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(54) **Elements of slide fasteners and accessories made of nickel-free white copper alloy**

Reissverschlüsselementen und Zubehörteilen aus nickelfreie Weisskupferlegierung

Éléments de fermeture à glissière et accessoires en alliage blanc de cuivre sans nickel

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Description**BACKGROUND OF THE INVENTION****1. Field of the Invention**

[0001] The present invention relates to elements, sliders, stops and so on of slide fasteners, or for accessories such as metal buttons, clothing fasteners and so on, having excellent strength, hardness, workability and corrosion resistance, and not causing nickel allergy, nor needle detectors to malfunction.

2. Description of the Prior Art

[0002] Hitherto, copper-nickel-zinc alloys such as nickel silver, which has a white alloy color tone, copper-zinc alloys represented by red brass and brass, and so on have been used, for example, as copper alloys for slide fasteners as mentioned above. However, nickel silver contains nickel as an alloying element, and thus has excellent corrosion resistance, but if used for a slide fastener or the like, then because the fastener will often come into contact with the skin, the problem of nickel allergy may arise. Moreover, copper-zinc alloys represented by 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] The present inventors thus developed and filed patent applications for nickel-free white copper alloys as disclosed in Japanese Patent Application Publication No. 11-124644, Japanese Patent Application Publication No. 2000-303129, Japanese Patent Application Publication No. 2000-303130 and Japanese Patent Application Publication No. 2001-3125. The nickel-free white copper alloys disclosed in Japanese Patent Application Publication No. 11-124644, Japanese Patent Application Publication No. 2000-303129, Japanese Patent Application Publication No. 2000-303130 and Japanese Patent Application Publication No. 2001-3125 have excellent strength, hardness, workability and corrosion resistance, and do not contain nickel, and hence the problem of nickel allergy does not arise, and moreover these alloys have high decorative value, with an attractive degree of whiteness being maintained.

[0004] However, since manganese contained in the above alloys is a magnetic substance, the above alloys have a magnetic nature, and thus they have a problem that, when carrying out an investigation using a needle detector to find pins in a sewn article such as clothing, the needle detector is caused to malfunction, and hence pins cannot be identified. In the case of Cu-Mn copper alloys to which Mn added is added in small amounts, the magnetization is low and hence the alloy does not tend to cause needle detectors to malfunction, but there is a problem in that the color tone of the alloy tends not to be white, and hence a high-quality impression tends not to be given.

[0005] As a needle detector countermeasure for the above alloys, one can envisage carrying out surface treatment by plating or the like such that needle detectors are not caused to malfunction; however, the plating film or the like formed on the alloy surface may peel off due to changes over time, contact with other members or the like, and in this case problems will arise in that, if the substrate alloy that has been plated contains a magnetic element as described above, then needle detectors will be caused to malfunction and hence it will not be possible to identify pins as described above, and moreover there will deteriorate its decorativeness. Moreover, although copper alloys that do not cause needle detectors to malfunction also exist, for example the color tone of the alloy is not white, or the alloy contains nickel which causes the problem of nickel allergy; there has been no alloy that satisfies all of the above requirements.

SUMMARY OF THE INVENTION

[0006] It is thus an object of the present invention to provide elements of slide fasteners or accessories that have a strength and excellent hardness comparable to those of nickel silver, as well as excellent workability, corrosion resistance and whiteness in addition to ductility, and are free from the fear of nickel allergy problems because of containing no nickel, and moreover when carrying out an investigation using a needle detector to identify pins in a sewn article, tend not to cause the needle detector to malfunction. Another object of the present invention is to provide a method of producing such a nickel-free white copper alloy.

[0007] The present invention is constituted as specified in the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Following is a description of the composition of the nickel-free white copper alloy used according to the present invention.

[0009] The object of the present invention can be attained by the composition specified above.

[0010] Zn has an effect of improving the mechanical properties of the alloy through its solid solution strengthening

effect, a deoxidizing action in the melt during melting, and an effect of reducing the cost of the alloy. If the Zn content is less than the above-mentioned 0.5 mass %, then the reduction in the cost of the alloy will be insufficient, and the degree of strengthening and the deoxidizing action in the melt will be insufficient. Moreover, if the Zn content is greater than 30 mass %, then the season cracking resistance will deteriorate.

[0011] Ti has an effect of improving the mechanical properties of the alloy through its solid solution strengthening effect, and an effect of whitening the color tone of the copper alloy. Moreover, by adding Ti instead of Zn, there is an effect of improving the season cracking resistance. Moreover, Ti has an effect of reducing the conductivity of the alloy, and hence an effect of preventing malfunctioning due to the generation of eddy currents with a needle detector. If the Ti content is less than 1 mass %, then it will not be possible to expect the effect of whitening the color tone of the copper alloy, whereas if the Ti content is 7 mass % or more, then a large amount of oxides will be generated upon melting, and hence melt casting will become difficult, and also it will no longer be possible to secure sufficient cold workability, and moreover the cost of the material will rise.

[0012] X is at least one element selected from the group consisting of Al, Sn, Ag and Mn; by further adding these elements to the Cu-Zn-Ti alloy described above within a range of 0.1 to 4 mass % (wherein the upper limit and the lower limit are not included), the following effects can be expected.

[0013] Al and Sn have an effect of improving the season cracking resistance through formation of a stable oxide film on the surface of the alloy. Moreover, they have an effect of improving the mechanical properties of the alloy through their solid solution strengthening effect, and an effect of reducing the cost of the alloy. If the content is 0.1 mass % or less, then the season cracking resistance of the alloy will be insufficient, and the strengthening effect will also be insufficient. Moreover, if the content is 4 mass % or more, then the structure will be formed of an $\alpha+\beta$ phase, and hence it will no longer be possible to secure sufficient cold workability.

[0014] Ag has an effect of improving the mechanical properties of the alloy through its solid solution strengthening effect, and an effect of whitening the color tone of the copper alloy. Moreover, by adding Ag instead of Zn, there is an effect of improving the season cracking resistance. If the Ag content is 0.1 mass % or less, then the effect of whitening the color tone of the copper alloy will diminish. Moreover, if the Ag content is 4 mass % or more, then it will no longer be possible to secure sufficient cold workability, and moreover the cost of the material will rise.

[0015] Mn has an effect of whitening the color tone of the copper alloy. Moreover, by adding Mn instead of Zn, there is an effect of improving the season cracking resistance. Furthermore, Mn has an effect of reducing the conductivity of the alloy, and hence an effect of preventing malfunctioning caused due to the generation of eddy currents with a needle detector can be expected. If the Mn content is 0.1 mass % or less, then the effect of whitening the color tone of the copper alloy will diminish. Moreover, if the Mn content is 4 mass % or more, then a large amount of oxides will be generated upon melting, and hence problems will arise with the properties of the product, and moreover it will no longer be possible to secure sufficient cold workability, and also the magnetization will increase, and hence needle detectors will be caused to malfunction.

[0016] Through the structure of the alloy composed of a single α -phase, it is possible to make the cold workability excellent, and make malfunctioning of needle detectors less prone to occur.

[0017] Moreover, through the magnetization in a magnetic field of 18 kOe being 80 memu/g or less, when carrying out an investigation using a needle detector to identify pins in a sewn article, the needle detector will not be caused to malfunction, i.e. the alloy can be made to have excellent ability to cope with needle detectors. Ordinarily, an alloy can be made to have needle detector coping ability by making the magnetization in a magnetic field of 18 kOe be 200 memu/g or less, but with the present invention this magnetization is 80 memu/g or less as mentioned above, and hence the alloy has yet better needle detector coping ability.

[0018] Furthermore, the conductivity being 20% IACS or less is a very effective condition for making eddy currents not prone to occur during measurements with a needle detector.

[0019] Regarding the composition described above, in the case that the Zn content is 2 to 13 mass % and the Ti content is 3 to 6 mass % (wherein the upper and lower limits are included), the alloy has a degree of whiteness comparable to that of a conventional nickel silver or high manganese Cu-Mn copper alloy, and is yet better in terms of workability.

[0020] In the production of the alloy having these characteristic features required in the present invention, it can be obtained by preparing a material alloy (starting alloy) having the above-specified composition, heating the alloy to 700 to 885°C, and then cooling it. Specifically, at the stage of preparing the material alloy, the magnetization of the material alloy in a magnetic field of 18 kOe will be more than 80 memu/g, but by heating the material alloy to 700 to 885°C and then cooling it, the magnetization in a magnetic field of 18 kOe becomes 80 memu/g or less, i.e. the magnetization is reduced, and hence the resultant alloy can be made to have better needle detector coping ability, i.e. the resultant alloy will not cause needle detectors to malfunction. If the heating temperature is below the above-mentioned temperature range, then a precipitate will be present, and hence the magnetization may rise, and moreover the structure will no longer be a single α -phase, and hence the cold workability will be poor. Moreover, if the heating temperature is conversely higher than the above-mentioned temperature range, then the alloy will be heated above the eutectic tem-

perature of Cu-Ti and brought to a molten state (a state of solid-liquid coexistence), thereby leading to a drop in product quality.

[0021] Moreover, in this method, the cooling after the heating is important, and it is important to carry out this cooling rapidly by quenching or the like. As the cooling method, rapid cooling by quenching or the like using water, air, a gas or another cooling medium is preferable. In particular, it is preferable to make the cooling rate during the cooling be at least 10 K/s. By carrying out cooling in this way, the structure becomes a single α -phase, which is useful for cold working, and hence an alloy that is also useful from a working perspective can be provided.

[0022] The alloy produced through the present invention is in ranges of $-2 < a^* < 7$ and $-3 < b^* < 20$ based on the chromaticity diagram of the (L^* , a^* , b^*) colorimetric system stipulated in JIS Z 8729.

[0023] 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). In particular, it is a characteristic feature of the of the present invention that the color tone is white, and hence the closer to being achromatic the better, and thus the color tone is specified by the chromaticity indexes a^* and b^* as mentioned above.

[0024] Moreover, in the present invention, since the alloy itself is an alloy that does not cause needle detectors to malfunction, a coating layer may be formed on the surface of the alloy. Even if the coating layer peels off, the problem of a needle detector being caused to malfunction and hence it not being possible to identify pins will not arise. In the case of forming a coating layer, the ranges of a^* and b^* must be set to be similar to those for the above-mentioned alloy, and by forming the coating layer, a yet whiter material can be provided. In this case as well, even if the coating layer happens to peel off, because the alloy forming the substrate has a color close to that of the coating layer, there will be no problem, particularly with regard to color.

[0025] Examples of such a coating layer are an Sn plating layer, a Cr plating layer, an Ag plating layer, and a Cu-Sn plating layer, although so long as the coating layer exhibits a color tone as described above, a coating layer other than these plating layers can be used. In the case of forming a coating layer, the technique may be a wet type or dry type plating; for example, as a wet type plating, electrolytic plating, electroless plating, melt plating or the like can be used, and as a dry type plating, physical vapor deposition (PVD), chemical vapor deposition (CVD) or the like can be used.

[0026] Regarding the thickness of the coating layer, 0.001 to 10 μm is an effective range in which the coating will be expected to have an effect, and problems such as peeling off will not occur, and also in consideration of cost. Moreover, depending on the usage, such a material may be subjected to post-processing such as cutting or bending. In such a case, in consideration of peeling off, wear and so on due to such processing, it is preferable to make the thickness of the coating layer be in a range of 0.005 to 5 μm .

EXAMPLES

[0027] Following is a specific description of the present invention through examples, but the present invention is of course not limited by the following examples. In the following examples, all percentages are indicated by mass % unless otherwise specified.

Test samples made from alloys used according to the present invention:

[0028] Test samples made from alloys used according to the present invention as shown in Tables 1 and 2 were prepared as follows, and were subjected to evaluation. Test samples of comparative examples were also prepared in the same way.

[0029] Pure Cu(99.9%), pure Zn(99.9 to 99.99%), pure Ti(99.9%), pure Al, pure Sn, pure Ag, pure Mn and pure Ni were measured for making up an ingot of 200 cm^3 for each of the prescribed compositions shown in Tables 1 and 2. Each composition was subjected to high-frequency melting in an Ar atmosphere (10 cmHg), and after leaving for 4 minutes, the melt was poured into a copper casting mold (40 mm in diameter $\times$ 28 mm in length). The ingot (200 cm^3) obtained was cut into lengths of about 7 mm, thus producing billets for extrusion.

[0030] Extrusion was carried out at a billet temperature of 800°C and a container temperature of 600°C. The extruded material (8 mm in diameter $\times$ approx. 1300 mm in length) was subjected to heat treatment comprising heating at 800°C for 1 hour followed by furnace cooling (hereinafter referred to as the 'heat treatment'). After this heat treatment, the extruded material (wire) was further heated to a temperature of 700 to 885°C, and then quenching was carried out using water as the cooling medium; the material obtained was taken as the test sample.

Table 1

	Alloy composition (mass %)						Color tone	Conductivity IACS%	Ni allergy	Structure	Magnetization memu/g
	Cu	Zn	Ti	Mn	Ni						
1	Balance	10	1	-	-		White	11	○	α	-4
2	Balance	10	3	-	-		White	10	○	α	-9
3	Balance	13	5	-	-		White	9	○	α	-8
4	Balance	27	2	-	-		White	10	○	α	-7
5	Balance	26	3	-	-		White	9	○	α	-3
6	Balance	21	2	-	-		White	9	○	α	-5
7	Balance	28	2	-	-		White	9	○	α	-7
8	Balance	6	2	-	-		White	12	○	α	-1
9	Balance	5	3	-	-		White	12	○	α	-2
1	Balance	35	0.5	-	-		Yellow	20	○	α	-2
2	Balance	20	10	-	-		White	8	○	α+β	-5
3	Balance	15	-	-	-		Yellow	37	○	α	-
4	Balance	24	-	-	14		White	7	x	α	-
5	Balance	15	-	10	-		White	3	○	α	157

Examples
of the
present
invention

Compara-
tive
examples

Table 2

		Alloy composition (mass%)									Color tone	Conductiv- ity IACS%	Ni allergy	Structure	Magnetiza- tion memu/g
		Cu	Zn	Ti	Al	Sn	Ag	Mn	Ni						
Examples of the present invention	1	Balance	10	1	0.4	-	-	-	-	White	11	○	α	-4	
	2	Balance	10	3	-	-	-	2	-	White	6	○	α	47	
	3	Balance	13	5	0.5	-	-	-	-	White	9	○	α	-8	
	4	Balance	27	2	0.3	-	-	-	-	White	10	○	α	-7	
	5	Balance	26	3	1	1	-	-	-	White	9	○	α	-3	
	6	Balance	21	2	1	-	-	-	-	White	9	○	α	-5	
	7	Balance	28	2	2	-	-	-	-	White	9	○	α	-7	
	8	Balance	6	2	-	-	-	-	2	-	White	7	○	α	49
	9	Balance	5	3	-	-	1	-	-	-	White	12	○	α	-2
Compara- tive examples	1	Balance	35	0.5	0.2	-	-	-	-	Yellow	3	○	α	-2	
	2	Balance	20	10	-	5	-	-	-	Yellow	3	○	α+β	-5	
	3	Balance	15	2	-	-	-	-	10	-	White	3	○	α	157
	4	Balance	24	-	-	-	-	-	-	14	White	7	x	α	-

Evaluation of test samples:

[0031] Regarding the color tone, the test samples obtained were mirror-polished using an SiC abrasive paper and a diamond paste, measurements were taken using a colorimeter (CR-300, made by Minolta Co., Ltd.), and the measurement results were expressed by means of L^* , a^* and b^* as stipulated in JIS Z 8729; if a^* and b^* were expressed within the ranges stated earlier then the color tone was recorded as being 'white', whereas otherwise the principal color was recorded. For all of the test samples of the present invention, the color tone was white, specifically a white close to achromatic.

[0032] Regarding the conductivity, a sample surface taken from each test sample was mirror-polished, the measuring probe of a digital conductivity meter (AutoSigma 3000 made by Hocking Kabushiki Kaisha) was placed in contact with the sample surface, and the conductivity value was measured. For the test samples of the present invention, it was found that the values were extremely good at 12% IACS or less. It can thus be seen that eddy currents will occur only with extreme difficulty during measurements with a needle detector. For coping with needle detectors, this is an extremely important property, along with the magnetization, described below.

[0033] Regarding nickel allergy, evaluation was carried out according to whether or not the test samples contained Ni, with the symbol 'O' being given to ones that did not contain Ni, and the symbol 'x' to ones that did contain Ni. All of the test samples of the present invention did not contain Ni, and hence were materials having no allergic problem due to nickel.

[0034] Regarding the structure, the test samples obtained were subjected to structure observation. The test samples of the present invention were composed of an α -phase only.

[0035] The magnetization of each test sample obtained was measured using an alternating gradient force magnetometer (model AFGM 2900-04C made by Princeton Measurements Corp.); approximately 0.1g of the test sample was placed in the magnetic field of an electromagnet, a magnetic field of 18 kOe was generated using the electromagnet, and the magnetization of the test sample was measured by changing the magnetic field. The measurement speed was 50msec/point. It was found that the test samples of the present invention have an extremely low magnetization of 50 memu/g or less even in a strong magnetic field of 18 kOe. Note that in the tables, a negative value of the magnetization indicates diamagnetism, and implies that the magnetization is a value close to 0. Moreover, '-' indicates that no measurement was taken.

[0036] It can be seen from the above results that to obtain a material that is excellent in terms of magnetization and conductivity, it is extremely important to use an alloy composition according to the present invention and the producing method according to the present invention.

[0037] Moreover, for the test samples of the present invention, the hardness was 100 Hv or more, there was no cracking or the like after 80% deformation, and excellent results were also obtained with regard to discoloration resistance and season cracking resistance.

[0038] According to the nickel-free white copper alloy and the method of producing the nickel-free white copper alloy used according to the present invention, the alloy has excellent strength and hardness, is ductile, has excellent workability, corrosion resistance, discoloration resistance and season cracking resistance, and has excellent whiteness, and hence an alloy having high decorative value can be provided; moreover, since the alloy does not contain nickel, there is no nickel allergy problem. Furthermore, the magnetization is extremely small even in a strong magnetic field of 18 kOe, and hence when carrying out an investigation using a needle detector to identify pins in a sewn article, the alloy tends not to cause the needle detector to malfunction. Due to these points, the alloy is extremely useful as an alloy used for accessories, in particular as an alloy used in articles that are attached by sewing.

Claims

1. Elements of slide fasteners and accessories to be attached to sewn products containing a nickel-free white copper alloy represented by the general formula $\text{Cu}_a\text{Zn}_b\text{Ti}_c$ wherein b and c are, in mass %, $0.5 \leq b \leq 30$ and $1 \leq c < 7$, and a is the balance, with unavoidable impurities also possibly being contained.
2. Elements of slide fasteners and accessories to be attached to sewn products containing a nickel-free white copper alloy represented by the general formula $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$ wherein X is at least one element selected from the group consisting of Al, Sn, Ag and Mn, b, c and d are, in mass %, $0.5 \leq b \leq 30$, $1 \leq c < 7$ and $0.1 < d < 4$, and a is the balance, with unavoidable impurities also possibly being contained.
3. Elements according to claim 1 or 2, containing an alloy composed of a single α -phase at room temperature.
4. Elements according to any of claims 1 through 3, containing an alloy having a magnetization of 80 memu/g or less

in a magnetic field of 18 kOe.

5. Elements according to any of claims 1 through 4, containing an alloy having a conductivity of 20 % IACS or less.

6. Elements according to any of claims 1 through 5, wherein b and c are, in mass %, $2 \leq b \leq 13$ and $3 \leq c \leq 6$.

7. Use of a nickel-free white copper alloy, represented by the general formula $\text{Cu}_a\text{Zn}_b\text{Ti}_c$, wherein b and c are, in mass %, $0.5 \leq b \leq 30$ and $1 \leq c < 7$, and a is the balance, with unavoidable impurities also possibly being contained for the production of elements of slide fasteners and accessories to be attached to sewn products.

8. Use of a nickel-free white copper alloy, represented by the general formula $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$, wherein X is at least one element selected from the group consisting of Al, Sn, Ag and Mn, b, c and d are, in mass %, $0.5 \leq b \leq 30$, $1 \leq c < 7$ and $0.1 < d < 4$, and a is the balance, with unavoidable impurities also possibly being contained as an alloy for the production of elements of slide fasteners or accessories to be attached to sewn products.

Patentansprüche

1. Elemente von Reißverschlüssen und Zubehör zur Anbringung an genähten Produkten, eine nickelfreie Weißkupferlegierung enthaltend, dargestellt durch die allgemeine Formel $\text{Cu}_a\text{Zn}_b\text{Ti}_c$, wobei b und c, als prozentualer Masseanteil, $0,5 \leq b \leq 30$ und $1 \leq c < 7$ ausmachen, und a den Restbetrag ausmacht, wobei außerdem unvermeidbare Verunreinigungen möglicherweise enthalten sein können.

2. Elemente von Reißverschlüssen und Zubehör zur Anbringung an genähten Produkten, eine nickelfreie Weißkupferlegierung enthaltend, dargestellt durch die allgemeine Formel $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$, wobei X mindestens ein Element ist, das aus der Gruppe ausgewählt wird, die aus Al, Sn, Ag und Mn besteht, wobei b, c und d, als prozentualer Masseanteil, $0,5 \leq b \leq 30$ und $1 \leq c < 7$ und $0,1 < d < 4$ ausmachen, und a den Restbetrag ausmacht, wobei außerdem unvermeidbare Verunreinigungen möglicherweise enthalten sein können.

3. Elemente nach Anspruch 1 oder 2, eine Legierung enthaltend, die aus einer einzigen α -Phase bei Raumtemperatur zusammengesetzt ist.

4. Elemente nach einem der Ansprüche 1 bis 3, eine Legierung enthaltend, die eine Magnetisierungsstärke von 80 memu/g oder weniger in einem magnetischen Feld von 18 kOe aufweist.

5. Elemente nach einem der Ansprüche 1 bis 4, eine Legierung enthaltend, die eine Leitfähigkeit von 20 % IACS oder weniger aufweist.

6. Elemente nach einem der Ansprüche 1 bis 5, wobei b und c, als prozentualer Masseanteil, $2 \leq b \leq 13$ und $3 \leq c \leq 6$ ausmachen.

7. Verwendung einer nickelfreien Weißkupferlegierung, dargestellt durch die allgemeine Formel $\text{Cu}_a\text{Zn}_b\text{Ti}_c$, wobei b und c, als prozentualer Masseanteil, $0,5 \leq b \leq 30$ und $1 \leq c < 7$ ausmachen, und a den Restbetrag ausmacht, wobei außerdem unvermeidbare Verunreinigungen möglicherweise enthalten sein können, für die Herstellung von Elementen von Reißverschlüssen und Zubehör zur Anbringung an genähten Produkten.

8. Verwendung einer nickelfreien Weißkupferlegierung, dargestellt durch die allgemeine Formel $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$, wobei X mindestens ein Element ist, das aus der Gruppe ausgewählt wird, die aus Al, Sn, Ag und Mn besteht, wobei b, c und d, als prozentualer Masseanteil, $0,5 \leq b \leq 30$, $1 \leq c < 7$ und $0,1 < d < 4$ ausmachen, und a den Restbetrag ausmacht, wobei außerdem unvermeidbare Verunreinigungen möglicherweise enthalten sein können, als eine Legierung für die Herstellung von Elementen von Reißverschlüssen und Zubehör zur Anbringung an genähten Produkten.

Revendications

1. Eléments de fermeture à glissière et accessoires destinés à être attachés à des articles cousus, constitués d'un alliage de cuivre, blanc et sans nickel, représenté par la formule générale $\text{Cu}_a\text{Zn}_b\text{Ti}_c$ dans laquelle b et c sont tels

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que, en pourcentages massiques, $0,5 \leq b \leq 30$ et $1 \leq c < 7$, et a équivaut au reste, des impuretés inévitables pouvant aussi être présentes.

5 2. Eléments de fermeture à glissière et accessoires, destinés à être attachés à des articles cousus, constitués d'un alliage de cuivre, blanc et sans nickel, représenté par la formule générale $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$ dans laquelle X représente au moins un élément choisi dans l'ensemble formé par Al, Sn, Ag et Mn, b, c et d sont tels que, en pourcentages massiques, $0,5 \leq b \leq 30$, $1 \leq c < 7$ et $0,1 < d < 4$, et a équivaut au reste, des impuretés inévitables pouvant aussi être présentes.

10 3. Eléments conformes à la revendication 1 ou 2, constitués d'un alliage qui forme, à la température ambiante, une unique phase alpha.

15 4. Eléments conformes à l'une des revendications 1 à 3, constitués d'un alliage dont l'aimantation, dans un champ magnétique de 18 kOe, vaut au plus 80 mUEM/g.

5 5. Eléments conformes à l'une des revendications 1 à 4, constitués d'un alliage dont la conductivité vaut au plus 20 % IACS.

20 6. Eléments conformes à l'une des revendications 1 à 5, dans lesquels b et c sont tels que, en pourcentages massiques, $2 \leq b \leq 13$ et $3 \leq c \leq 6$.

25 7. Emploi, dans la fabrication d'éléments de fermeture à glissière ou d'accessoires destinés à être attachés à des articles cousus, d'un alliage de cuivre, blanc et sans nickel, représenté par la formule générale $\text{Cu}_a\text{Zn}_b\text{Ti}_c$ dans laquelle b et c sont tels que, en pourcentages massiques, $0,5 \leq b \leq 30$ et $1 \leq c < 7$, et a équivaut au reste, des impuretés inévitables pouvant aussi être présentes.

30 8. Emploi, dans la fabrication d'éléments de fermeture à glissière ou d'accessoires destinés à être attachés à des articles cousus, d'un alliage de cuivre, blanc et sans nickel, représenté par la formule générale $\text{Cu}_a\text{Zn}_b\text{Ti}_c\text{X}_d$ dans laquelle X représente au moins un élément choisi dans l'ensemble formé par Al, Sn, Ag et Mn, b, c et d sont tels que, en pourcentages massiques, $0,5 \leq b \leq 30$, $1 \leq c < 7$ et $0,1 < d < 4$, et a équivaut au reste, des impuretés inévitables pouvant aussi être présentes.