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(71) Applicant: **N.V. BEKAERT S.A.**
8550 Zwevegem (BE)

(72) Inventors:
- **van Loo, Gilbert**
  8530 Harelbeke (BE)
- **Gonnissen, Danny**
  8800 Roeselare (BE)
- **Declercq, Dries**
  8930 Lauwe (BE)
- **de Leyn, Kristof**
  8500 Kortrijk (BE)

(54) Lead-in wire

(57) The invention relates to a lead-in wire comprising a steel core surrounded by a nickel-iron alloy. Also a method of manufacturing a lead-in wire is described.

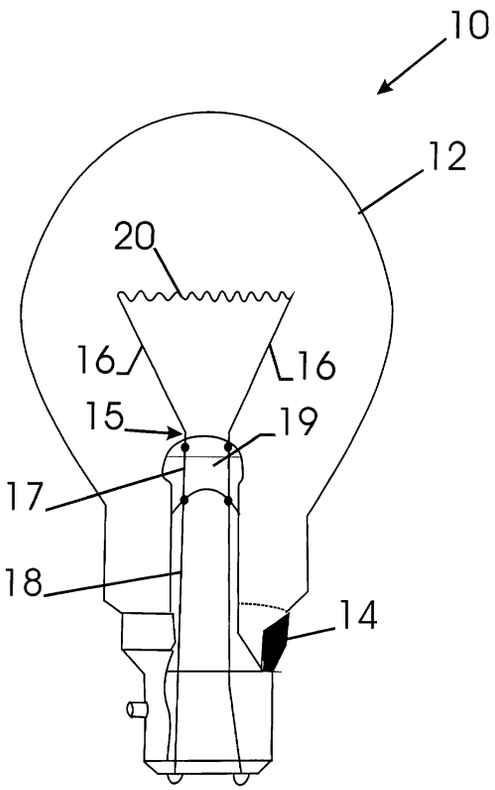

Fig. 1

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Description

Field of the invention.

[0001] The invention relates to a lead-in wire for use in lamps and electron tubes and to lamps and electron tubes comprising such a lead-in wire. The invention further relates to a method for the manufacturing of lead-in wires.

Background of the invention.

[0002] The inner lead-in wire of a lamp, which is the part of the lead-in wire extending from a stem of glass upwardly inside the glass envelope, is generally made of nickel because its high melting point.
Also wires made of a nickel alloy such as an alloy consisting of 98 wt% Ni and 2 wt% Mn, wires of an nickel-iron alloy or nickel plated steel wires are known in the art.
[0003] Since nickel is a rather expensive metal it is desirable to replace the nickel by a cheaper material.
However, the lead-in wires made of a substitute material should meet the necessary quality requirements

Summary of the invention.

[0004] It is an object of the present invention to provide a lead-in wire that can be manufactured at low costs.
It is another object to provide a lead-in wire with a high corrosion protection at high temperatures.
It is a further object to provide a lead-in wire with a high ductility.
[0005] According to a first aspect of the present invention, a lead-in wire is provided. The lead-in wire is in particular suitable as inner lead-in wire of a lamp or electron tube.
The lead-in wire according to the present invention comprises a steel core surrounded by a coating layer comprising a nickel-iron (NiFe) alloy.
[0006] Preferably, the coating layer comprising the nickel-iron alloy has a thickness higher than 0.1 μm, for example between 0.2 and 10 μm. It is particularly advantageous that the coating layer has a thickness between 1 and 5 μm, for example between 1.5 and 2.5 μm.
[0007] The nickel-iron layer has an iron content of at least 1 wt%. Preferably, the iron content is higher than 30 wt% and more preferably higher than 40 wt%, for example 50 wt%.
The Ni content of the coating layer is higher than 1 wt%. Preferably, the content of Ni is higher than 30 wt%, and more preferably higher than 400 wt%, for example 50 wt%.
[0008] A preferred coating composition comprises between 30 and 70 wt% Ni and between 30 and 70 wt% Fe. More preferably the coating comprises between 50 and 60 wt% Ni and between 40 and 50 wt% Fe.
[0009] The presence of iron in the coating layer can be due to diffusion of iron, for example of the steel, into the coating layer or may be due to the presence of iron salts during the application of the coating layer.
[0010] Possibly, a gradient of the iron or nickel content over the thickness of the coating can be observed.
In a preferred embodiment the concentration of nickel increases towards the outer surface of the coating layer.
[0011] The steel core may have any cross-section, such as cirular, oval-shaped or rectangular cross-sections.
Preferred cores have a circular cross-section and a diameter ranging between 0.2 and 2 mm, for example 0.35 or 0.50 mm.
[0012] The steel core is typically made of low carbon steel, although other metal wires may also be employed.
[0013] The lead-in wires according to the present invention are suitable to be used for illumination lamps and electron tubes.
Illumination lamps are considered to include incandescent lamps, gas discharge lamps, flash lamps and the like.
[0014] According to a second aspect a method of manufacturing a lead-in wire according to the present invention is provided :
The method comprises the steps of

- providing a steel core;
- forming a coating layer comprising a nickel-iron alloy on said steel core.

[0015] Any coating technique that results in obtaining a coating layer according to this invention can be considered. Such techniques are for example hot dip, vapour deposition, chemical plating, melt plating, melt spraying and electroplating.
[0016] The nickel-iron alloy can be formed by applying a nickel coating on the steel core and by subjecting the coated wire to a heat treatment, whereby the temperature is at least 400 °C to form a nickel-iron alloy.
[0017] Alternatively, the nickel-iron coating layer is formed by applying a coating layer comprising nickel and iron to the steel core. Possibly, the coated wire is subjected to a heat treatment in a subsequent step.
[0018] The method for the application of the coating layer may comprise the application of a mixture of nickel and iron. Possibly the application of the coating layer is followed by a heat treatment.
[0019] According to a further aspect an illumination lamp or electron tube comprising a lead-in wire according to the present invention is provided.

Brief description of the drawings.

[0020] The invention will be described into more detail with reference to the accompanying drawings wherein

- FIGURE 1 is a cross-section of a lamp comprising a lead-in wire according to the present invention.

Description of the preferred embodiments of the invention.

[0021] A lead-in wire according to the present invention is manufactured as follows :
A steel wire is drawn to a determined diameter, e.g. to a diameter of 0.35 mm.
In a first step a nickel coating layer is applied on a low carbon steel wire. For the application of the nickel layer the following parameters may be used:

- bath composition:

  $NiSO_4.6H_2O$: 225 - 410 g/L
  $NiCl_2.6H_2O$: 30 - 100 g/L
  H_3BO_3 : 25 - 40 g/L

- pH : 1.5-5.2
- Temperature : 45 - 70°C
- Current density : 1 - 20 A/dm^2

[0022] Other suitable baths comprise for example Ni-sulfamate.
[0023] The thickness of the applied nickel coating is for example 0.8 μm.
[0024] After the application of the nickel coating, the coated wire is subjected to a heat treatment, for example at a temperature higher than 400 °C.
By this heat treatment a nickel-iron alloy is formed. The thickness of this nickel-iron alloy is for example 1.6 μm.
[0025] An alternative method comprises the electrolytic application of a nickel-iron alloy by using a plating bath comprising iron salts and nickel salts.
[0026] The nickel-iron coating forms a closed layer characterised by a low porosity . The coating has a high ductility so that the coated wire can be rolled or bent.
Furthermore, the nickel-iron coating layer is giving the steel wire a good corrosion protection at high temperatures.
[0027] Referring to Figure 1, the cross-section of a lamp 10 is shown. The lamp comprises a light-transmitting, glass envelope 12 secured to a base member 14.
[0028] Lead-in wires 15 generally comprise three segments of different materials.
More particularly, lead wires comprise an inner lead-in wire 16, an intermediate wire 17 and an outer lead-in wire 18. The different segments of the lead-in wire are soldered or welded, for example buttwelded.
The intermediate wire is positioned in a stem of pressed glass.
The upper portion of the stem is inserted into the glass envelope of the lamp. The portion of the lead-in wire extending upwardly from the stem constitute the inner lead-in wire, while the portions of the lead-in wires extending downwardly from the stem constitute the outer lead-in wire.
The intermediate wire is preferably a dumet wire. A dumet wire has a nickel-iron core coated with a copper layer.
The inner lead-in wire comprises a wire according to the present invention.
A coiled filament 20, which is generally a tungsten filament is clamped by the ends of the two inner lead-in wires. Therefore, the inner lead-in wires are at one end rolled and bent, for example over 180°.
This rolling and bending imposes high requirements such as a good ductility on the lead-in wires. The nickel-iron alloy coating of the lead-in wire according to the present invention does meet this requirement.

Claims

1. Lead-in wire comprising a steel core, said steel core being surrounded by a coating layer comprising a nickel-iron alloy.

2. Lead-in wire according to claim 1, whereby said layer has a thickness between 1 and 10 μm.

3. Lead-in wire according to any one of the preceding claims, whereby said nickel-iron alloy has a nickel content between 30 and 70 wt% and an iron content between 30 and 70 wt%.

4. A method of manufacturing a lead-in wire according to any one of claims 1 to 3, said method comprising the steps of

   - providing a steel core;
   - forming a coating layer comprising a nickel-iron alloy on said steel core.

5. A method according to claim 4, whereby said coating layer comprising a nickel-iron alloy is formed by

   - applying a nickel coating on said steel core;
   - subjecting the coated wire to a heat treatment, whereby the temperature is at least 400 °C to form a nickel-iron alloy.

6. A method according to claim 4, whereby said coating layer comprising a nickel-iron alloy is formed by

   - applying a coating layer comprising nickel and iron to said steel core.

7. Lamp or electron tube comprising at least one lead-in wire according to any one of claims 1 to 3.

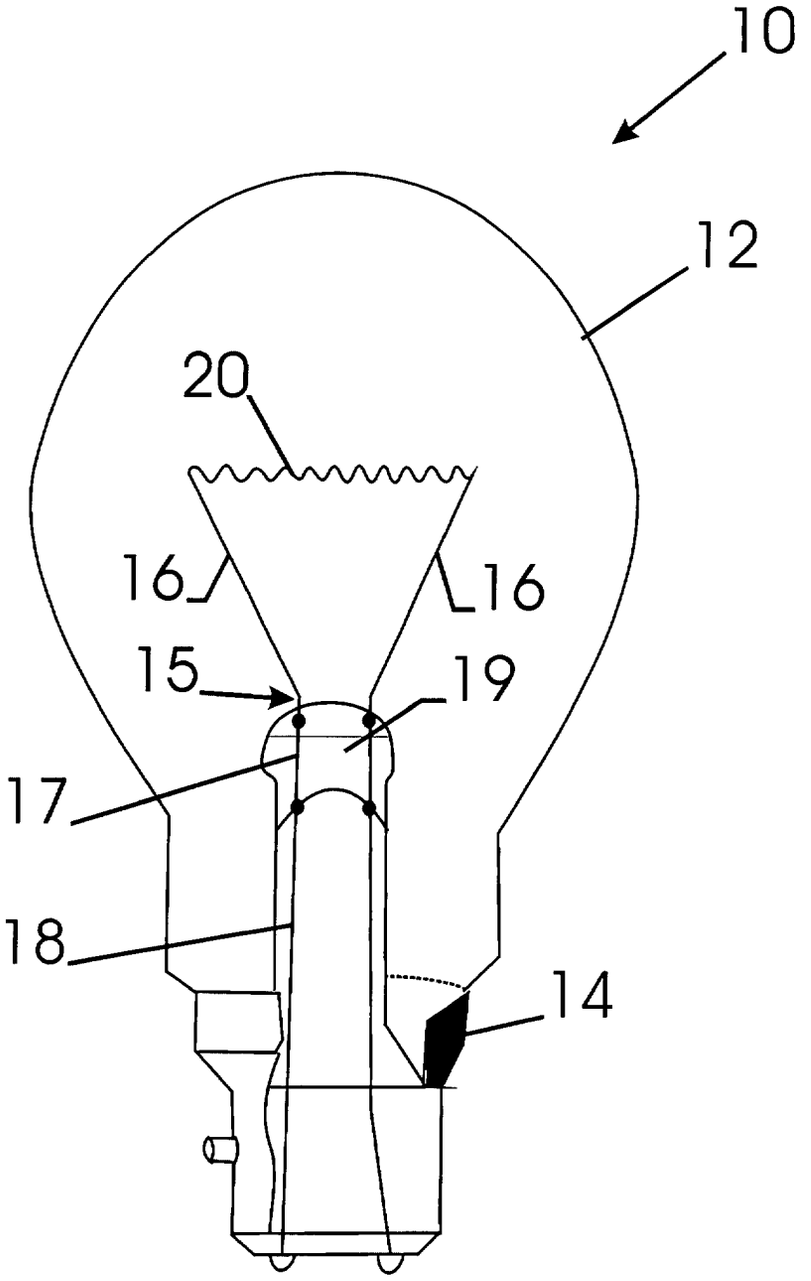

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 1154

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 145 (C-1178), 10 March 1994 (1994-03-10) & JP 05 320842 A (TOKIN CORP), 7 December 1993 (1993-12-07) * abstract *	1-5	H01J5/46 H01J61/36 H01K1/40
A	EP 0 923 109 A (BRUNO DIETZE FA) 16 June 1999 (1999-06-16) * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01J
H01K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 August 2001	Oestreich, S

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 20 1154

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-08-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 05320842 A	07-12-1993	NONE	
EP 0923109 A	16-06-1999	DE 19754806 A	01-07-1999
		US 5986404 A	16-11-1999