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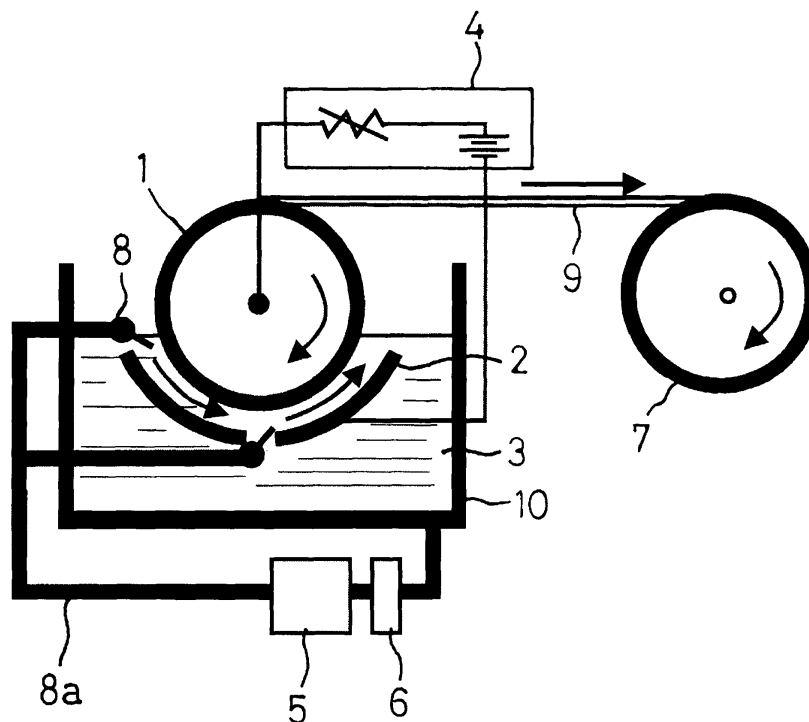
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(54) **Apparatus and method for fabricating metal fibres using electroforming**

(57) An apparatus and method for fabricating metal fibers using electroforming are provided in which continuous metal fibers can be fabricated. Here, any kind of metal which can be electroplated is electro-deposited

on the surface of a negative electrode in diameter of a desired size corresponding to a plurality of non-conductive patterns of the negative electrode surface in an electrolyzer, and the electro-deposited metal is continuously separated.

**FIG. 1**



## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

[0001] The present invention relates to an apparatus and method for fabricating metal fibers using electroforming, and more particularly, to a metal fiber fabrication apparatus and method using electroforming, in which any kind of metal which can be electroplated is electro-deposited on the surface of a negative electrode in diameter of a desired size corresponding to a non-conductive pattern of the negative electrode surface in an electrolyzer, and the electro-deposited metal is continuously separated.

#### Description of the Related Art

[0002] As disclosed in Korean Patent Publication No. 2001-0036472, a conventional metal fiber fabrication technology has several demerits such as a limitation of a material with respect to metal fibers, a difficulty of fabrication using a fast cooling solidification method, and a limitation of a diameter of less than 30 $\mu$ m and a length within the range of from several to several tens millimeters. Therefore, user can not control a diameter of metal fibers more than 30 $\mu$ m.

[0003] Also, as disclosed in Korean Patent Publication No. 1995-0005949, a method of fabricating metal fibers through extruding or drawing has shortcomings of an occurrence of junctions between particles of metal during extruding and a difficulty of separation of individual fibers after extruding.

[0004] To solve these problems, there are a method of oxidizing the surface of metal powder in advance or plating other metal on the surface of metal powder, a method of mixing metal powder with salt, oxide or carbon black, etc. However, such a manufacturing process is complicated and thus a manufacturing cost is increased.

### SUMMARY OF THE INVENTION

[0005] To solve the above problems, it is an object of the present invention to provide a method for fabricating metal fibers with a single process or a minimized number of processes, using electroforming, differently from a conventional metal fiber fabrication method using a complicated process, and a metal fiber fabrication apparatus employing the same.

[0006] It is another object of the present invention to provide an apparatus and method for fabricating metal fibers using electroforming, in which any kind of metal which can be electroplated is fabricated into metal fibers of a desired size.

[0007] It is still another of the present invention to provide an apparatus and method for fabricating metal fib-

ers using electroforming, in which metal fibers are continuously fabricated to thereby overcome a limitation in a length of a metal fiber which is a conventional problem.

[0008] It is yet another of the present invention to provide an apparatus and method for fabricating metal fibers using electroforming, in which size of metal fibers such as the width and thickness thereof can be easily adjusted, lest the metal fibers should be limited to have a size of a cross-sectional area within the range of from several micrometers to several millimeters.

[0009] To accomplish the above object of the present invention, there is provided a metal fiber fabrication apparatus for fabricating metal fibers continuously, the metal fiber fabrication apparatus comprising: an electrolyzer containing an electrolyte necessary for electro-deposition of the metal fibers to be aimed; an insoluble positive electrode member installed in the electrolyte and connected to a negative end of a power supply; a negative electrode member which is connected to a positive end of the power supply, and partially soaked in the electrolyte and rotatably installed at a certain distance from the positive electrode member, in which an electro-deposition surface is precisely ground; and a plurality of non-conductive patterns installed on the outer circumferential surface of the negative electrode member, which form a plurality of annular contact windows which are parallel with each other and whose rotational directions are consistent with that of the negative electrode member, whereby a number of the electro-deposited metal patterns are continuously exfoliated from the surface of the negative electrode member exposed in the air, in the shape corresponding to the plurality of annular contact windows according to rotation of the negative electrode member at a state where power has been applied, to thereby obtain a number of metal fibers.

[0010] Preferably, the negative electrode member is formed of a cylindrical body which is rotatably supported, and the positive electrode member is formed of a hemisphere type of a shell which maintains a certain distance from the negative electrode member.

[0011] Also, the negative electrode member may be formed of an endless loop-shaped belt which is rotatably supported, and the positive electrode member may be formed of a flat plate shape which maintains a certain distance from the lower surface of the negative electrode member which is soaked in an electrolyte.

[0012] Preferably, the metal fiber fabrication apparatus further comprises an electrolyte circulation unit for circulating an electrolyte to maintain a uniform composition of the electrolyte. In this case, the electrolyte circulation unit comprises a circulation tube withdrawn from a lower portion of the electrolyzer in which a leading-end nozzle is positioned in a space between the negative electrode member and the positive electrode member, a filter installed in the circulation tube, for removing a foreign matter, and a circulation pump for circulating the electrolyte.

[0013] According to another aspect of the present invention, there is also provided a metal fiber fabrication apparatus for fabricating metal fibers discontinuously, the metal fiber fabrication apparatus comprising: an electrolyzer containing an electrolyte necessary for electro-deposition of the metal fibers to be aimed; an insoluble positive electrode member installed in the electrolyte and connected to a negative terminal of a power supply; a negative electrode member which is connected to a positive terminal of the power supply, and soaked in the electrolyte at a certain distance from the positive electrode member, in which an electro-deposition surface is precisely ground; and a plurality of non-conductive patterns installed on the outer circumferential surface of the negative electrode member, which form a plurality of annular contact windows which are parallel with each other, whereby a number of the electro-deposited metal patterns are continuously exfoliated from the surface of the negative electrode member, in the shape corresponding to the plurality of annular contact windows at a state where power has been applied, to thereby obtain a number of metal fibers.

[0014] According to still another aspect of the present invention, there is also provided a metal fiber fabrication method for fabricating metal fibers continuously by using electroforming, the metal fiber fabrication method comprising the steps of: filling an electrolyzer with an electrolyte necessary for electro-deposition of the metal fibers to be aimed; applying DC (direct-current) power between an insoluble positive electrode member installed in the electrolyte and a negative electrode member which is partially soaked in the electrolyte and rotatably installed at a certain distance from the positive electrode member, and on the precisely ground outer circumferential surface of which a plurality of non-conductive patterns which form a plurality of annular contact windows which are parallel with each other and whose rotational directions are consistent with the rotational direction of the negative electrode member are formed, to thereby electro-deposit metal to be aimed on the outer circumferential surface of the negative electrode member through the plurality of annular contact windows, and rotate the negative electrode member; and continuously exfoliating a number of the electro-deposited metal patterns from the surface of the negative electrode member exposed in the air, in the shape corresponding to the plurality of annular contact windows according to rotation of the negative electrode member at a state to thereby obtain metal fibers.

[0015] According to yet another aspect of the present invention, there is also provided a metal fiber fabrication method for fabricating metal fibers discontinuously by using electroforming, the metal fiber fabrication method comprising the steps of: filling an electrolyzer with an electrolyte necessary for electro-deposition of the metal fibers to be aimed; applying DC (direct-current) power between an insoluble and plate-shaped positive electrode member installed in the electrolyte and a plate-

shaped negative electrode member which is soaked in the electrolyte at a certain distance from the positive electrode member, and on the precisely ground outer circumferential surface of which a plurality of non-conductive patterns which form a plurality of annular contact windows which are parallel with each other, to thereby electro-deposit metal fibers to be aimed on the outer circumferential surface of the negative electrode member through the plurality of annular contact windows; and exposing the negative electrode member in the air, in the shape corresponding to the plurality of annular contact windows, thereby exfoliating a number of the electro-deposited metal patterns as metal fibers.

[0016] Preferably, the metal fiber fabrication method further comprises the steps of draining and filtering the electrolyte in the lower portion of the electrolyzer so that composition of the electrolyte is uniformly maintained, and filling the filtered electrolyte into an opposing surface between the negative electrode member and the positive electrode member.

[0017] As described above, differently from the conventional art, the present invention can fabricate metal fibers through a continuous process without limiting length of the metal fiber. Also, differently from the existing method which adopts an existing extruding or drawing method, or an existing fast cooling solidification method, the present invention employs an electroforming method using electroplating, to thereby remarkably save a manufacturing cost through a simplified process and produce metal fibers by use of simple equipment in a narrow place.

[0018] Further, the present invention can easily fabricate metal fibers in a desired size, since it facilitates to adjust width and thickness as well as length of metal fibers within the range of from several micrometers to several millimeters, and can fabricate metal fibers with respect to various alloys and all kinds of metal which can be used in an existing plating process, as well as pure metal.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above objects and other advantages of the present invention will become more apparent by describing the preferred embodiments thereof in more detail with reference to the accompanying drawings in which:

FIG. 1 is a schematic diagram showing an apparatus for fabricating continuous metal fibers according to a first embodiment of the present invention, using a drum-shaped negative electrode;

FIG. 2 is a schematic diagram showing an apparatus for fabricating continuous metal fibers according to a second embodiment of the present invention, using a belt-shaped negative electrode;

FIG. 3 is a schematic diagram showing an apparatus for fabricating discontinuous metal fibers ac-

cording to a third embodiment of the present invention, using a batch-shaped negative electrode; FIGs. 4A and 4B are a cross-sectional view and a front view showing a pattern on the surface of the negative electrode member according to the first through third embodiments, respectively; FIG. 5 is a graphical view illustrating a result of a tensile test of a sample piece fabricated according to the present invention; and FIG. 6 shows a microscopic picture of metal fibers fabricated according to the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0020]** Preferred embodiments of the present invention will be described with reference to the accompanying drawings.

**[0021]** First, referring to FIG. 1, an apparatus for fabricating continuous metal fibers according to a first embodiment of the present invention includes an electrolyzer 10, an insoluble positive electrode member 2, and a negative electrode member 1. The electrolyzer 10 contains an electrolyte 3 necessary for electro-deposition of metal fibers 9 to be aimed. The insoluble positive electrode member 2 is installed in the electrolyte 3 in a hemisphere-shaped shell. The negative electrode member 1 is a cylindrical body opposing the positive electrode member 2 at a certain distance from the positive electrode member 2. The rotational shaft between both ends of the negative electrode member 1 is rotatably supported. The outer circumferential surface of the cylindrical body is precisely ground or polished. Then, a plurality of non-conductive patterns are fixedly installed on the outer circumferential surface of the negative electrode member 1, to thereby form a plurality of annular contact windows which are parallel with each other with respect to a circumferential direction.

**[0022]** The negative electrode member 1 is preferably formed of a hollow body such as a pipe, and is made of a conductive material such as stainless steel which does not react upon an electrolyte. The positive electrode member 2 is made of an insoluble material in which  $\text{IrO}_2$  is coated on a Ti steel plate.

**[0023]** Also, the negative electrode member will be described below in detail with reference to FIGs. 4A and 4B. As shown in FIGs. 4A and 4B, a number of annular contact windows 15a are formed between a number of non-conductive patterns 14, on the surface of the negative electrode member 15. In this case, the width and depth of each annular contact window 15a with respect to the negative electrode member 15 are determined in correspondence to the width and thickness of metal fibers 9 to be fabricated. It is preferable that the non-conductive patterns 14 are a high-intensity material as thermosetting resin.

**[0024]** Preferably, the metal fiber fabrication apparatus further includes a current supply unit 4 which uniformly supplies the positive electrode member 2 and the

negative electrode member 1 with DC current necessary for electroplating, an electrolyte circulation pump 5 for circulating an electrolyte 3 to maintain a uniform composition of the electrolyte 3 and remove hydrogen generated from the negative electrode, and a filter 6 for removing a foreign matter which can be generated during continuous fabrication of metal fibers.

**[0025]** In this case, it is preferable that the filtered electrolyte 3 which circulates into the electrolyzer 10 via the filter 6, the circulation pump 5 and a circulation tube 8a from the lower portion of the electrolyzer 10 is supplied through nozzles 8 which is positioned in a space between the negative electrode member 1 and the positive electrode member 2, for the purpose of uniform stirring.

**[0026]** Also, the electrolyte stirring unit including the filter 6, the circulation pump 5 and the circulation tube 8a includes a paddle whose both ends are supported on the rotational shaft of the negative electrode member 1, and which rotates along the circumference or moves along the axial direction.

**[0027]** In the metal fiber fabrication apparatus as constructed above according to the first embodiment of the present invention, an electrolyte 3 necessary for electro-deposition of the metal fibers to be aimed is filled into an electrolyzer. Then, DC (direct-current) power is applied between a negative electrode member which is partially soaked in the electrolyte 3 and rotates and a positive electrode member 2 which is completely soaked in the electrolyte 3, in which both the negative and positive electrodes oppose each other with a predetermined distance therebetween. Accordingly, electro-deposition is made on the surface of the negative electrode member 1 via a plurality of annular contact windows 15a in correspondence to the pattern of the contact windows 15a.

**[0028]** Here, if an adhesive tape is attached on the surface of the negative electrode member electro-deposited via the contact windows according to rotation of the negative electrode member 1 and exposed in the air, and then separated therefrom, the metal electro-deposited on the surface of the negative electrode member 1 is exfoliated and obtained as a plurality of metal fibers 9 since the surface of the negative electrode member 1 has been polished. Also, according to the rotation of the negative electrode member 1, the metal fibers 9 are continuously obtained in correspondence to the patterns of the annular contact windows 15a.

**[0029]** Thus, if the metal fibers 9 which are continuously produced according to rotation of the negative electrode member 1 are made to be wound on a reel 7 at the state where the exfoliated metal fibers 9 are fixed on the reel 7, a uniform composition and a uniform size of metal fibers can be obtained in a user's desired length.

**[0030]** The metal fibers 9 which can be fabricated according to the above-described fabrication method can be made of any kinds of metal which can be electroplat-

ed. The metal fibers can be obtained within the range from several micrometers to several millimeters according to establishment of the size of the annular contact windows 15a.

**[0031]** For example, in a case that an alloy fiber of Fe-80wt%Ni is fabricated according to a first embodiment of the present invention, a drum-shaped negative electrode member 1 is made to rotate by using an electrolyte 3 including a solution of nickel chloride and sulfuric salt as main components, a uniform composition of an alloy fiber of Fe-80wt%Ni can be continuously fabricated. Here, it is preferable that a current density is supplied within the range of from 3 to 40A/cm<sup>2</sup>, a flow rate of a pump which stirs the electrolyte 3 is within the range of from 30 to 200cm/sec, a hydrogen ion concentration index pH of the electrolyte is within the range of from 1 to 5, and a temperature of the electrolyte is within the range of from the normal temperature to 50°C.

**[0032]** FIG. 2 shows an apparatus for fabricating continuous metal fibers according to a second embodiment of the present invention, using a belt-shaped negative electrode.

**[0033]** The second embodiment of the present invention is configured to have the same components as those of the first embodiment, except that a negative electrode member 11 is of an endless belt-shaped structure which is rotatably supported and a positive electrode member 2a is of a flat plate-shaped structure to maintain a certain distance from the negative electrode member 11.

**[0034]** Thus, in the case of the second embodiment of the present invention, the same elements as those of the first embodiment are assigned with the same reference numerals as those of the first embodiment. The detailed description thereof will be omitted with respect to the same elements. In the second embodiment, a plurality of non-conductive patterns 14 are attached on the surface of the negative electrode member 11, as in the case of the first embodiment.

**[0035]** Thus, in the case of the second embodiment, if belt driving rollers 11a and 11b are rotated, metal fibers 9 corresponding to a plurality of annular contact windows 15a whose rotational directions are consistent with the rotational direction of the negative electrode member 11, are continuously produced and then produced metal fibers 9 are wound on a reel 7 via a guide roller 12.

**[0036]** The metal fibers 9 obtained according to the second embodiment are the same as that of the first embodiment.

**[0037]** FIG. 3 is a schematic diagram showing an apparatus for fabricating discontinuous metal fibers according to a third embodiment of the present invention, using a batch-shaped negative electrode.

**[0038]** As shown in FIG. 3, a negative electrode member 13 and a positive electrode member 2a are opposed to each other and are of a flat plate-shaped structure, respectively.

**[0039]** Except for the structure of the negative electrode member 13, the third embodiment is configured to have the same structure as that of the second embodiment. Thus, in the case of the third embodiment of the present invention, the same elements as those of the second embodiment are assigned with the same reference numerals as those of the second embodiment. The detailed description thereof will be omitted with respect to the same elements. In the third embodiment, a plurality of non-conductive patterns 14 as shown in FIGs. 4A and 4B are attached on the surface of the negative electrode member 11, as in the case of the second embodiment.

**[0040]** In the third embodiment, the negative electrode member 13 is installed in an electrolyte 10 and then an electroplating process is executed. In this case, when electro-deposition is made on the surface of the negative electrode member, a plurality of metal fibers of a uniform length in correspondence to a plurality of contact windows which are parallel with each other which are determined by the non-conductive patterns 14 are obtained without undergoing a cutting process. The above-described third embodiment of the present invention is a batch-shaped metal fiber fabrication method in which the above-described processes are repeated regularly and a metal fiber of a uniform length can be obtained at a certain period.

**[0041]** The metal fiber fabrication method according to the present invention will be described below in more detail with reference to Example 1 and Example 2.

#### Example 1

**[0042]** In Example 1, an alloy fiber of Fe-80wt%Ni has been fabricated using a drum-shaped negative electrode member 1. An electrolyte 3 including a solution of nickel chloride and sulfuric salt as main components is used in order to fabricate an alloy fiber of Fe-80wt%Ni. A uniform composition of an alloy fiber of Fe-80wt%Ni has been continuously fabricated while the drum-shaped negative electrode member 1 is rotated. Here, a current density is 10A/cm<sup>2</sup>, a flow rate of a pump which stirs the electrolyte 3 is 120cm/sec, a hydrogen ion concentration index pH of the electrolyte is 3, and a temperature of the electrolyte is 45°C.

**[0043]** The strength of the metal fibers produced under the above-described conditions is shown in FIG. 5. FIG. 5 is a graphical view illustrating a result of a tensile test of a sample piece fabricated according to the present invention. In general, as is known, a yield strength value and a hardness value of the Fe-80wt%Ni alloy are 97MPa and 60HRB (345MPa), respectively (Metal Handbook, ASM. 9th ed. Vol. 3, p610). In the result of measuring the strength of the Fe-80wt%Ni alloy fiber of the present invention, the yield strength value and the hardness value are 2119MPa and 6170MPa, respectively. From these results, the metal fibers according to the present invention have an excellent me-

chanical performance of about twenty times or so in comparison with the conventional art.

## Example 2

**[0044]** As shown in FIG. 1, a Ni fiber has been fabricated using a drum-shaped negative electrode member 1. In order to fabricate a Ni fiber, an electrolyte 3 including a solution of nickel chloride and sulfuric salt as main components is used. A uniform composition of a metal fiber has been continuously fabricated while the drum-shaped negative electrode member 1 is rotated. Here, a current density is 10A/cm<sup>2</sup>, a flow rate of a pump which stirs the electrolyte 3 is 120cm/sec, a hydrogen ion concentration index pH of the electrolyte is 3, and a temperature of the electrolyte is 45°C.

**[0045]** FIG. 6 shows a microscopic picture of metal fibers fabricated according to the present invention. A microscopic picture of a metal fiber produced under the above-described condition is shown in FIG. 6, in which the thickness of the produced metal fiber of long length has been found uniform.

**[0046]** As described above, differently from the conventional art, the present invention can fabricate metal fibers through a continuous process without limiting length of the metal fiber. Also, differently from the existing method which adopts an existing extruding or drawing method, or an existing fast cooling solidification method, the present invention employs an electroforming method using electroplating, to thereby remarkably save a manufacturing cost through a simplified process and produce metal fibers by use of simple equipment in a narrow place.

**[0047]** Further, the present invention can easily fabricate metal fibers in a desired size, since it facilitates to adjust width and thickness as well as length of metal fibers within the range of from several micrometers to several millimeters, and can fabricate metal fibers with respect to various alloys and all kinds of metal which can be used in an existing plating process, as well as pure metal.

**[0048]** As described above, the present invention has been described with respect to particularly preferred embodiments. However, the present invention is not limited to the above embodiments, and it is possible for one who has an ordinary skill in the art to make various modifications and variations, without departing off the spirit of the present invention.

## Claims

1. A metal fiber fabrication apparatus for fabricating metal fibers continuously, the metal fiber fabrication apparatus comprising:

an electrolyzer containing an electrolyte necessary for electro-deposition of the metal fibers to

be aimed;

an insoluble positive electrode member installed in the electrolyte and connected to a negative terminal of a power supply;

a negative electrode member which is connected to a positive terminal of the power supply, and partially soaked in the electrolyte and rotatably installed at a certain distance from the positive electrode member, in which an electro-deposition surface is precisely ground; and a plurality of non-conductive patterns installed on the outer circumferential surface of the negative electrode member, which form a plurality of annular contact windows which are parallel with each other and whose rotational directions are consistent with that of the negative electrode member,

whereby a number of the electro-deposited metal patterns are continuously exfoliated from the surface of the negative electrode member exposed in the air, in the shape corresponding to the plurality of annular contact windows according to rotation of the negative electrode member at a state where power has been applied, to thereby obtain a number of metal fibers.

2. The metal fiber fabrication apparatus of claim 1, wherein the negative electrode member is formed of a cylindrical body which is rotatably supported, and the positive electrode member is formed of a hemisphere type of a shell which maintains a certain distance from the negative electrode member.
3. The metal fiber fabrication apparatus of claim 1, wherein the negative electrode member may be formed of an endless loop-shaped belt which is rotatably supported, and the positive electrode member may be formed of a flat plate shape which maintains a certain distance from the lower surface of the negative electrode member which is soaked in an electrolyte.
4. The metal fiber fabrication apparatus of claim 1, wherein the negative electrode member is made of a conductive material which does not react upon the electrolyte and the positive electrode member is made of an insoluble material where IrO<sub>2</sub> is coated on a Ti steel plate.
5. The metal fiber fabrication apparatus of claim 1, wherein the respective width and depth of the annular contact windows formed on the surface of the negative electrode member by the non-conductive patterns are determined in correspondence to the width and thickness of metal fibers to be produced.
6. The metal fiber fabrication apparatus of any one of

claims 1 to 5, further comprising an electrolyte circulation unit for circulating an electrolyte to maintain a uniform composition of the electrolyte.

7. The metal fiber fabrication apparatus of claim 6, wherein the electrolyte circulation unit comprises a circulation tube withdrawn from a lower portion of the electrolyzer in which a leading-end nozzle is positioned in a space between the negative electrode member and the positive electrode member, a filter installed in the circulation tube, for removing a foreign matter, and a circulation pump for circulating the electrolyte.

8. A metal fiber fabrication apparatus for fabricating metal fibers discontinuously, the metal fiber fabrication apparatus comprising:

an electrolyzer containing an electrolyte necessary for electro-deposition of the metal fibers to be aimed;

an insoluble and plate-shaped positive electrode member installed in the electrolyte and connected to a negative terminal of a power supply;

a plate-shaped negative electrode member which is connected to a positive terminal of the power supply, and soaked in the electrolyte at a certain distance from the positive electrode member, in which an electro-deposition surface is precisely ground; and

a plurality of non-conductive patterns installed on the outer circumferential surface of the negative electrode member, which form a plurality of annular contact windows which are parallel with each other,

whereby a number of the electro-deposited metal patterns are discontinuously exfoliated from the surface of the negative electrode member, in the shape corresponding to the plurality of annular contact windows at a state where power has been applied, to thereby obtain a number of metal fibers.

9. A metal fiber fabrication method for fabricating metal fibers continuously by using electroforming, the metal fiber fabrication method comprising the steps of:

filling an electrolyzer with an electrolyte necessary for electro-deposition of the metal fibers to be aimed;

applying DC (direct-current) power between an insoluble positive electrode member installed in the electrolyte and a negative electrode member which is partially soaked in the electrolyte and rotatably installed at a certain distance from the positive electrode member, and on the

precisely ground outer circumferential surface of which a plurality of non-conductive patterns which form a plurality of annular contact windows which are parallel with each other and whose rotational directions are consistent with the rotational direction of the negative electrode member are formed, to thereby electro-deposit metal to be aimed on the outer circumferential surface of the negative electrode member through the plurality of annular contact windows, and rotate the negative electrode member; and

continuously exfoliating a number of the electro-deposited metal patterns from the surface of the negative electrode member exposed in the air, in the shape corresponding to the plurality of annular contact windows according to rotation of the negative electrode member at a state to thereby obtain metal fibers.

10. A metal fiber fabrication method for fabricating metal fibers discontinuously by using electroforming, the metal fiber fabrication method comprising the steps of:

filling an electrolyzer with an electrolyte necessary for electro-deposition of the metal fibers to be aimed;

applying DC (direct-current) power between an insoluble and plate-shaped positive electrode member installed in the electrolyte and a plate-shaped negative electrode member which is soaked in the electrolyte at a certain distance from the positive electrode member, and on the precisely ground outer circumferential surface of which a plurality of non-conductive patterns which form a plurality of annular contact windows which are parallel with each other, to thereby electro-deposit metal fibers to be aimed on the outer circumferential surface of the negative electrode member through the plurality of annular contact windows; and

exposing the negative electrode member in the air, in the shape corresponding to the plurality of annular contact windows, thereby exfoliating a number of the electro-deposited metal patterns as metal fibers.

11. The metal fiber fabrication method of claim 9 or 10, further comprising the steps of draining and filtering the electrolyte in the lower portion of the electrolyzer so that composition of the electrolyte is uniformly maintained, and filling the filtered electrolyte into an opposing surface between the negative electrode member and the positive electrode member.

FIG. 1

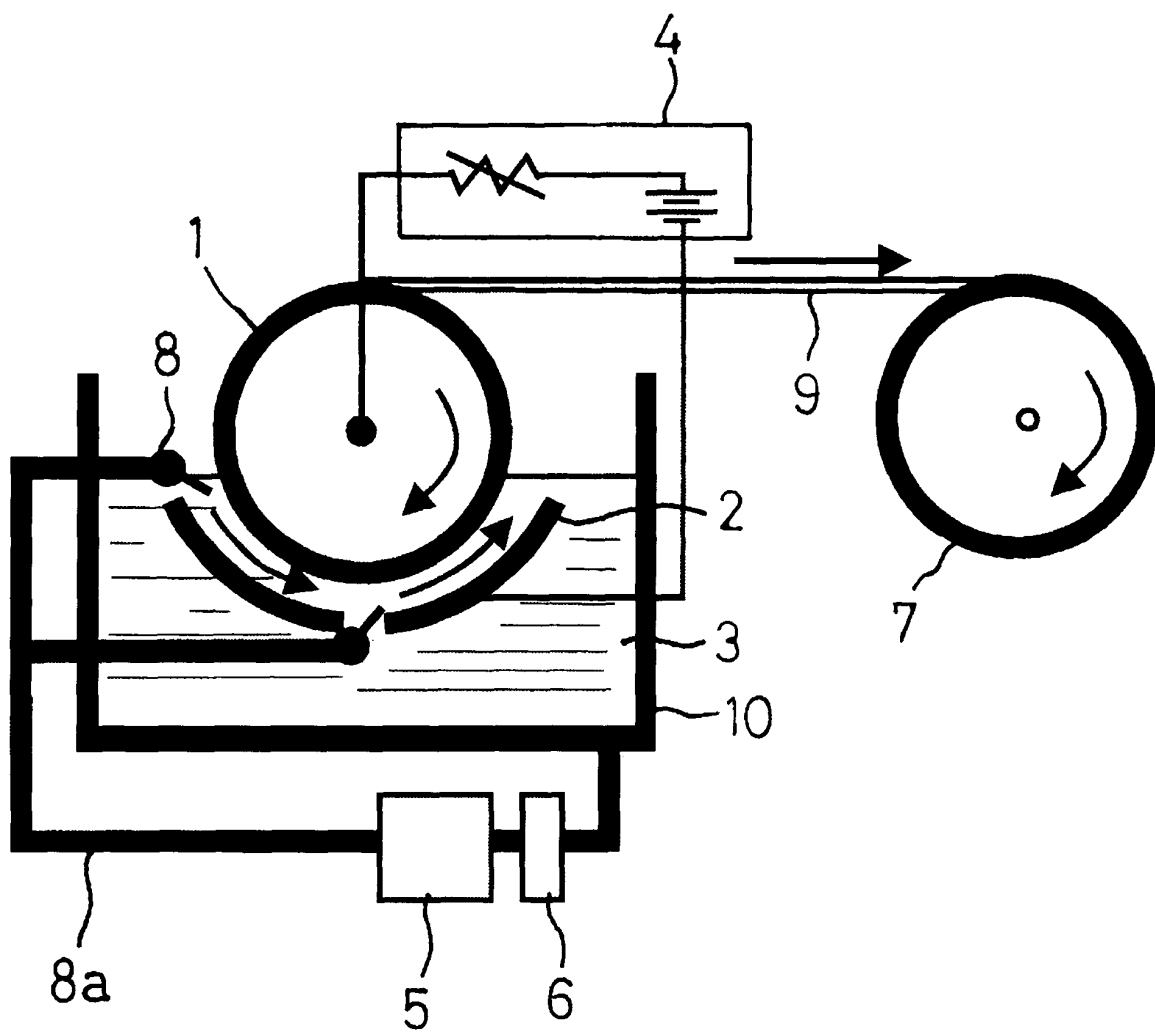


FIG. 2

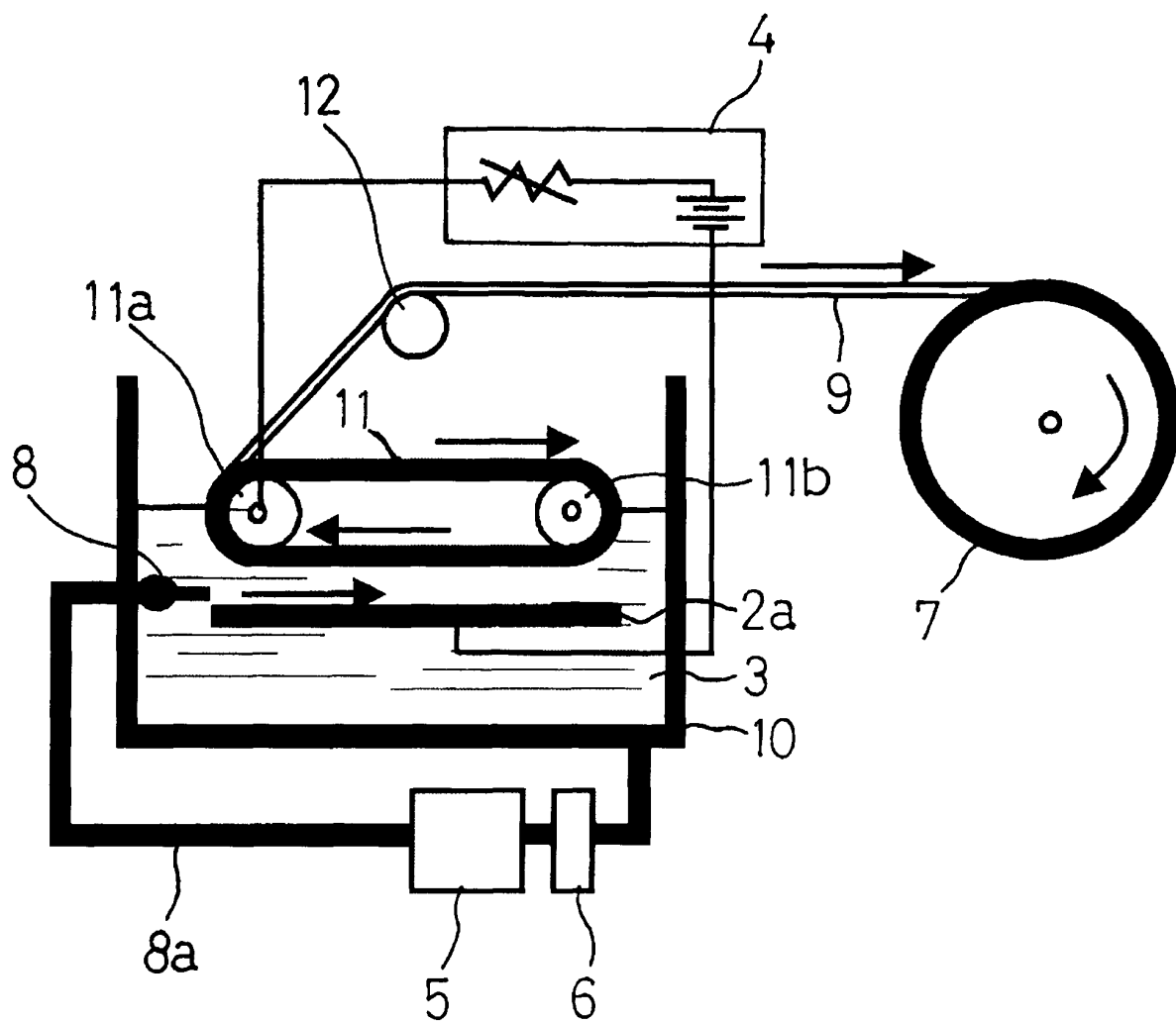
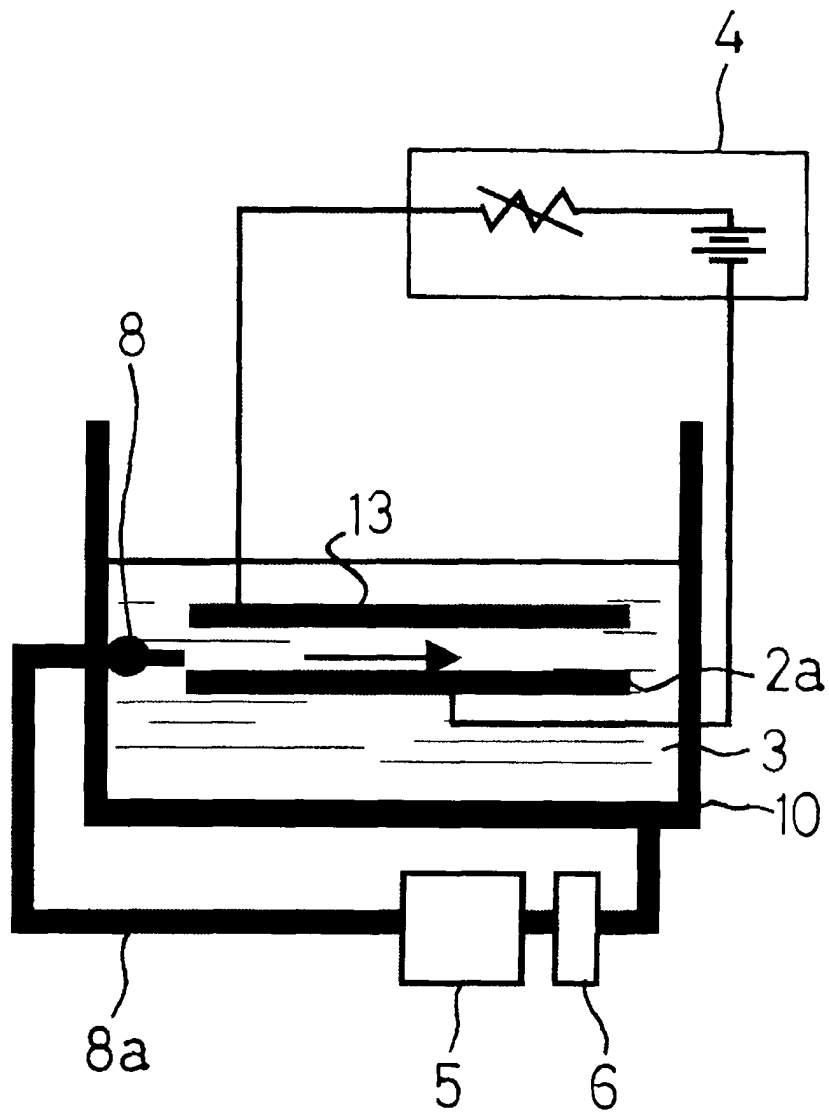
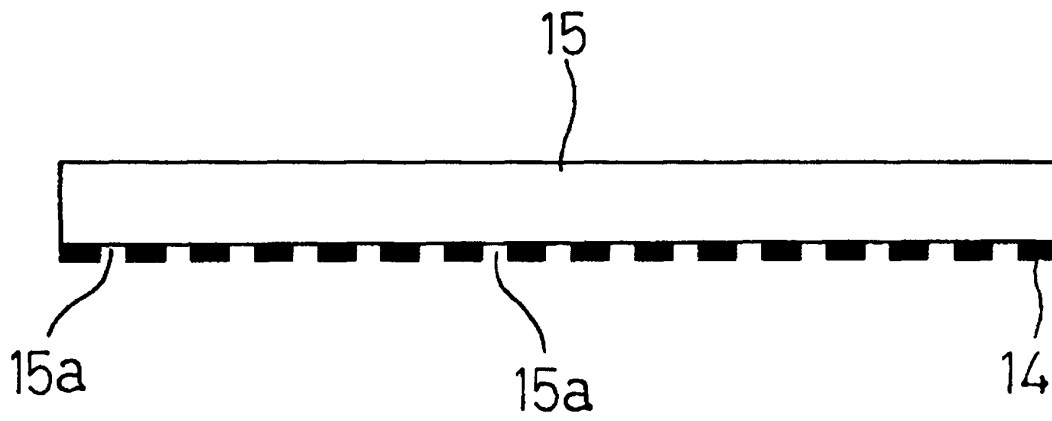


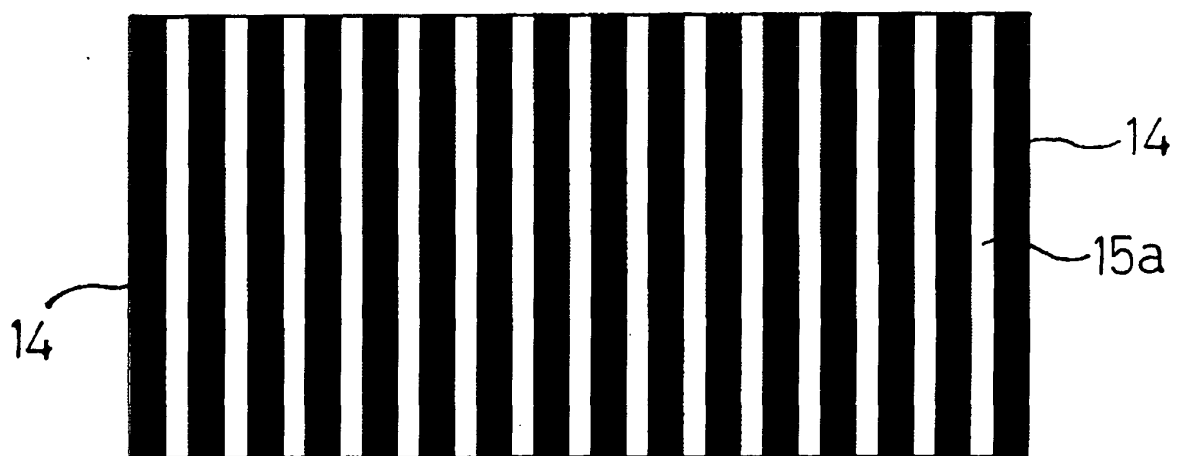
FIG. 3



**FIG. 4a**



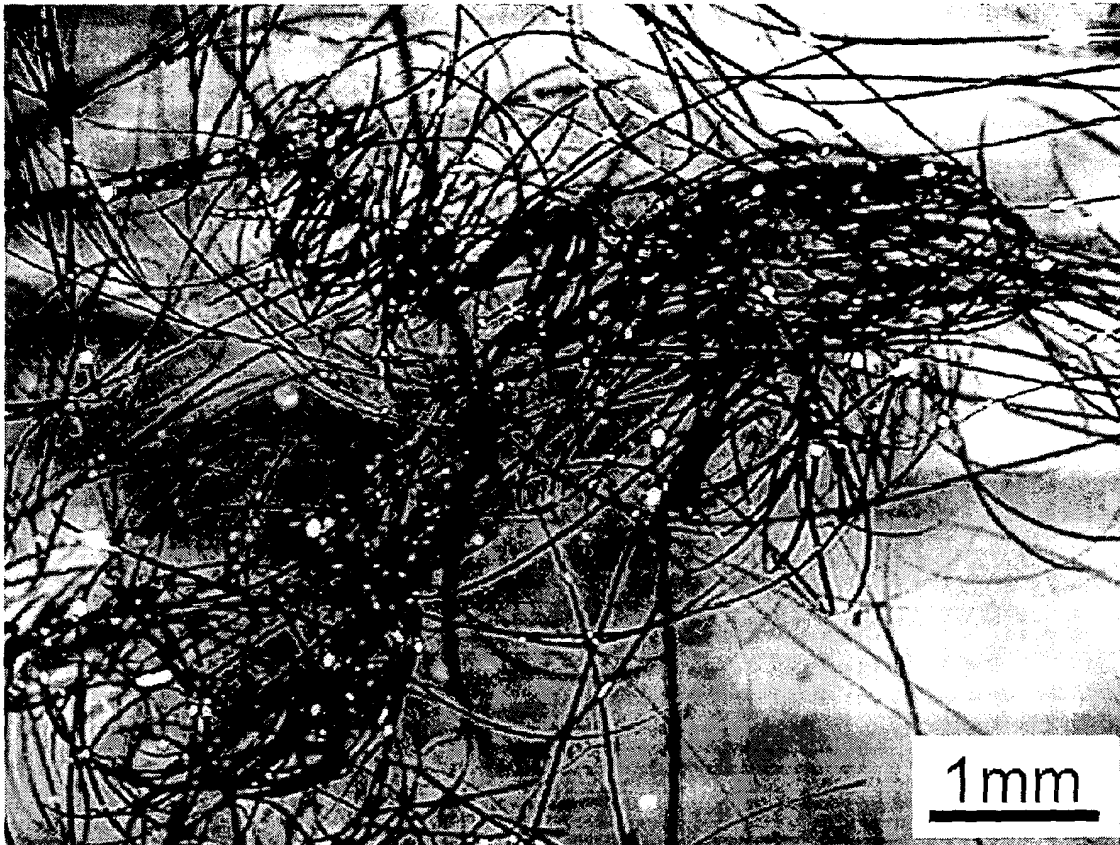
**FIG. 4b**



**FIG. 5**



**FIG. 6**





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 03 00 3412

| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 18 00 285 A (BRITISH COPPER REFINERS LTD) 3 July 1969 (1969-07-03)<br>* page 3, paragraph 2 *<br>* page 4 *<br>* page 7, paragraph 2 - page 8, paragraph 1 *<br>* page 9, paragraph 3 - page 10, paragraph 1 * | 1-3,6,9                                          | C25D1/04                                     |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * figure 1 *                                                                                                                                                                                                      | 11                                               |                                              |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | GB 1 350 758 A (DAWKINS J C F)<br>24 April 1974 (1974-04-24)                                                                                                                                                      | 1,5,8-10                                         |                                              |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * page 2, line 5-30,41-49,71,80,116 - page 3, line 39 *<br>* figures *                                                                                                                                            | 2                                                |                                              |
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European Patent  
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| X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                                          |                                                                                                                                                                                                                                                                              |                                              |

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