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(54) **Low melting point alloy of tin, bismuth and antimony for fusible elements of low voltage fuses**

(57) The present invention relates to the ecologically safe low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) containing from 4.0 % to 17.0 % by weight of bismuth (Bi) and from 1.0 % to 3.0 % by weight of

antimony (Sb), the rest being tin (Sn), and to its use for fusible elements of low voltage fuses.

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Description

Technical Field

[0001] The present invention relates to a low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb), designated as ETI-Sn-Bi-Sb in the continuation, which is ecologically safe, and to its use for fusible elements of low voltage fuses.

Technical Problem

[0002] Low melting alloys are functional components of low voltage high capacity blade-contact fuses. When an increased current runs through the fuse, the fusible element representing a vital part of the fuse heats up. If the temperature exceeds the melting point of the low melting alloy, the latter melts and begins to melt the fusible element, which is normally made of copper, silver or new silver, at an exactly defined position. The higher the temperature the faster the melting, which is stopped by the breaking of the fusible element and an interruption of the circuit.

[0003] When selecting the low melting alloys there should be considered their physical-chemical, technological and ecological properties as well as economy. By taking all of them into account, the possibilities if choosing the alloy are relatively limited. It has turned out that the most suitable are tin-base alloys with chosen appropriate major alloying elements and a possible addition of minor alloying elements for the correction and optimization of the properties of the alloy.

[0004] As major alloying elements only bismuth (Bi) and indium (In) are technologically and economically acceptable. The properties of the alloys comprising these alloying elements are in principle and actually very different from the ones comprising cadmium (Cd). Therefore there must be provided additional alloying elements making the essential technological and application properties of the new alloys as similar as possible to SnCd20.

[0005] Thus, there existed a need for a new alloy, which would be ecologically acceptable in its composition and, with regard to its technical and technological as well as physical properties, could replace the existing ecologically harmful alloys for fusible elements of low voltage fuses.

Prior Art

[0006] On each fusible element normally made of pure copper of very narrow tolerances (up to ± 0.003 mm) and with a conductivity of 58.8×10^6 S/m, there is applied, at an exactly defined position, a layer of a solder made of a tin(Sn)-cadmium(Cd)-alloy and a few millimetres wide. This alloy is very important for a correct action of the fuse since by a correct proportion of the two elements it is achieved that at a defined overload current

the fuse interrupts the circuit within the prescribed time and thus protects the installation and the user (transformer, engine,...) from being destroyed.

[0007] It is known that cadmium (Cd) is an element, which, already in small amounts, is very toxic to natural substances and living beings. In EU countries the legislation forbids the production, processing and use of cadmium (Cd). By 2008 at the latest, all articles (colours, batteries) containing cadmium (Cd) will either have to be withdrawn from sale or an appropriate substitute for this heavy metal will have to be found.

[0008] There are also known alloys of lead and tin (Pb-Sn), which are also harmful to the environment due to the toxicity of lead.

[0009] Alloys that do not contain ecologically harmful elements like Cd and Pb, e.g. combinations Zn-Ag-Bi-Cu and Zn-In-Al, are used as well, yet due to their technical and physical properties such as melting point, wettability etc., they are limited only to certain uses.

[0010] In EP 1 189 252 A1 there are described solders from tin(Sn)-base alloys in combination with bismuth (Bi), copper (Cu) and indium (In), which, however, are economically doubtful due to the high price of indium.

[0011] The present technology of production of fuses and the action thereof are adapted to the existing ecologically harmful alloy of tin (Sn) and cadmium (Cd) SnCd20, which ought to be replaced by one or more ecologically safe alloys with technological and application properties as similar as possible to the existing ones.

Technical Solution

[0012] We have found that the stated problems can be successfully solved by the low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) ETI-Sn-Bi-Sb of the present invention, which is ecologically safe and by its technical and physical properties (melting point, conductivity, wettability) corresponds to the requirements of the use for fusible elements of low voltage fuses.

[0013] The ecologically safe low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) ETI-Sn-Bi-Sb of the present invention by its technical and technological as well as physical properties entirely replaces the existing harmful alloys of tin (Sn) and cadmium (Cd) for fusible elements of low voltage fuses.

[0014] Thus, the first object of the present invention is the low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) ETI-Sn-Bi-Sb containing from 4.0 % to 17.0 % by weight of bismuth (Bi) and from 1.0 % to 3.0 % by weight of antimony (Sb), the rest being tin (Sn).

[0015] The above-disclosed low melting alloy is produced in the form of definite or infinite wire of a round or square longitudinal section of dimensions (diameter or side length) from 0.5 mm to 3.0 mm.

[0016] Thus, the second object of the invention is the above-disclosed low melting alloy in the form of definite or infinite wire of round or square longitudinal section of dimensions (diameter or side length) from 0.5 mm to 3.0

mm.

[0017] The third object of the invention is the use of the above-disclosed low melting alloy for fusible elements of low voltage fuses.

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Claims

1. Low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) containing from 4.0 % to 17.0 % by weight of bismuth (Bi) and from 1.0 % to 3.0 % by weight of antimony (Sb), the rest being tin (Sn). 10
2. Low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) according to claim 1 in the form of a definite or infinite wire of a round or square longitudinal section of dimensions (diameter or side length) from 0.5 mm to 3.0 mm. 15
3. Use of low melting alloy of tin (Sn), bismuth (Bi) and antimony (Sb) according to claim 1 or 2 for fusible elements of low voltage fuses. 20

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EUROPEAN SEARCH REPORT

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EP 04 46 8014

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 31 May 2005	Examiner Gregg, N
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EP 04 46 8014

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The members are as contained in the European Patent Office EDP file on
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