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54 Method for forming a metal sieve material, device for performing said method and metal sieve material formed.

57 In a method for forming a sieve material a base sieve material is connected as a cathode in an electroplating bath; said bath contains an amount of a compound having properties of a second class brightener and during electrodeposition a flow of liquid is maintained through the perforations of the base sieve material.

A thin deposit is allowed to form; said deposit is removed from the base sieve and thickened under essentially the same conditions in a further electroplating step. The thickened deposit has perforations of essentially the same size as the perforations in the base sieve material.

The method may be carried out continuously. The invention concerns also a device for carrying out the method according to the invention.

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Method for forming a metal sieve material, device for performing said method and metal sieve material formed

BACKGROUND OF THE INVENTION

The invention relates to a method for forming a metal sieve material, in which a metal layer is deposited by electroplating on a separately formed base sieve material which is provided with a separating layer and the deposited metal layer is removed, a liquid flow through the perforations of the base sieve material being maintained during at least a part of the electroplating treatment and a compound being present in the electroplating bath which possesses at least properties of a second class brightener.

Such a method is known from the Dutch Patent Application 8005427. Said Patent Application describes a method for manufacturing a sieve material by forming a metal precipitate on a base sieve material by electroplating, a liquid being allowed to flow through the openings of the base sieve material during the precipitation of the metal to ensure that the metal growth takes place essentially perpendicularly to the outside surface of the base sieve material, as a result of which the openings of the final sieve material are essentially equally as large as the openings of the base sieve material.

Advantageously, an organic compound which possesses the properties of a second class brightener is included in the bath liquid while said method is being carried out, in which connection butynediol and/or ethylene cyanohydrin may be mentioned as examples; in general, an organic compound which contains at least one unsaturated bond which does not belong to a $\text{C}=\text{C}-\text{O}$ group.

This known method has the disadvantage that if the metal layer to be removed must have a large thickness, the base sieve material must be correspondingly rigid because otherwise the base material may be considerably damaged during the removal of the second deposit.

In addition there is the disadvantage that, if the base sieve material has to be used several times, to achieve a considerable thickness of the metal layer to be removed, the base sieve material is kept "occupied" for the whole electroplating treatment so that to achieve a considerable production, the quantity of base sieve material which is in circulation may be very large.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a solution for said disadvantages.

This object is achieved by the method of the said type according to the invention, it being characterized in that the metal layer removed is subjected to further electroplating treatment under essentially the same conditions as during its formation and metal is deposited to form a metal layer until the desired thickness is achieved.

The method according to the invention therefore offers the possibility of removing a metal layer deposited on the base sieve material while the latter is still very thin and to subject said removed sieve material, whose perforations are essentially equally as large as the perforations in the base material, and to subject it to a further electroplating treatment, metal being deposited on the material until the desired final thickness has been achieved.

During the last-named metal deposition process, the metal layer removed is connected as cathode in an electroplating bath and a liquid flow is maintained through the perforations of the metal removed in order to ensure in this step that the perforations of the sieve material keep essentially the same cross-section as the cross-section which was present in the base sieve material.

In particular, during the deposition of metal on the base sieve material and also during the deposition of metal on the metal layer removed from the base sieve material a pulsating current may be used.

By using said pulsating current, a regulation of the so-called growth ratio of the deposits may be ensured assuming a constant composition of the electroplating bath; by a suitable choice of the pulse parameters, a deposit of the desired geometrical form may be achieved.

The above-named method in which a pulsating current is used during the growth is described in the Dutch Patent Application no. 8105150.

According to the invention, after the final thickness of the formed sieve material has been achieved, a wear-resistant and/or corrosion-resistant coating is expediently applied thereto.

Such a coating may, for example, consist of an electrophoretically deposited plastic-material layer, an inorganic layer, such as quartz or titanium nitride, deposited by cathode sputtering, or of a chromium or tin/nickel layer deposited by electroplating.

In certain cases, the mechanical properties of the sieve material formed may be still further improved by subjecting the sieve material to a heat treatment at a temperature of up to 300°C for 0.5 to 5 hours; such a treatment may ensure the removal of in-built stress and the prevention of brittleness. If desired, a protective gas such as nitrogen is used during the treatment.

Very advantageously, the method according to the invention is carried out continuously.

By this is meant that the thin metal deposit formed on a suitable base sieve material may be removed continuously and may be passed as a web through the various subsequent electroplating baths which, for example, may be formed by a bath of the same composition as the bath with which the first deposit was formed on the base sieve material and a bath from which, for example, a corrosion-and/or wear-resistant chromium layer is deposited. Many kinds of metals or metal alloys may be considered for forming the metal deposit on the base sieve material, such as nickel, copper and iron; however, nickel is very suitable for many types of applications.

If the method according to the invention is carried out in a continuous manner, the base sieve material is very advantageously embodied in the form of a cylinder, a part of which is immersed in an electroplating bath and in which case an anode material is present in said bath which is arranged in a manner such that a gap is present between the surface of the base sieve material and the surface of the anode material.

In an advantageous embodiment of such a continuous method, liquid flow will take place through the perforations of the cylinder-shaped base sieve material, flowing from the interior of the cylinder in the direction of the anode.

The base sieve material may be manufactured in a classical manner by forming a metal deposit on a mandrel consisting of a network-like pattern of electrically conducting bars and electrically insulating areas included between the latter and removing said metal deposit to act as the base sieve material.

The base sieve material may, however, also be manufactured in another manner, consideration being given to starting from a completely continuous material in which a pattern of perforations of the desired form and size is provided by means of mechanical, radiation beam or etching techniques. The initial material may consist of metal, plastic material or glass; in the case of plastic material or glass, an electrically conducting layer has additionally to be formed after the formation of the perforation pattern so that it is possible to connect the base sieve material formed as a cathode in an

electroplating bath. To deposit electrically conducting layers on insulating materials, many techniques are known to those skilled in the art, such as evaporation, electroless metallization etc.

Advantageously, the starting material is formed by a thin-wall, seamless nickel cylinder in which a pattern of perforations of desired size, form and distribution is provided by means of the above-named techniques.

If clamped and connected as cathode, such a cylinder-shaped base sieve material is exceptionally suitable for carrying out the method according to the invention in a continuous manner.

To remove a metal deposit formed on the base sieve material the application of a separating layer is of exceptional importance. Such separating layers are known per se; to form a separating layer to be used once, use is often made of agents such as beeswax.

To carry out the method on a large scale, such a temporary separating layer is not suitable.

The method according to the invention proceeds with good results if the base sieve material is covered with a separating layer with permanent release properties. Such a material is formed, for example, by chromium.

The Applicant has now found that an excellent separating layer is also obtained if, after it has been formed, the base sieve material is subjected to an oxidation treatment to form an oxidized surface layer of a nature such that the current distribution is not, or virtually not, influenced thereby, while a strong adhesion between the metal deposit and the base sieve material is nevertheless prevented. Such an oxidation may be carried out with an acid potassium dichromate or a potassium permanganate solution. The oxidation film is sufficiently stable to make it possible to form a large number of removable deposits without renewal or replenishment.

The invention is also embodied in a device for carrying out the method according to the invention as is described above and this is characterized in that it comprises the baths needed for the various electroplating treatments, means for connecting the base sieve material as cathode, means for connecting the removed metal deposit as cathode, liquid flow regulating means and/or current-pulsing means, as well as means for detaching the deposit formed on the base sieve material and the guiding thereof through the various electroplating baths.

Finally, the invention relates to a formed metal sieve material obtained by using the method of the invention which is characterized in that the dimensions of the perforations in the sieve material essentially correspond to the dimensions of the perforations in the base sieve material.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be explained by means of the drawing, in which:

Figure 1a to d diagrammatically shows the steps needed to carry out the method of the invention.

Figure 2 represents a section through a bar of a sieve material according to the invention in one of the possible final forms.

Figure 3a to i-incl. provides a representation of some of the possible end forms of the sieve material according to the invention, and

Figure 4 provides a diagrammatic representation in section of a device for carrying out the method according to the invention continuously.

In Figure 1, the reference numeral 1 shows a base sieve material which, for example, consists of nickel material having a thickness of approx. 50 μ in which a perforation pattern with perforations 4 has been provided by means of the laser beam technique. Figure 1b indicates that a deposit 2 is formed on the base sieve material 1, a liquid flow as indicated by the arrows being maintained through the openings 4 during at least a part of the growth process; the metal deposit 2 having approximately the same thickness as the base sieve material.

Figure 1c indicates that the metal deposit 2 is removed from the base sieve material, while Figure 1d indicates that a metal deposit 3 is formed on the removed metal deposit 2, a liquid flow also being maintained through the perforations of the removed metal deposit 2 during at least a part of the growth process. Deposit 3 in this case is about equal in thickness to deposit 2. Of course the ratio between the thicknesses of the deposits 2 and 3 to the thickness of the base material may be chosen at will.

Instead of using liquid flow, the use of a pulsed electric current may also be chosen during the growth process optionally in combination with a liquid flow. In all cases, the bath liquid will advantageously contain an organic compound which promotes the growth of metal perpendicularly on the outside surface of the sieve material, examples of such compounds which may be named being ethylene cyanohydrin and butynediol.

In Figure 2 reference numeral 2 again indicates the metal deposit which has been removed from the base sieve material 1. As in Figure 1d, a fresh metal layer 3 has been deposited on said metal deposit 2, care being taken, through bath composition and growth conditions, that the cross-section of the metal grown is not larger, or virtually not larger, than the original cross-section of the bars of the base sieve material.

Finally a corrosion-and/or wear-resistant layer 4 has been applied over the assembly of metal layer 2 and metal layer 3 and this may, for example, consist of chromium or tin/nickel, but may also be formed from other wear-resistant and/or corrosion-resistant materials known in the art.

In Figure 3a to i, a number of possible final forms of metal sieve materials is shown such as those which can be obtained by using the method according to the invention. The invention is not, however, limited to said forms.

Figure 4 shows diagrammatically an equipment for carrying out the method according to the invention continuously.

5 Indicates, for example, a nickel bath in which is present a suitable quantity of butynediol, in which a base sieve material is rotatably mounted in the form of a cylinder 7 and a stationary anode 6 is present, and in which a liquid flow is maintained during at least a part of the growth process with flow from the cathode to the anode and indicated by the arrows. By setting the cathode current density and rotation speed of the cathode respectively, it is possible to achieve the result that, after completion of the passage through the immersion path, a deposit has formed on the base sieve material which is sufficiently thick to be removed. Once the process of forming and removal has been started, the removed material 8 will be passed by means of guide rollers 13 to subsequent baths such as a so-called thickening bath 9 in which there is an anode 10 and in which liquid flow through the material connected as cathode also takes place in the direction of the anode 10 (indicated by arrows).

If sufficient thickness has been achieved, the material can be further passed, for final treatment, through a bath 11 in which a wear-resistant and/or corrosion-resistant layer is applied by electroplating, after which the completely formed metal sieve material at 14 is finally reeled up.

Of course, subsequent to bath 9 and prior to bath 11 yet one or more baths identical with bath 9 can be inserted if, because of electroplating considerations, it is attractive to distribute the growth path in such a bath over several baths.

Instead of bath 11, a station may, of course, also be chosen in which a wear-resistant and/or corrosion-resistant layer is applied in another manner. For the last-named method of application, consideration may be given to the electrophoretic deposition of material, deposition by means of electrostatic spraying methods, deposition by means of vacuum techniques such as evaporation and cathode sputtering etc.

Claims

1. Method for forming a metal sieve material in which a metal layer (2) is deposited by electroplating on a separately formed base sieve material (1) which is provided with a separating layer and the deposited metal layer (2) is removed, a liquid flow through the perforations (4) of the base sieve material (1) being maintained during at least a part of the electroplating treatment and a compound being present in the electroplating bath which possesses properties of a second class brightener, characterized in that the removed metal layer (2) is subjected to a further electroplating treatment under essentially the same conditions as during its formation and metal is deposited to form a metal layer (3) until the desired thickness has been achieved.

2. Method according to claim 1, characterized in that a pulsating current is used to deposit the metal layer (2) on the base sieve material (1) and to deposit the metal layer (3) on the removed metal layer (2).

3. Method according to claims 1-2, characterized in that, after the final thickness of the formed sieve material has been achieved, a wear-resistant and/or corrosion-resistant coating (4) is applied thereto.

4. Method according to claim 3, characterized in that the coating (4) is applied by an electroplating method and is chosen from chromium and tin/nickel.

5. Method according to one or more of the Claims 1-4, characterized in that the finished sieve material is subjected to heat treatment at a temperature of 300°C for 0.5-5 hours, if desired, using an inert protective gas.

6. Method according to Claims 1-5, characterized in that the method is carried out continuously.

7. Method according to one or more of the preceding claims, characterized in that the base sieve material (1) is manufactured by providing a starting material with perforations of the desired size and in the desired pattern by means of mechanical, radiation beam or etching techniques and, if necessary, the material perforated in this way is provided with an electrically conducting coating.

8. Method according to claim 7, characterized in that the starting material has been chosen from metal, plastic or glass.

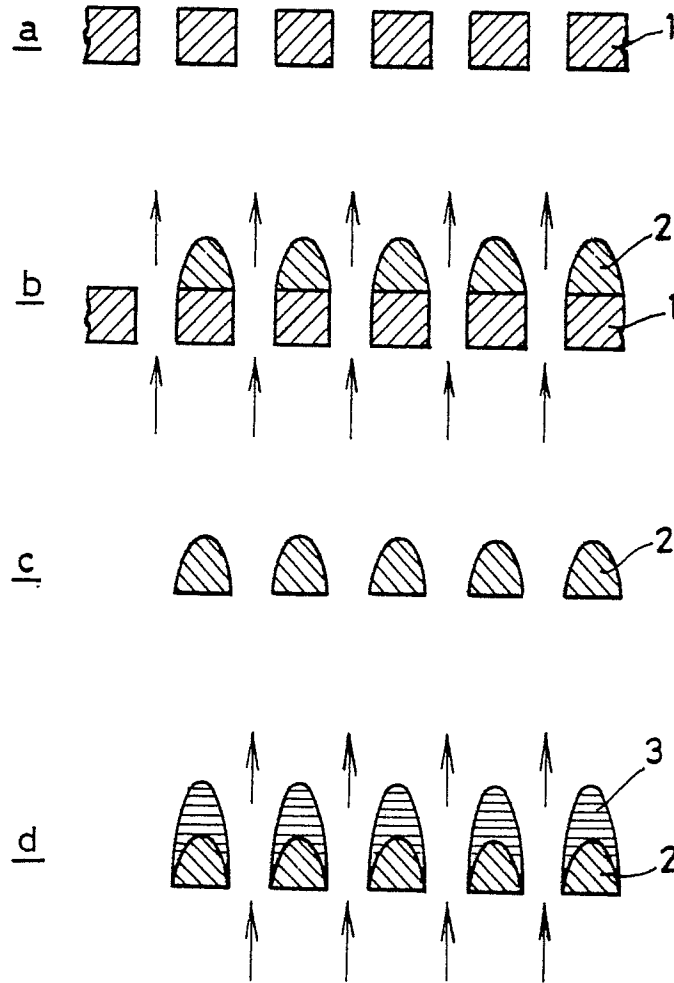
9. Method according to claims 7-8, characterized in that the starting material is formed by a thin-walled seamless nickel cylinder.

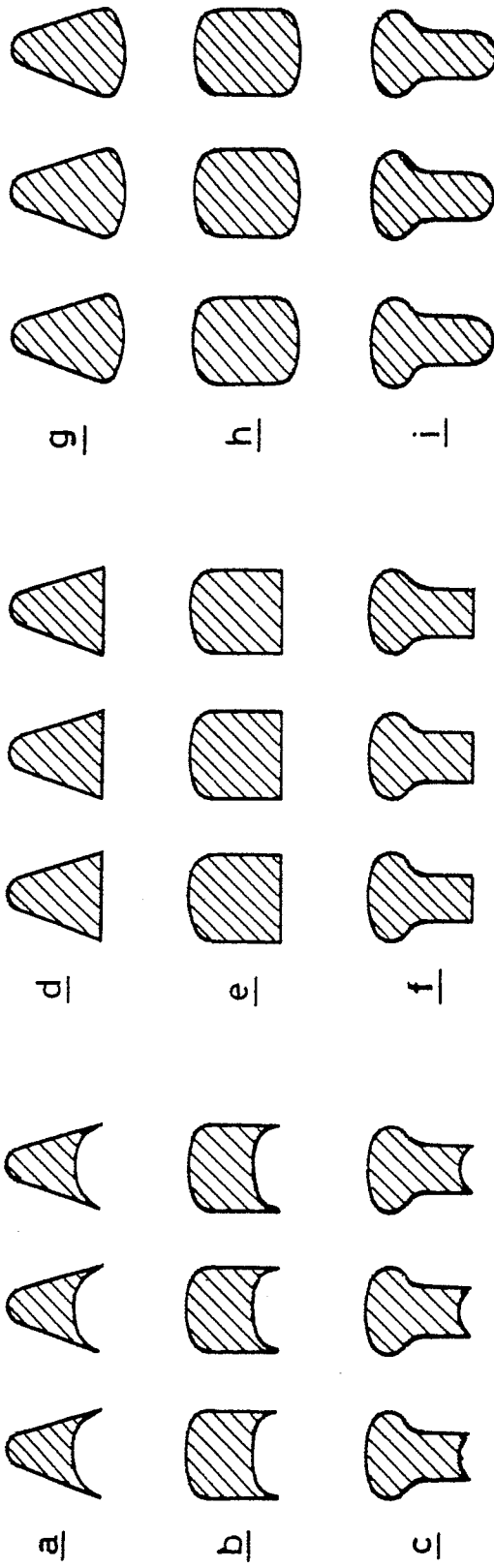
10. Method according to one or more of the preceding claims, characterized in that the separating layer on the base sieve material consists of a material with permanent release properties.

11. Method according to claim 10, characterized in that the separating layer is formed on the base sieve material (1) by oxidation of the base sieve material, for example with an acid potassium dichromate or potassium permanganate solution.

12. Device for carrying out the method according to one or more of the preceding claims, characterized in that it comprises the baths (6, 9, 11) needed for the various electroplating treatments, means for connecting the base sieve material as cathode, means for connecting the removed metal deposit as cathode, liquid flow regulating means and/or current-pulsing means as well as means (13) for detaching the deposit formed on the base sieve material and the passing thereof through the various electroplating baths.

13. Formed metal sieve material obtained by using the method according to one or more of the preceding claims 1-10, characterized in that the dimensions of the perforations in the sieve material essentially correspond to the dimensions of the perforations in the base sieve material (1).

**FIG. 1.**



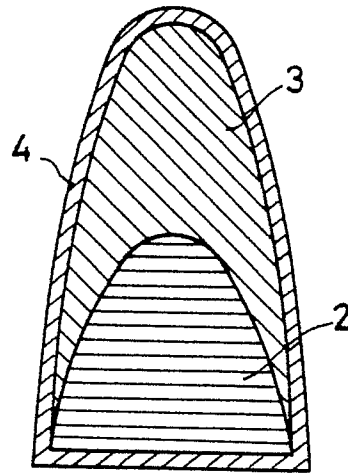


FIG. 2.

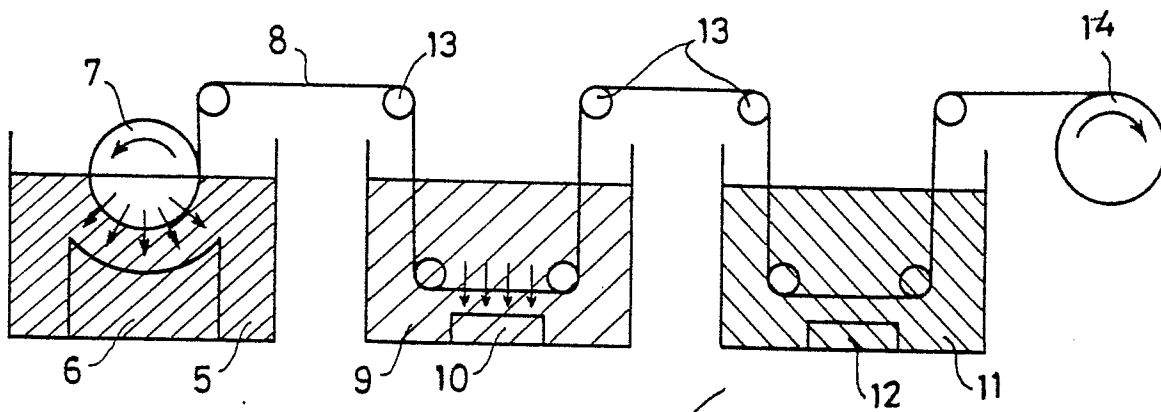


FIG. 4.



EP 87 20 1143

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. 4)
X	EP-A-0 110 463 (STORK SCREENS) * Claims 6,8 *	1,3,4, 8,9,10 ,12,13	C 25 D 1/08
A	DE-B-1 160 258 (STEDING) * Column 3, lines 38-42; column 4, lines 1-5 * -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			C 25 D B 41 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15-10-1987	Examiner NGUYEN THE NGHIEP
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			