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(54) SCREEN ROLLER WITH A PATTERN LAYER IN AN ELECTROPLATED TOP LAYER, AND ROLLER BODY FOR SUCH A ROLLER

RASTERWALZE MIT EINER GEMUSTERTEN SCHICHT IN EINER GALVANISCHEN DECKSCHICHT UND WALZKÖRPER FÜR EINE DERARTIGE WALZE

ROULEAU D'IMPRESSION A TRAMES COMPORTANT UNE COUCHE SUPERIEURE A DESSIN REALISEE PAR DEP T ELECTROLYTIQUE, ET UN CORPS DE ROULEAU POUR LEDIT ROULEAU

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(73) Proprietor: **STORK SCREENS B.V.**
NL-5831 AT Boxmeer (NL)

(72) Inventors:
- **THUIS, Henricus Hermanus Wilhelmus**
  NL-5831 CB Boxmeer (NL)
- **BOSCH, Albert Jan**
  NL-5447 PK Rijkevoort (NL)

(74) Representative: **Barendregt, Frank, Drs. et al**
van Exter Polak & Charlouis B.V.,
P.O. Box 3241
2280 GE Rijswijk (NL)

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Description

The invention relates in the first place to a screen roller at least comprising a cylindrical metal roller body and shaft means, with a pattern of recesses present on the external surface of the roller body.

Screen rollers are generally known (e.g. US-A 4,567,827 ; DE-A 33 36 374) and usually comprise a thick-walled or solid metal cylinder in the surface of which a screen pattern is provided by means of suitable methods which can involve, for example, the use of a knurling roller.

Such a knurling roller is provided with bulges on the external surface; during the formation of a pattern of recesses for a screen roller the knurling roller is pressed with force against the surface of the rotating roller body, while the knurling roller is simultaneously made to undergo a movement which is parallel to the axis of the rotating roller body.

Such known screen rollers are commonly used in methods in which in, for example, a printing process a uniform layer of ink or another coating material has to be applied directly or indirectly by means of an intermediate roller, e.g. of rubber, to a printing roller or to a conveyed web of material.

Through uniform filling of the recesses of the screen roller with ink or another suitable coating medium and bringing the surface of the screen roller directly or indirectly into contact with the printing block to be used or the web to be coated, the ink or the medium is transferred to the printing block or the web to be coated.

Such known rollers (e.g. DE-A 33 36 374), which on account of their manufacture in the pattern-bearing part are often made of copper or have a functional surface layer of copper, have the disadvantage that, as a result of the relatively low hardness of the copper, their shook resistance leaves something to be desired. Although a wear-resistant layer covering the pattern-bearing copper layer is generally present on the surface, the softness of the underlying copper material will be such that in the event of impacts deformation of the surface readily occurs. A deformation of the surface affects the evenness of the coating layer to be applied to a printing block or web, and is therefore a rejection criterion for the screen roller.

During handling of the roller for fitting on or removal from a printing machine, pressing of other rollers or squeegees against the screen roller and uneven places in, for example, a web to be coated can cause the above-mentioned flaws to occur in the surface evenness of the roller. Thorough analysis relating to reasons for rejection of screen rollers has shown that up to about 50% are rejected because of surface damage to the roller body.

In order to provide a solution to the problem described, the screen roller according to the invention as described above is characterized as indicated in the characterizing part of claim 1. In a roller body of copper and/or with a functional surface layer of copper this Cu will be of a hardness which is generally less than 200 HV. By now applying a functional electroplated surface layer of the required thickness and of considerably greater initial hardness because of the deformation process, a roller having a considerably increased resistance to deformation through mechanical influences during handling and use is obtained.

The metal of the roller body is generally selected from copper, steel and aluminium.

The metal selected for the electroplated layer having a greater hardness than the above-mentioned metals for the roller body due to mechanical deformation is nickel, alloyed nickel or doped nickel. Assuming a copper roller body, this body will generally be of a hardness which is equal to a maximum of 200 HV. A plated layer of nickel is, for example, of a hardness of 200 to 650 HV and when used in the roller body according to the invention will show good results; an electroplating with a hardness of min. 250 HV is preferably used. Suitable nickel alloys which can be mentioned are, for example, nickel/cobalt and nickel/ beryllium with hardnesses up to 400 HV.

In particular, a screen roller according to the invention will therefore have a roller body with a hardness up to 200 HV, an electroplated Ni-based layer being connected to the roller body and this electroplated layer being of a hardness of at least 250 HV. Doped nickel is understood to mean a nickel deposition in which non-metallic substances such as inorganic metalloids and organic products or decomposition products thereof are incorporated. Of the metalloids, phosphorus can be mentioned in particular, while a nickel layer which is formed in a bath with organic brighteners, such as disodium benzene-m-disulphonic acid, hydroxypropionitrile or butynediol, contains organic material. The electroplated layer on the metal roller body is advantageously nickel which is doped with 4 to 12 wt.-% phosphorus. Such coats doped with phosphorus can have a hardness of 300 to 700 HV depending on the degree of incorporation in the nickel lattice and the type of additive, which gives the screen roller according to the invention exceptionally good properties.

Nickel containing 11% phosphorus can have a hardness of up to approximately 650 HV; heat treatment makes this hardness rise further to about 950 HV (HV = Vickers hardness).

The thickness of the electroplated layer will depend on the depth of the recesses to be made in this layer; in general, the thickness can lie between 0.1 and 2.5 mm.

More particularly, the electroplated layer will be of a thickness in the range between 0.5 and 1.5 mm. In what is described above the point of departure is an electroplated layer in which a pattern of recesses is present and which is connected to the roller body.

With this construction the electroplated layer can in the first place be formed separately and then connected to the roller body.

The connection to the roller body can be carried out in several ways:

a) by temporarily in a known manner increasing the diameter of a sleeve-shaped metal layer (a so-called sleeve) with an internal diameter which is slightly smaller than the external diameter of the roller body, sliding it round the roller body, and reducing the diameter, so that the sleeve is connected in a clamping manner to the roller body;

b) by connecting the metal sleeve by glueing or soldering to the roller body.

The metal sleeve can, however, also be deposited in an electrodeposition process directly onto the roller body and connected in that way.

In cases a) and b) the pattern of recesses can be produced prior to or following the connection of the metal layer to the roller body.

It has been found particularly advantageous that the initial hardness increases as a result of mechanical deformation of the specific functional layer, in this case nickel with a special doping; this contrasts with the situation in which the functional layer is of copper. Through deformation of an electroplated nickel layer which is on a roller body, a hardness change from, for example, originally 180-300 HV to 300-400 HV (100 p) is found. Deformation can occur, for example, with the use of a knurling roller for the formation of a pattern of recesses. Where we spoke above of an electroplated layer it must be understood that this can be either a single layer or a layer consisting of several component layers. In the case of a layer made up of several component layers all component layers can have the same composition and thickness. The compositions can also be different, and contain one or more of the above-mentioned compositions, while the thicknesses of the component layers can also differ.

In particular, if the electroplated layer is made of nickel which is doped in one of the above-mentioned ways, the roller body can be made of e.g. steel or copper. The doped electroplated nickel layer in that case is of such favourable hardness compared with the base material that the final screen roller has greater shock resistance than was considered achievable before.

Of course, apart from the shock resistance of the roller assembly, wear resistance and/or corrosion resistance of the roller surface are also necessary; the electroplated layer containing the pattern of recesses of the screen roller is for this purpose preferably coated with a thin layer of wear-resistant and/or corrosion-resistant material selected from materials such as: e.g. hard chromium, hard nickel, titanium nitride, titanium carbide, boron nitride, chromium nitride and tungsten carbide, or combinations thereof. Of course, the material of the wear-resistant and/or corrosion-resistant material layer is not restricted to the materials mentioned above; other materials, such as organic layers, for example polytetrafluoroethylene or ceramic layers, cermet, dispersion-hardened layers, can also be applied.

The thin protective top layer of wear-resistant and/or corrosion-resistant material is in general of a thickness between 1 and 50 micrometers; in particular, this thin layer is of a thickness of between 3 and 15 micrometers.

The invention also relates to a roller body of metal for a screen roller, in which the roller body can be provided on its external surface with recesses which are arranged in a regular manner in a pattern, and in which said roller body according to the invention is characterized in that an electroplated metal layer with properties such as those described for the screen roller according to the invention is connected thereto.

The invention will now be explained with reference to the drawing, in which:

Figure 1 shows diagrammatically a screen roller according to the invention;
Figure 2 shows a cross-section of the wall of a roller according to the invention; and
Figure 3 shows on an enlarged scale one recess in the electroplated layer of a screen roller according to the invention.

Figure 1 shows diagrammatically a screen roller in which the roller is indicated by reference number 1 and the roller body bears the number 2. The shaft means are indicated by 3, and a part of the roller surface in which the recesses are arranged in a pattern is indicated by 4.

As stated earlier, the roller body 2 can be a solid roller body; the roller body can also be a thick-walled roller body in which the shaft means are fixed by means of discs inside the periphery of the thick-walled roller body.

Figure 2 shows a part of the wall of a thick-walled roller body with an electroplated layer connected thereto, the recesses being provided in the electroplated layer. The wall of the roller body is indicated by number 20; the electroplated layer bears the number 21, and the recesses formed in the electroplated layer are indicated by the number 22. The walls between the different recesses 22 are indicated by 23.

In the case of Figure 2 the electroplated layer 21 is deposited directly onto the roller body 20 using an electroplating process which is known per se. The metal of the metal layer 21 is, for example, doped nickel.

Figure 3 shows a part of the electroplated layer of Figure 2 on an enlarged scale. The electroplated metal, for example nickel with organic doping, is indicated by 30. It is indicated by 31 that after formation of the pattern of recesses a wear-resistant and/or corrosion-resistant layer such as, for example, a hard chromium layer is applied.

As regards the method of application of the thin layer 31, the selection can be made from various application techniques.

The earlier mentioned hard chromium or hard nickel layers can also be applied by electroplating.

The metal nitride or metal carbide layers also mentioned can be formed using, for example, cathodic sputtering processes starting from the compound itself or using reactive cathodic sputtering processes in which

the metal concerned is sputtered in a gas atmosphere which is suitable for supplying the elements which are necessary for the formation of the appropriate metal nitride or metal carbide compound.

For the application of the earlier mentioned wear-resistant and/or corrosion-resistant compounds use can also be made of techniques such as chemical vapour deposition, processes (CVD), physical vapour deposition processes (PVD) and plasma jet spraying processes.

In connection with the screen roller according to the invention described above, reference is also made to the published European Patent Application 0,160,341. The publication mentioned describes a screen roller of the same type as that to which the invention relates.

The roller in the above-mentioned publication comprises a roller body around which a thin perforated sleeve which remains detachable from the roller body is pushed.

The perforations in the sleeve extend over the whole thickness of the sleeve and am of a shape which depends on the method of manufacture of the sleeve.

The present invention relates to a screen roller which has a closed electroplated layer which is connected to the roller body and is provided with recesses.

The shape of the recesses and the pattern of arrangement can be determined freely by selection of the production method.

It is pointed out that the screen roller according to the invention can have its electroplated layer removed from it in the event of wear after long use and can be provided again with a new metal layer.

The screen roller according to the invention is therefore renewable.

Claims

1. Screen roller (1) at least comprising a cylindrical metal roller body and shaft means (3) with a pattern (4) of recesses present on the external surface of the roller body, **characterized in that** the pattern (4) of recesses (22) is present in an electroplated metal layer (21), which is connected to the roller body (20) and of which the hardness, with respect to the initial hardness, is increased as a result of mechanical deformation of said metal layer (21), wherein the metal of the electroplated layer is selected from nickel, alloyed nickel and doped nickel.

2. Screen roller according to claim 1, comprising a cylindrical metal roller body (20) with a hardness up to 200 HV, **characterized in that** the electroplated layer (21) is of a hardness of at least 250 HV.

3. Screen roller according to claim 1, **characterized in that** an electroplated layer (21) of nickel is present on the metal roller body (20), which layer is doped with one or more organic or inorganic additives or decomposition products thereof.

4. Screen roller according to claim 3, **characterized in that** the nickel is doped with one or more additives or decomposition products thereof which have properties of first and/or second class brighteners.

5. Screen roller according to claim 4, **characterized in that** the nickel is doped with an additive selected from sodium salt of benzene-m-disulphonic acid, butynediol and hydroxypropionitrile.

6. Screen roller according to claim 1, **characterized in that** an electroplated layer (21) of nickel which is doped with phosphorus (P) is present on the metal roller body (20).

7. Screen roller according to claim 6, **characterized in that** the nickel is doped with 4 - 12 wt.-% P.

8. Screen roller according to one or more of the preceding claims, **characterized in that** the electroplated layer (21) is of a thickness in the range from 0.1 to 2.5 mm.

9. Screen roller according to claim 6, **characterized in that** the electroplated layer (21) is of a thickness in the range from 0.5 to 1.5 mm.

10. Screen roller according to one or more of the preceding claims, **characterized in that** the electroplated layer (30) containing the pattern of recesses is coated with a thin layer (31) of wear-resistant and/or corrosion-resistant material selected from materials such as; hard chromium, hard nickel, titanium nitride, titanium carbide, boron nitride, chromium nitride and tungsten carbide.

11. Screen roller according to claim 10, **characterized in that** the thin layer (31) of wear-resistant and/or corrosion-resistant material is of a thickness in the range from 5 to 50 micrometers.

12. Screen roller according to claim 11, **characterized in that** the thin layer (31) is of a thickness in the range from 10 to 15 micrometers.

13. Roller body (2) of metal for a screen roller (1), in which the roller body (2) can be provided on its external surface with recesses (5) which are arranged in a regular manner in a pattern (4), **characterized in that** an electroplated layer (21) with properties such as those indicated in one or more of claims 1 to 12 is connected to the roller body (20).

Patentansprüche

1. Rasterwalze (1), die mindestens einen zylindrischen Metallwalzenkörper und eine Welle (3) mit einem Muster (4) von Vertiefungen, die sich auf der äußeren Oberfläche des Walzenkörpers befinden,

umfaßt, **dadurch gekennzeichnet**, daß sich das Muster (4) von Vertiefungen (22) in einer galvanisch abgeschiedenen Metallschicht (21) befindet, die mit dem Walzenkörper (20) verbunden ist, und deren Härte bezüglich der ursprünglichen Härte, infolge der mechanischen Verformung der Metallschicht (21), erhöht ist, wobei das Metall der galvanisch abgeschiedenen Schicht aus Nickel, legiertem Nikkel und dotiertem Nickel ausgewählt ist,

2. Rasterwalze nach Anspruch 1, die einen zylindrischen Metallwalzenkörper (20) mit einer Härte bis zu 200 HV umfaßt, **dadurch gekennzeichnet**, daß die galvanisch abgeschiedene Schicht (21) eine Härte von mindestens 250 HV besitzt.

3. Rasterwalze nach Anspruch 1, **dadurch gekennzeichnet**, daß sich eine galvanisch abgeschiedene Schicht (21) aus Nickel auf dem Metallwalzenkörper (20) befindet, die mit einem oder mehreren organischen oder anorganischen Zusatzstoffen oder Zersetzungsprodukten davon dotiert ist.

4. Rasterwalze nach Anspruch 3, **dadurch gekennzeichnet**, daß das Nickel mit einem oder mehreren Zusatzstoffen oder Zersetzungsprodukten davon dotiert ist, die die Eigenschaften von Glanzmitteln erster und/oder zweiter Klasse besitzen.

5. Rasterwalze nach Anspruch 4, **dadurch gekennzeichnet**, daß das Nickel mit einem Zusatzstoff, der aus Natriumsalz von Benzol-m-disulfonsäure, Butindiol und Hydroxypropionitril ausgewählt wird, dotiert ist.

6. Rasterwalze nach Anspruch 1, **dadurch gekennzeichnet**, daß sich auf dem Metallwalzenkörper (20) eine galvanisch abgeschiedene Schicht (21) von Nickel befindet, welche mit Phosphor (P) dotiert ist.

7. Rasterwalze nach Anspruch 6, **dadurch gekennzeichnet**, daß das Nickel mit 4 bis 12 Gew.% P dotiert ist.

8. Rasterwalze nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß die galvanisch abgeschiedene Schicht (21) eine Dicke im Bereich von 0,1 bis 2,5 mm besitzt.

9. Rasterwalze nach Anspruch 6, **dadurch gekennzeichnet**, daß die galvanisch abgeschiedene Schicht (21) eine Dicke im Bereich von 0,5 bis 1,5 mm besitzt.

10. Rasterwalze nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß die galvanisch abgeschiedene Schicht (30), die das Muster von Vertiefungen enthält, mit einer dünnen Schicht (31) eines verschleißfesten und/oder korrosionsfesten Materials beschichtet ist, welches aus Materialien, wie: Hartchrom, Hartnickel, Titannitrid, Titancarbid, Bornitrid, Chromnitrid und Wolframcarbid ausgewählt wird.

11. Rasterwalze nach Anspruch 10, **dadurch gekennzeichnet**, daß die dünne Schicht (31) des verschleißfesten und/oder korrosionsfesten Materials eine Dicke im Bereich von 5 bis 50 µm besitzt.

12. Rasterwalze nach Anspruch 11, **dadurch gekennzeichnet**, daß die dünne Schicht (31) eine Dicke im Bereich von 10 bis 15 µm besitzt.

13. Metallwalzenkörper (2) für eine Rasterwalze (1), bei der der Walzenkörper (2) auf seiner äußeren Oberfläche mit Vertiefungen (5) versehen werden kann, die in regelmäßigem Muster (4) angeordnet sind, **dadurch gekennzeichnet**, daß eine galvanisch abgeschiedene Schicht (21) mit solchen Eigenschaften, wie sie in einem oder mehreren der Ansprüche 1 bis 12 genannt sind, mit dem Walzenkörper (20) verbunden ist.

Revendications

1. Rouleau tramé (1) comprenant au moins un corps métallique cylindrique de rouleau et un moyen formant arbre (3), un motif (4) en creux étant présent sur la surface extérieure du corps de rouleau, caractérisé en ce que le motif (4) constitué par des creux (22) se trouve dans une couche métallique (21) formée par dépôt électrolytique, reliée au corps (20) de rouleau et dont la dureté, par rapport à la dureté initiale, est accrue par suite de déformations mécaniques de ladite couche métallique (21), rouleau dans lequel le métal de la couche formée par dépôt électrolytique est choisi parmi le nickel, des alliages de nickel et le nickel dopé.

2. Rouleau tramé selon la revendication 1, comprenant un corps métallique cylindrique (20) de rouleau ayant une dureté Vickers maximale 200, caractérisé en ce que la couche (21) formée par dépôt électrolytique a une dureté Vickers minimale 250.

3. Rouleau trame selon la revendication 1, caractérisé en ce qu'une couche de nickel (21) formée par dépôt électrolytique est présente sur le corps métallique (20) de rouleau, laquelle couche est dopée avec un ou plusieurs additifs organiques ou inorganiques ou produits de décomposition de ceux-ci.

4. Rouleau tramé selon la revendication 3, caractérisé en ce que le nickel est dopé avec un ou plusieurs additifs ou produits de décomposition de ceux-ci qui ont des propriétés de brillanteurs de première et/ou de seconde classe.

5. Rouleau trame selon la revendication 4, caractérisé en ce que le nickel est dopé avec un additif choisi parmi le sel de sodium d'acide benzène-m-disulphonique, le butynédiol et l'hydroxypropionitrile.

6. Rouleau tramé selon la revendication 1, caractérisé en ce qu'une couche de nickel (21) formée par dépôt électrolytique et dopée avec du phosphore (P) est présente sur le corps métallique (20) de rouleau.

7. Rouleau tramé selon la revendication 6, caractérisé en ce que le nickel est dopé avec 4 à 12% de P en poids.

8. Rouleau tramé selon l'une ou plusieurs des revendications précédentes, caractérisé en ce que la couche (21) formée par dépôt électrolytique a une épaisseur de 0,1 à 2,5 mm.

9. Rouleau tramé selon la revendication 6, caractérisé en ce que la couche (21) formée par dépôt électrolytique a une épaisseur de 0,5 à 1,5 mm.

10. Rouleau tramé selon l'une ou plusieurs des revendications précédentes, caractérisé en ce que la couche (30) formée par dépôt électrolytique et contenant le motif en creux est revêtue par une couche mince (31) de matière résistant à l'usure et/ou résistant à la corrosion, choisie parmi des matières telles que le chrome dur, le nickel dur, le nitrure de titane, le carbure de titane, le nitrure de bore, le nitrure de chrome et le carbure de tungstène.

11. Rouleau tramé selon la revendication 10, caractérisé en ce que la couche mince (31) de matière résistant à l'usure et/ou résistant à la corrosion a une épaisseur de 5 à 50 micromètres.

12. Rouleau tramé selon la revendication 11, caractérisé en ce que la couche mince (31) a une épaisseur de 10 à 15 micromètres.

13. Corps métallique (2) de rouleau pour rouleau tramé (1), dans lequel le corps (2) de rouleau peut être pourvu, sur sa surface extérieure, de creux (5) disposés d'une manière régulière selon un motif (4), caractérisé en ce qu'une couche (21) formée par dépôt électrolytique et ayant des propriétés telles que celles indiquées dans l'une ou plusieurs des revendications 1 à 12 est reliée au corps (20) de rouleau.

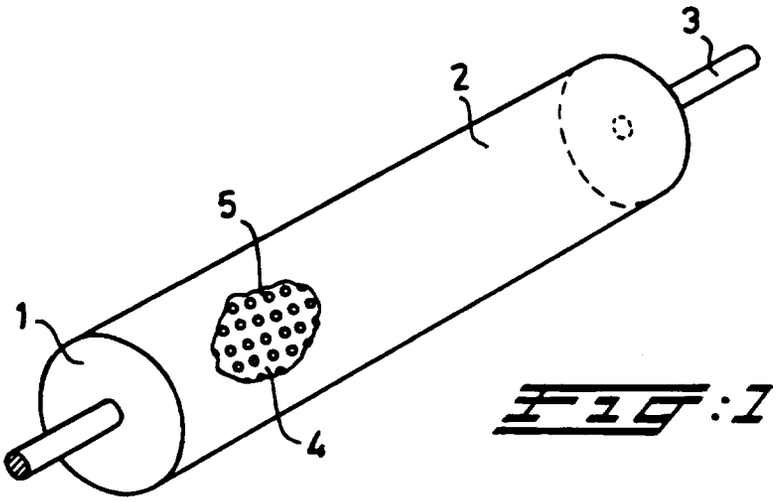

Fig: 1.

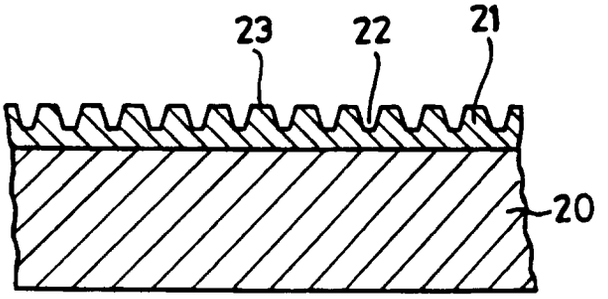

Fig: 2.

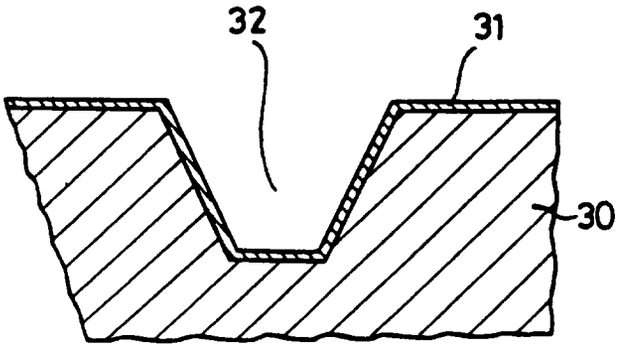

Fig: 3.