaped body having a rectangular cross section, through several stages; cutting the body at a prescribed interval to form slider bodies; and then mounting a spring or pull on the slider body if necessary. The pulls are also manufactured from the plate-shaped body having a rectangular cross section, by punching out into a prescribed shape, and are crimped onto the slider bodies. The bottom stop 5 may be a separable fitting comprising an insert pin, a box pin and a box, so that the pair of slide fastener chains can be separated through the opening by the slider.

[0017] Fig. 2 shows a method of manufacturing the elements 3, the top stops 4 and the bottom stops 5 of the slide fastener shown in Fig. 1, and a method of attaching these to the core parts 2 of the fastener tapes

1. As shown in the drawing, the elements 3 are prepared by the below steps: a deformed wire 8 having an approximately Y-shaped cross section is cut into pieces of a prescribed dimension; and pressing the pieces to form an engaging head part 9 on each element 3. And then, foot parts 10 of each element 3 are crimped onto the core part 2 of the fastener tape 1, and thus mounting on the element 3.

[0018] The top stop 4 is prepared by cutting a rectangular wire 11 having a rectangular cross section into pieces of a prescribed dimension, bending the pieces to have an approximately C-shaped cross section. And then, the top stop 4 is crimped onto the core part 2 of the fastener tape 1, thus mounting on the top stop 4. The bottom stop 5 is prepared by cutting the deformed wire 12 having an approximately X-shaped cross section into pieces of a prescribed dimension. And then, the top stop 5 is crimped onto the core part 2 of the fastener tape 1, thus mounting on the top stop 5.

[0019] Note that in the drawing, it appears that the elements 3 and the top and bottom stops 4 and 5 are mounted onto the fastener tape 1 at the same time. But, in actual practice, elements 3 are first attached continuously onto the fastener tape 1 to compose a fastener chain, and then the elements 3 in regions where a stop is to be attached are removed from the fastener chain. And, the prescribed stops 4 and 5 are mounted on in these regions near to the elements 3.

In order to manufacture and attach the constituent members as described above, it is necessary for the elements and the stops to make up the constituent members of the slide fastener to be an alloy having excellent cold workability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Fig. 1 is a conceptual drawing of a slide fastener.

[0021] Fig. 2 is a drawing to explain a method of attaching a bottom stop, a top stop and elements to a fastener tape.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Following is a specific description of the present invention through an example and a comparative example. However, the present invention is not limited whatsoever by the following example.

Example

[0023] Using (99.99%) pure Cu, (99.9%) pure Zn and (99.9%) pure Mn as raw materials, these materials were melted in a continuous casting apparatus such that the composition would become $\text{Cu}_{75}\text{Zn}_{15}\text{Mn}_{10}$ by mass%, and continuous wires were manufactured by casting the melt through a carbon die of diameter 8mm.

Comparative Example

[0024] Continuous wires were manufactured by the same method as in the Example, except that the composition was made to be $\text{Cu}_{83}\text{Zn}_4\text{Mn}_{12}\text{Al}_1$ by mass%.

[0025] The continuous wires obtained through the above Example and Comparative Example were evaluated with regard to continuous castability, surface state and so on.

[0026] The continuous castability of the alloys was evaluated by several times of actual continuous casting using the above-mentioned continuous casting apparatus. With the alloy of the Comparative Example, the wire broke when the weight thereof was between 100 and 150kg, whereas with the alloy of the Example, the wire broke when the weight thereof was between 300 and 500kg. It was thus found that the continuous castability was 2 to 5 times better for the alloy of the Example of the present invention than that of the Comparative Example.

[0027] Moreover, the surface of each wire manufactured was observed, some parts blackened near the broken point with several continuous wires of the Comparative Example. On the other hand, with wires of the Example, such blackened portions were not present. Upon analyzing the blackened portions, it was found that they were a compound of Al and the carbon of the die. Upon cutting the wires just at the blackened part and observing the cut surface, internal defects such as cavities were found. Moreover, upon observing the structure of the continuous wire of the present invention, it was found that the structure was a single α phase.

[0028] The continuous wires of the Example were subjected to drawing and rolling, thus manufacturing continuous deformed wires respectively having an approximately Y-shaped cross section and an approximately X-shaped cross section, and a continuous rectangular wire, as shown in Fig. 2. Next, the continuous deformed wires and the continuous rectangular wire obtained were subjected to several cold workings to form every constituent member. And, the constituent members were mounted on fastener tapes, thus manufacturing a slide fastener. The slide fastener manufactured did not contain nickel and hence there would be no nickel allergy. Furthermore, the external appearance displays excellent whiteness as with a slide fastener manufactured based on nickel silver, and the color was within the above-mentioned ranges for a^* and b^* stipulated in JIS Z 8729. Moreover, during the manufacture of the slide fastener, cold working was easily performed, with no problem in workability.

[0029] Furthermore, during a slide fastener was manufactured as described above, after forming the continuous deformed wires and the continuous rectangular wire, the wires were electrolytically plated with a Cu-Sn alloy. And then, after mounting the constituent members on the fastener tapes, the slide fastener was electroless-plated with Sn. Except for the additional plating process-

es, the slide fastener was manufactured in the same way as described above.

[0030] The slide fastener obtained was as good as described earlier with regard to all of nickel allergy, whiteness and workability. Moreover, upon investigating the corrosion resistance and the discoloration resistance, it was found that the effects were more prominent than with the slide fastener unaccompanied the plating described earlier. 5

[0031] According to the present invention, a copper alloy for slide fasteners having the following advantages can be provided: The alloy displays excellent whiteness, does not contain nickel and hence does not have the problem of nickel allergy, and has excellent continuous castability and casting quality. 10 15

Claims

1. A copper alloy for slide fasteners having excellent continuous castability, having a composition represented by a general formula $\text{Cu}_a\text{Zn}_b\text{Mn}_c$, wherein regarding a, b and c, in mass%, $10 \leq b \leq 20$, $8 \leq c \leq 15$, and a is a remainder, with unavoidable impurities being contained. 20 25
2. A copper alloy for slide fasteners according to claim 1, wherein a color tone such that a^* and b^* , which represent a color tone as stipulated in JIS Z 8729, satisfy $0 < a^* < 2$ and $7 < b^* < 16$. 30
3. A copper alloy for slide fasteners according to claim 1 or 2, being a single α phase at room temperature.
4. A copper alloy for slide fasteners according to any of claims 1 through 3, a surface thereof being plated. 35
5. An element, which is a constituent member of a slide fastener, comprising the copper alloy for slide fasteners according to any of claims 1 through 4. 40
6. A stop, which is a constituent member of a slide fastener, comprising the copper alloy for slide fasteners according to any of claims 1 through 4. 45

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Fig. 1

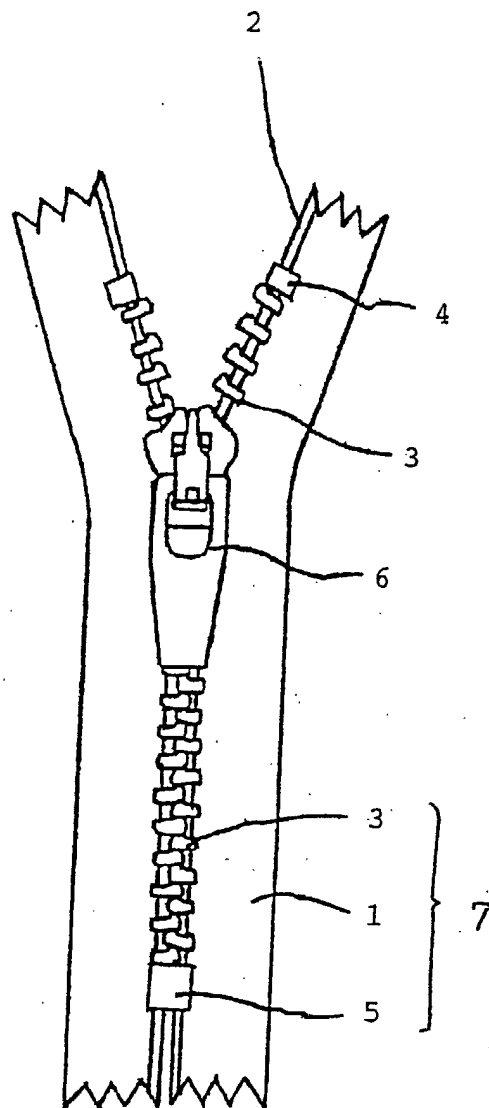
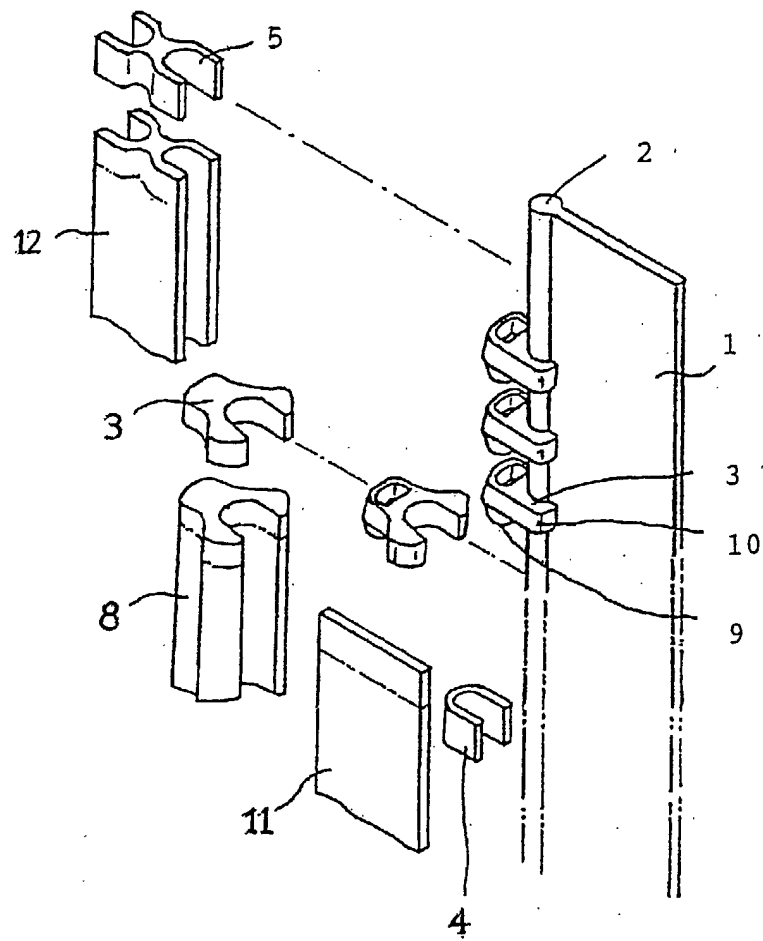


Fig. 2





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Application Number
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Place of search THE HAGUE		Date of completion of the search 28 November 2002	Examiner Vlassi, E
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