(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 509 396 B9**

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see
Claims DE 13
Claims EN 6

(48) Corrigendum issued on:
16.09.2009 Bulletin 2009/38

(45) Date of publication and mention of the grant of the patent:
11.03.2009 Bulletin 2009/11

(21) Application number: **03727109.5**

(22) Date of filing: **03.06.2003**

(51) Int Cl.:
B41C 1/05 *(2006.01)* ***B41M 3/14*** *(2006.01)*
B23K 26/00 *(2006.01)*

(86) International application number:
PCT/CH2003/000348

(87) International publication number:
WO 2003/103962 (18.12.2003 Gazette 2003/51)

(54) METHOD OF MANUFACTURING AN ENGRAVED PLATE

VERFAHREN ZUR HERSTELLUNG EINER GRAVIERTEN PLATTE

PROCEDE DE FABRICATION D'UNE PLAQUE GRAVEE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

(30) Priority: **05.06.2002 EP 02405452**

(43) Date of publication of application:
02.03.2005 Bulletin 2005/09

(60) Divisional application:
08158524.2 / 1 987 950

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(56) References cited:
WO-A-96/26466 **DE-A- 10 044 403**

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Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention relates generally to the field of intaglio printing for the production of security papers, especially banknotes.

[0002] More precisely, this invention concerns a method of manufacturing an engraved plate for intaglio printing of sheets of security papers, wherein a non-engraved plate is submitted to a programmed engraving process by a computer controlled engraving tool.

[0003] Traditionally, the manufacture of intaglio plates is a long and complex process, which begins with the hand engraving of a steel or copper plate, making a copy of this first plate, adding by chemical engraving other elements, making several plastic imprints of this final original plate, welding them together, and going through an important number of galvanic bathes to obtain the final product, being the intaglio printing plate to be mounted on the machine. The whole process of plate manufacturing can take several months, and is therefore very long and costly.

[0004] EP 0 322 301 offers a slightly shortened method of manufacturing intaglio steel plates, with an electro-erosion step. First, a copper dupe of the original hand-made copper plate is obtained by electro-forming. Thereafter this dupe is used as electrode in an electro-erosion process, wherein the electrode and the steel plate, which shall be engraved, are moved one relatively to the other. Thus, this method does not circumvent the long and difficult manufacture by hand of the original plate. This method of manufacturing plates is indeed not used in the security printing industry as the plates do not have the required precision.

[0005] WO 97/48555 describes a process of the above-defined type for producing deep-drawn steel plates, which avoids the hand engraving step. Surface components are chosen in a line drawing, the edge of the surface components defining nominal outlines. From each nominal outline to which a nominal depth is allocated, a tool path is then calculated. Then an engraving tool, a laser or a chisel, is guided in such a way that a part of the surface of the plate corresponding to the various surface components is removed. A part of a surface component removed at a predetermined depth may be further deepened in a further engraving step, so that the depth of such a surface component is not necessarily constant. Nevertheless, the definition of the engraved pattern, as far as the variation of depth is concerned, is lower than the definition of the original drawing.

[0006] WO 96/26466 describes a method of manufacture of polymeric precursor plates of intaglio printing plates by photo-ablation which also avoids hand engraving. First, an image corresponding to the intaglio pattern is converted to a mask which has opaque and transparent portions. Light from an excimer laser forms on a polymeric workpiece an image of a region of the mask, the transparent portions corresponding to the regions which are ablated in the workpiece. The mask and the workpiece are moved so as to provide scanning of the image. Since the mask is an image merely composed of transparent and opaque portions, this method does not use information concerning variable depth, and does not provide precise control on the depths of the engravings.

[0007] DE 10044403 discloses the preamble of claim 1 and describes a gravure printing method producing a half-tone image represented by irregular linear structures. In a first step an image in form of pixel data is provided and displayed by a computer. A designer analyses the image in terms of variable and various linear structures. Then, the data corresponding to the linear structures are stored in the computer in a vector based data format. In a subsequent engraving step, the vector based formated data guide an engraving tool, thus engraving an intaglio printing plate, following the data corresponding to the linear structures.

[0008] One aim of the present invention is to reduce the processing time and cost of the production of intaglio printing plates by circumventing the tedious steps of engraving vignettes and portraits by hand.

[0009] A further aim is to simultaneously maintain a high level of quality of intaglio printing plates, as traditionally manufactured, that is to say to obtain a very finely defined gravure.

[0010] A current practice in the security paper printing industry is to associate more than one printing processes on a same security paper, that is to say to submit a security paper sheet to the plurality of different printing processes so as to render forgery more difficult. As examples of other printing processes used in the security printing industry, and especially for banknotes, one can cite offset, screen printing, foil application, and numbering.

[0011] It is a known fact in the security printing industry, that the intaglio printing process causes a sheet distortion due to the high printing pressure needed to push the sheet of paper into the engravings of the printing plate. The other above-mentioned printing processes used to produce the same sheet do not cause the same distortion. As a result of this distortion, not all prints from different processes will be in register on the sheet. The term "sheet" refers here both to individual, generally rectangular sheets of paper, and to continuous strips of paper.

[0012] It is a further aim of the present invention to correct this distortion so that the prints obtained by the different involved printing processes will all be in register.

[0013] These aims are achieved by a method as defined in the introduction, wherein said programmed engraving process engraves the non-engraved plate according to the three-dimensional guiding pixel data (X, Y, Z) of a master depth-map of a said plate, wherein said master depth-map is generated by at least one computer stored original depth-map, said original depth-map comprising a three-dimensional raster image of at least a part of one said security paper, wherein an elementary engraving step is associated to each three-dimensional pixel data.

[0014] The present invention is thus based on the use

of a depth-map, which is a computer file, which contains a three-dimensional raster image of the engraving, on the use of a plate as a workpiece to be engraved and on a tool receiving a depth-map information.

[0015] Preferably, the engraving tool is a laser engraving machine, and an elementary laser engraving step is associated to each pixel of the raster image. The depth of the engraving is specified by each pixel data of the raster image. Successive engraving steps may follow a pixel column of the plate, then the adjacent column, and so on. Since neighbouring oblique aligned pixels may exhibit the same depth, corresponding for example to a drawing line, the finished plate provides an image corresponding to intaglio printing, whereas the manufacturing process of the plate itself corresponds to a raster pattern.

[0016] The plate, which is engraved, may be an intaglio printing plate. The plate, which is engraved, may also be a precursor of an intaglio printing plate, which is thereafter further processed by metal depositions as known in the prior art.

[0017] The three-dimensional raster image associated to a given security paper comprises information concerning the coordinates (X, Y) of location of each pixel, together with a depth information (Z), associated to the same pixel.

[0018] It is obtained by processing one or several three-dimensional elements. These elements may be :

a) three-dimensional line patterns;
b) three-dimensional raster patterns, especially raster security patterns;
c) three-dimensional elements composed of a number of flat areas, embedded or not, of various depths and shapes;
d) three-dimensional scans of low relief.

[0019] Such three-dimensional line patterns may consist of strings of segments, each segment having its own specified length, width and depth.

[0020] The three dimensional raster patterns may be directly computer generated, or obtained from scanned drawings or computer designed drawings processed by an algorithm, which determines the depth of each pixel of the raster pattern. The algorithm associates a depth to each pixel so that the raster pattern is similar to line profiles observed in hand engravings.

[0021] The master depth-map provides for a plurality of repetitions of the original depth-map(s) on the engraved plate and contains information on their positions in the plane of the plate. The master depth-map thus may provide for a number of repetitions of an original depth-map according to a pattern of rows and columns.

[0022] According to a preferred embodiment of the invention, the master depth-map contains information about the sheet distortion resulting from an intaglio printing process and the parameters for the compensation of said distortion.

[0023] The master depth-map may contain permanently pixel data for the engraving of a whole plate, in particular pixel data generated according information to compensate for the sheet distortion.

[0024] The computer may also store the original depth-map(s) corresponding to one security paper and the distortion correction parameters, so that the master depth-map data are generated in flight during the engraving process, to save time and disk space.

[0025] Other particulars and advantages of the invention will further appear to those skilled in the art from the following description of a preferred embodiment, referring to the drawings, in which:

- Figure 1 illustrates schematically the state of the art method of production of intaglio plates.
- Figure 2 illustrates schematically the method subject of this invention to manufacture intaglio plates.
- Figure 3a illustrates a three-dimensional line, and Figure 3b illustrates a three-dimensional line pattern.
- Figure 4 illustrates a three-dimensional raster pattern.
- Figure 5 illustrates other three-dimensional patterns.
- Figure 6 illustrates a three-dimensional original depth-map.
- Figures 7a, 7b, and 7c illustrate an original depth-map.
- Figure 8 illustrates a master depth-map.
- Figures 9a, 9b, 9c and 9d illustrate embodiments of the present invention.

[0026] Figure 1 illustrates schematically the state of the art process traditionally used in security printing plants for the manufacture of intaglio printing plates.

[0027] The first step is the hand engraving on a steel or copper die of an image with depth, like a portrait. This step requires months of labour by a highly skilled engraver.

[0028] The second step is to make a copy of this hand engraved die, and to add by chemical engraving other lines on the die. These lines can be a computer generated security pattern to be printed during the intaglio process.

[0029] The third step is to make plastic imprints of this die. One will make as much imprints as there will be security documents printed on each sheet.

[0030] The fourth step is to cut the imprints to shape.

[0031] The fifth step is to place the said cut imprints in rows and columns, and then to weld them together, to create a multi-image plastic assembly.

[0032] The sixth step is to silver the multi-image plastic assembly.

[0033] The seventh step is to deposit on the plastic assembly a copper layer in a galvanic copper bath to produce a copper plate.

[0034] The eighth step is to deposit a nickel layer on the copper plate in a nickel plating bath.

[0035] The product resulting from all those steps in this state of the art technology is a so-called nickel-alto, which will be used as a precursor for the production of the nickel

intaglio printing plates to be mounted in the intaglio presses.

[0036] Figure 2 illustrates the main steps of the present invention, which will eliminate at least the first seven steps described in the state of the art.

[0037] The first step is to create an original depth-map which is generated as follows:

1) Generation of three-dimensional elements with depth information. These elements can be, non exclusively, of the following types:

a. Three-dimensional line patterns. For example, these lines can be composed of strings of segments, each segment having its own specified length, width, and depth. Figure 3a shows an enlarged portion of a line with variable width and depth where the depth of each segment is displayed on the computer screen by its colour, and in grey shades in this black & white printing of the screen image. Figure 3b shows similarly a simple, computer generated, three-dimensional line pattern with variable width and depth.

b. Three-dimensional security raster patterns, for example computer generated or produced from scanned hand drawings or computer-designed drawings processed by an algorithm which determines the depth of each pixel of the raster pattern according to line profiles similar to those observed in hand engravings, as illustrated in Figure 4. For example, profiles can be selected for each line or for any group of lines. Types of profiles include, non exclusively, V-shaped and U-shaped profiles of various opening angles, as well as square-shaped profiles. The maximum depth of a line as well as the line depth - line width correlation can be specified.

c. Other types of three-dimensional elements such as three-dimensional elements composed of a number of flat areas, embedded or not, of various depths and shapes (Figure 5) or three-dimensional scans of low reliefs.

2. Assembly of the three-dimensional elements into an original file with depth information, as illustrated in Figure 6.

3. Generation of an original depth-map. The processing of the original file produces a single three-dimensional raster image. Figures 7a, 7b, and 7c display the same depth-map with increasing zoom factor. The depth of each pixel is displayed by its grey level. In Figure 7c, individual pixels can be seen. Their size corresponds to a resolution of 8000 dpi.

[0038] The second step is the generation of a master depth-map which includes information on the repetition and the positions on the plate of the original depth-map, as well as information on the distortion to be applied in order to compensate the sheet distortion that occurs during printing (Figure 8) so that all printing processes applied to a same sheet will all be in register.

[0039] The master depth-map is used by the engraving tool, which engraves the plate pixel by pixel. Laser engraving machines capable to transfer the information stored by each pixel are known to those skilled in the art.

[0040] The master depth-map data can be generated in-flight during the engraving, to save time and disk space. This is particularly useful when the master depth-map corresponds to a repetition of original depth-maps.

[0041] Those skilled in the art will understand that many variants of the depth-map generating process are feasible.

[0042] The three-dimensional elements may be assembled into more than one original file, for example several separate files for non overlapping elements. The original depth-maps generated therefrom may be repeated within the master depth-map according various rules differing from a mere repetition in rows and columns.

[0043] The assembly of superposing elements into an original file and depth-map, with a (X, Y, Z) information for each pixel, may obey to various rules, depending upon the wanted final visual effect, e.g. if one element shall locally overlie the other(s) or not.

[0044] Figure 9a, 9b, 9c and 9d illustrate embodiments of the present invention.

[0045] In Figure 9a, the engraving tool is a YAG laser and the engraved plate is a polymer plate which serves as a precursor of the intaglio printing plate. The engraved plate is mounted on a rotating cylinder. The laser is moving in a direction parallel to the axis of the cylinder. The control of the laser movement and of its intensity as well as the movement of the cylinder are performed by a computer which generates in-fight the master depth-map data taking into account the compensation of the sheet deformation which occurs during the intaglio printing process.

[0046] In Figure 9b, the embodiment is similar to the one described in Figure 9a except that the plate is mounted on a flat surface. The movements of the laser and of the plate are parallel to the plate.

[0047] Engraved polymer plates are silvered and serve as precursors of Nickel alto plates in the nickel galvanic baths.

[0048] According to a variant, the plate to be engraved is constituted of a layered structure comprising

- a metallic base plate
- an adhesive layer
- a polymer layer.

[0049] The polymer layer is engraved according to the process of the invention. Particularly suitable polymers for the engraving process are polyimides containing carbon black dispersed therein for enhancing the absorption

of the laser beam. This type of material permits a particularly high definition engraving. An example of a suitable material is the carbon loaded polyimide sold under the trade name "KAPTON" by "Du Pont de Nemours".

[0050] In Figure 9c, the embodiment is similar to the one described in Figure 9a except that the plate is metallic and that the laser is an excimer laser.

[0051] In Figure 9d, the embodiment is similar to the one described in Figure 9b except that the plate is metallic and that the laser is an excimer laser.

[0052] These embodiments are given only as examples and other embodiments falling under the scope of the claims may be developed by those skilled in the art. For example there may be a plurality of engraving tools guided by the master depthmap, those tools working in a synchronous way, in particular there may be as much engraving tools as there are columns of security papers on the printing sheets with said security papers.

Claims

1. A method of manufacturing an engraved plate for intaglio printing of sheets of security papers, wherein a non engraved plate is submitted to a programmed engraving process by a computer controlled engraving tool, **characterised in that** said programmed engraving process engraves said non engraved plate according to the three-dimensional guiding pixel data (X, Y, Z) of a master depth-map of one said sheet, wherein said master depth-map is generated by at least one computer stored original depth-map, said original depth-map consisting of a three-dimensional raster image of at least a part of one said security paper, and wherein an elementary engraving step is associated to each three-dimensional pixel data.

2. A method as claimed in claim 1, wherein said engraved plate is an intaglio printing plate.

3. A method as claimed in claim 1, wherein said engraved plate is a precursor of an intaglio printing plate.

4. A method as claimed in anyone of claims 1 to 3, wherein said engraved plate is a metallic plate.

5. A method as claimed in anyone of claims 1 to 3, wherein said engraved plate comprises a polymer layer and wherein said polymer layer is engraved.

6. A method as claimed in claim 5, **characterised in that** said engraved plate is a precursor plate comprising the following layers:

   - a metallic base
   - an adhesive layer
   - a polymer layer.

7. A method as claimed in claim 6, **characterised in that** said polymer layer is a polyimide containing dispersed carbon black material.

8. A method as claimed in anyone of the preceding claims, wherein said engraving tool is a laser engraving machine.

9. A method according to anyone of the preceding claims, **characterised in that** said engraving tool is an excimer laser or a YAG-laser.

10. A method according to any of the preceding claims, **characterised in that** said three dimensional raster image is generated by processing at least one three-dimensional element selected from:

    a) three-dimensional line patterns
    b) three-dimensional raster patterns
    c) three-dimensional elements composed of flat areas
    d) three-dimensional scans of low relief

    or a combination thereof.

11. A method according to claim 10, **characterised in that** said three-dimensional line patterns are made of strings of segments, each segment having its own specified length, width and depth.

12. A method according to claim 10, **characterised in that** said three-dimensional raster patterns are computer generated or produced from scanned hand drawings or computer-designed drawings processed by an algorithm which determines the depth of each pixel of the raster pattern according to line profiles of hand engravings.

13. A method according to any one of claims 1 to 12, **characterised in that** said master depthmap provides for multiple repetitions on the plate of each original depthmap and contains information on the positions of said repetitions in the plane of the plate.

14. A method according to claim 13, **characterised in that** said master depthmap contains pixel data generated according information to compensate for the sheet distortion during intaglio printing, and guides the engraving tool accordingly.

15. A method according to any one of the preceding claims, **characterised in that** there is a plurality of engraving tools guided by said master depthmap, those tools working in a synchronous way.

16. A method according to claim 15, **characterised in**

that there are as much engraving tools as there are columns of security papers on the printed sheets with said security papers.

Patentansprüche

1. Verfahren zur Herstellung einer gravierten Platte für den Intaglio-Druck von Bögen von Sicherheitspapieren, bei dem eine nicht gravierte Platte einer programmierten Gravur mittels eines rechnergesteuerten Gravierwerkzeugs unterzogen wird, **dadurch gekennzeichnet, dass** bei der programmierten Gravur die nicht gravierte Platte entsprechend den dreidimensionalen Führungs-Bildpunktedaten (X, Y, Z) einer Haupt-Tiefenvorlage für einen einzelnen Bogen graviert wird, wobei die Haupt-Tiefenvorlage aus mindestens einer rechnergespeicherten Ur-Tiefenvorlage generiert wird, die aus einem dreidimensionalen Rasterbild mindestens eines Teils eines einzelnen Sicherheitspapiers besteht, und wobei jedem dreidimensionalen Bildpunkt-Datensatz ein elementarer Gravurschritt zugeordnet ist.

2. Verfahren nach Anspruch 1, bei dem die gravierte Platte eine Intaglio-Druckplatte ist.

3. Verfahren nach Anspruch 1, bei dem die gravierte Platte ein Vorläufer für eine Intaglio-Druckplatte ist.

4. Verfahren nach einem der Ansprüche 1 bis 3, bei dem die gravierte Platte eine Metallplatte ist.

5. Verfahren nach einem der Ansprüche 1 bis 3, bei dem die gravierte Platte eine Polymerisatschicht aufweist und die Polymerisatschicht graviert wird.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** die gravierte Platte eine Vorläuferplatte mit folgenden Schichten ist:

   - eine Metall-Grundschicht
   - eine Klebstoffschicht
   - eine Polymerisatschicht.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die Polymerisatschicht ein Ruß dispergiert enthaltendes Polyimid ist.

8. Verfahren nach einem der vorgehenden Ansprüche, bei dem das Gravierwerkzeug eine Laser-Gravurmaschine ist.

9. Verfahren nach einem der vorgehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gravierwerkzeug ein Excimer- oder ein YAG-Laser ist.

10. Verfahren nach einem der vorgehenden Ansprüche, **dadurch gekennzeichnet, dass** das dreidimensionale Rasterbild generiert wird durch Verarbeiten mindestens eines dreidimensionalen Elements, das gewählt ist unter den folgenden:

    (a) dreidimensionale Linienmuster
    (b) dreidimensionale Rastermuster
    (c) dreidimensionale, aus flachen Bereichen zusammengesetzte Elemente
    (d) dreidimensionale Abtastungen mit flachem Relief oder eine Kombination derselben.

11. Verfahren nach Anspruch 10, **dadurch gekennzeichnet, dass** die dreidimensionalen Linienmuster aus Segmentketten hergestellt sind, deren Segmente jeweils eine eigene Länge, Breite und Tiefe aufweisen.

12. Verfahren nach Anspruch 10, **dadurch gekennzeichnet, dass** die dreidimensionalen Rastermuster rechnergeneriert oder aus abgetasteten Handzeichnungen oder rechnerentworfenen Zeichnungen erzeugt werden, die mit einem Algorithmus bearbeitet werden, der die Tiefe jedes Bildpunkts des Rastermusters nach Linienprofilen von Handgravuren bestimmt.

13. Verfahren nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** die Haupt-Tiefenvorlage die Platte jeder Ur-Tiefenvorlage mehrfach wiederholt und Informationen über die Positionen der Wiederholungen in der Plattenebene enthält.

14. Verfahren nach Anspruch 13, **dadurch gekennzeichnet, dass** die Haupt-Tiefenvorlage Bildpunktdaten enthält, die nach Informationen zur Kompensation der Bogenverzerrung im Intaglio-Druck generiert sind, und das Gravierwerkzeug entsprechend führt.

15. Verfahren nach einem der vorgehenden Ansprüche, **dadurch gekennzeichnet, dass** mehrere Gravierwerkzeuge vorliegen, die von der Haupt-Tiefenvorlage geführt werden und synchron arbeiten.

16. Verfahren nach Anspruch 15, **dadurch gekennzeichnet, dass** so viele Gravierwerkzeuge wie auf den Sicherheitspapier-Druckbögen Spalten von Sicherheitspapieren vorliegen.

Revendications

1. Procédé de fabrication d'une plaque gravée pour l'impression taille douce de feuilles de papiers de sécurité, dans lequel une plaque non gravée est soumise à un processus de gravure programmé par un outil de gravure commandé par ordinateur, **carac-**

térisé en ce que ledit processus de gravure programmé grave ladite plaque non gravée selon les données de pixel de guidage en trois dimensions (X, Y, Z) d'une carte maîtresse de profondeur d'une dite feuille, dans lequel ladite carte maîtresse de profondeur est générée par au moins une carte originale de profondeur stockée dans un ordinateur, ladite carte originale de profondeur consistant en une image tramée en trois dimensions d'au moins une partie d'un dit papier de sécurité, et dans lequel une étape de gravure élémentaire est associée à chaque donnée de pixel en trois dimensions.

2. Procédé tel que revendiqué dans la revendication 1, dans lequel ladite plaque gravée est une plaque d'impression taille douce.

3. Procédé tel que revendiqué dans la revendication 1, dans lequel ladite plaque gravée est un précurseur d'une plaque d'impression taille douce.

4. Procédé tel que revendiqué dans l'une quelconque des revendications 1 à 3, dans lequel ladite plaque gravée est une plaque métallique.

5. Procédé tel que revendiqué dans l'une quelconque des revendications 1 à 3, dans lequel ladite plaque gravée comprend une couche de polymère et dans lequel ladite couche de polymère est gravée.

6. Procédé tel que revendiqué dans la revendication 5, **caractérisé en ce que** ladite plaque gravée est une plaque de précurseur comprenant les couches suivantes :

- une base métallique
- une couche d'adhésif
- une couche de polymère.

7. Procédé tel que revendiqué dans la revendication 6, **caractérisé en ce que** ladite couche de polymère est un polyimide contenant du noir de carbone dispersé.

8. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel ledit outil de gravure est une machine de gravure au laser.

9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit outil de gravure est un laser à excimer ou un laser YAG.

10. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite image tramée en trois dimensions est générée en traitant au moins un élément en trois dimensions choisi parmi :

a) des motifs de ligne en trois dimensions
b) des motifs d'image tramée en trois dimensions
c) des éléments en trois dimensions composés de zones plates
d) des scans en trois dimensions à bas relief

ou une combinaison de ceux-ci.

11. Procédé selon la revendication 10, **caractérisé en ce que** lesdits motifs de ligne en trois dimensions sont composés de chaînes de segments, chaque segment ayant ses propres longueur, largeur et profondeur spécifiques.

12. Procédé selon la revendication 10, **caractérisé en ce que** lesdits motifs d'image tramée en trois dimensions sont générés par ordinateur ou produits à partir de dessins à la main scannés ou des dessins conçus par ordinateur traités par un algorithme qui détermine la profondeur de chaque pixel du motif d'image tramée selon des profils de ligne de gravures manuelles.

13. Procédé selon l'une quelconque des revendications 1 à 12, **caractérisé en ce que** ladite carte maîtresse de profondeur fournit des répétitions multiples sur la plaque de chaque carte originale de profondeur et contient des informations sur la position desdites répétitions dans le plan de la plaque.

14. Procédé selon la revendication 13, **caractérisé en ce que** ladite carte maîtresse de profondeur contient des données de pixel générées selon des informations pour compenser la distorsion de la feuille pendant l'impression en taille douce, et guide l'outil de gravure en conséquence.

15. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il y a une pluralité d'outils de gravure guidés par ladite carte maîtresse de profondeur, les outils travaillant de manière synchrone.

16. Procédé selon la revendication 15, **caractérisé en ce qu'**il y a autant d'outils de gravure qu'il y a de colonnes de papiers de sécurité sur les feuilles imprimées avec lesdits papiers de sécurité.

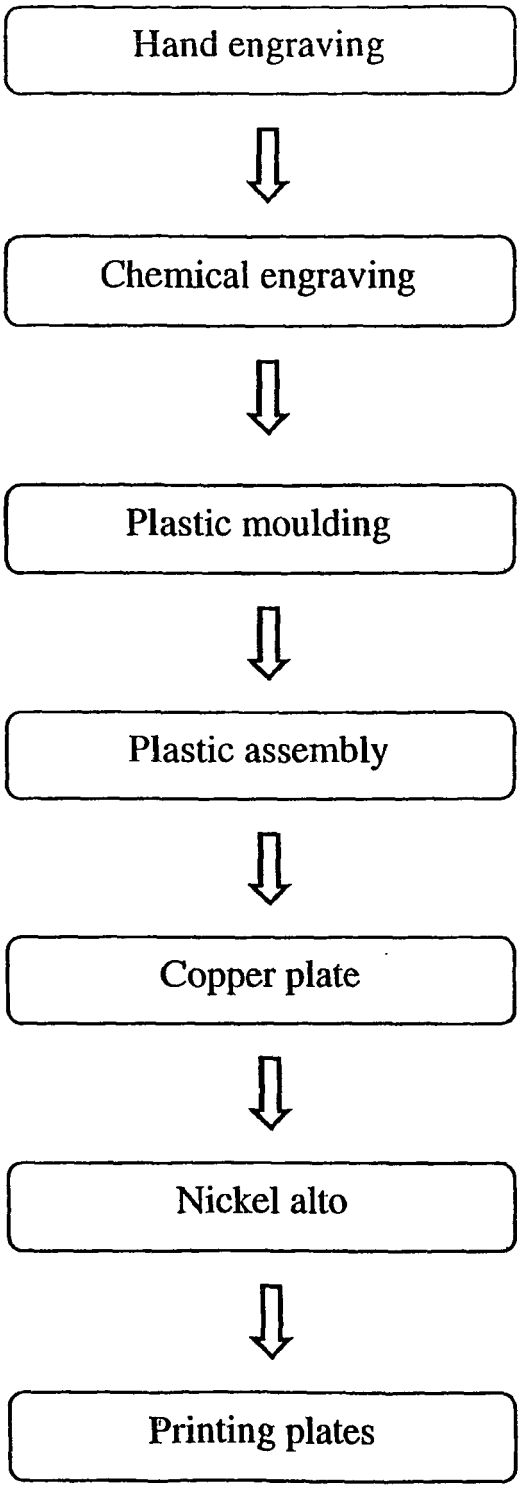
Hand engraving
Chemical engraving
Plastic moulding
Plastic assembly
Copper plate
Nickel alto
Printing plates

Figure 1

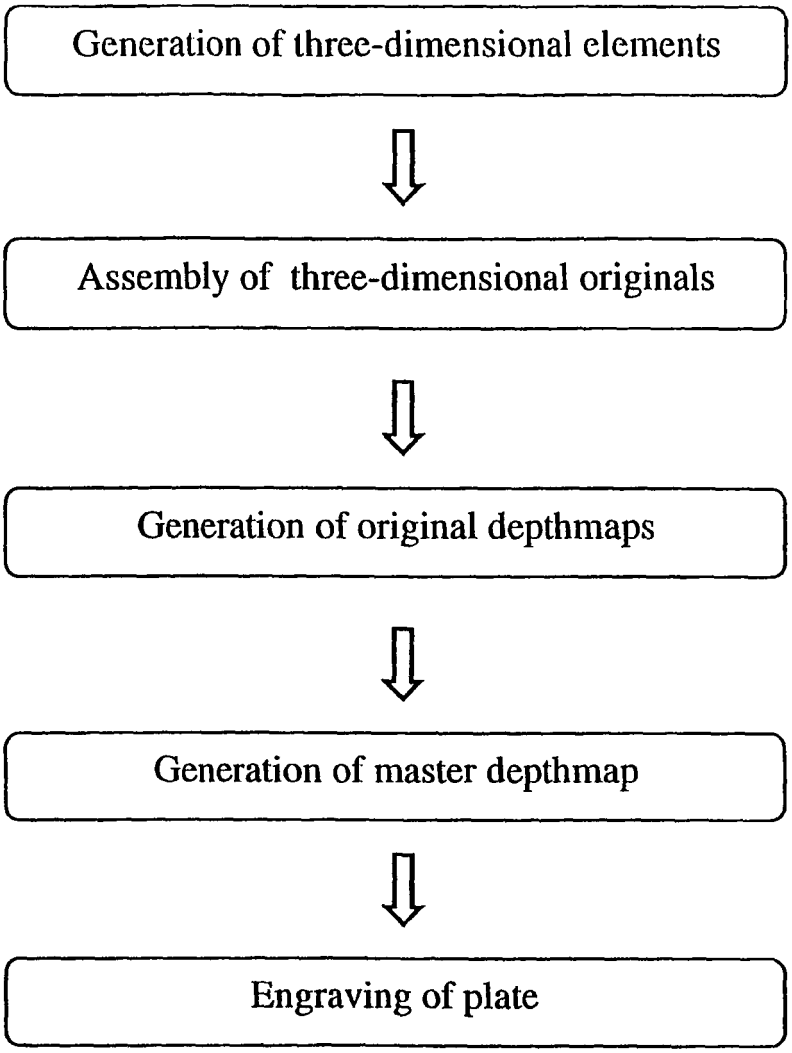
Generation of three-dimensional elements
Assembly of three-dimensional originals
Generation of original depthmaps
Generation of master depthmap
Engraving of plate

Figure 2

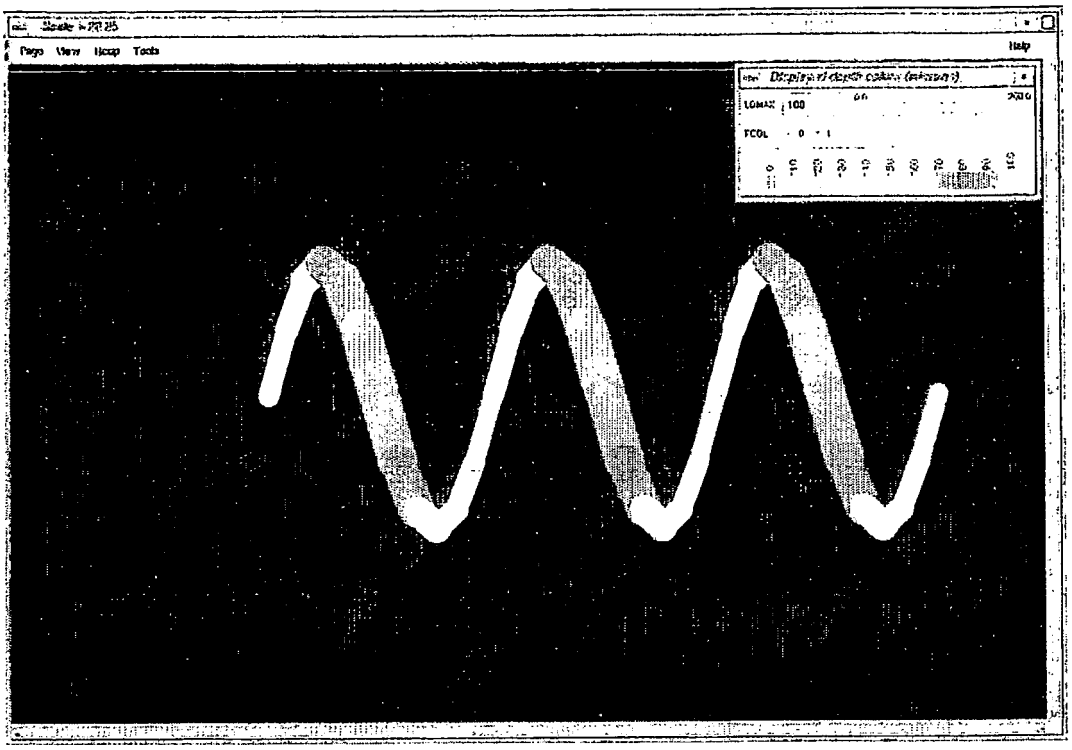

Figure 3a

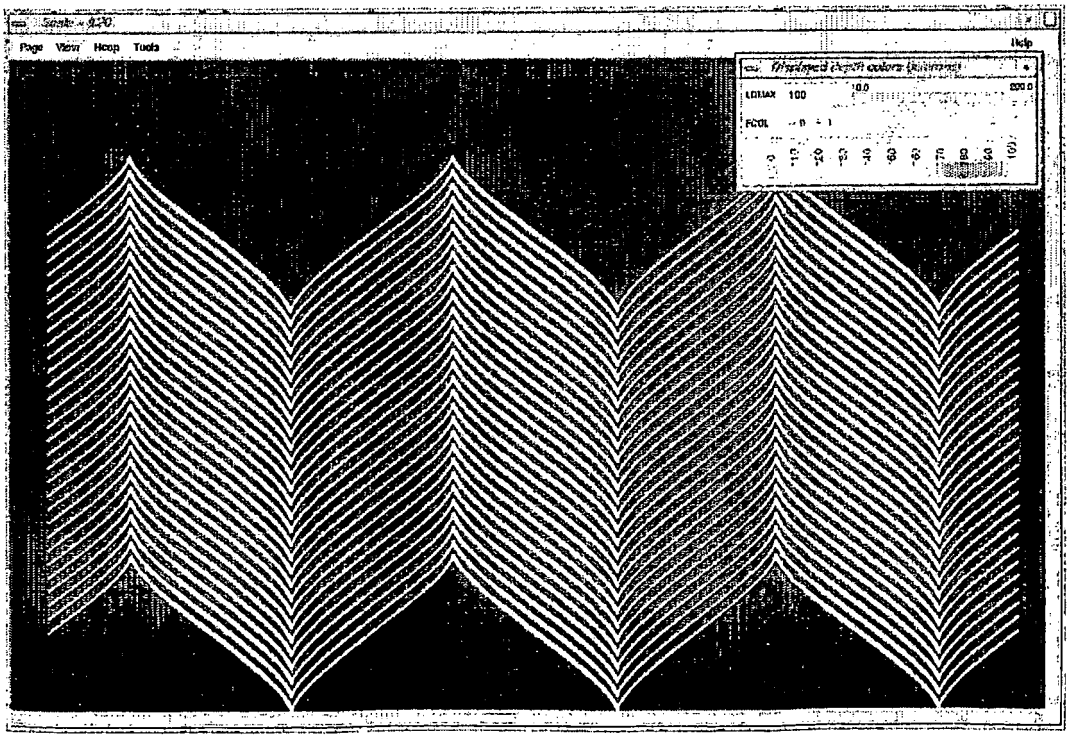

Figure 3b

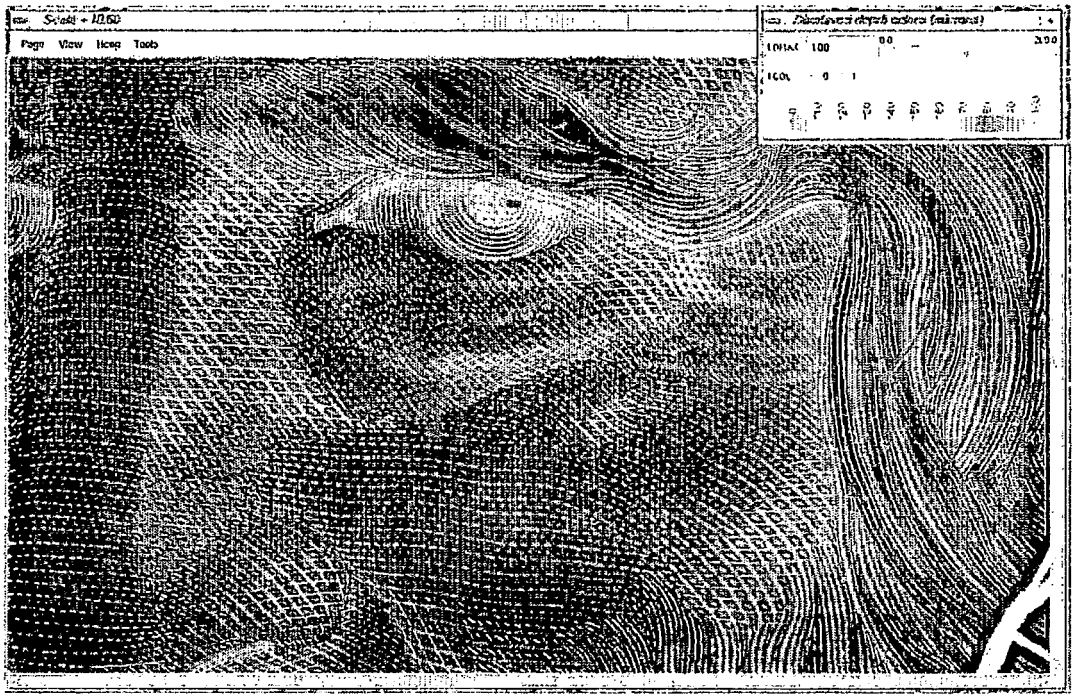

Figure 4

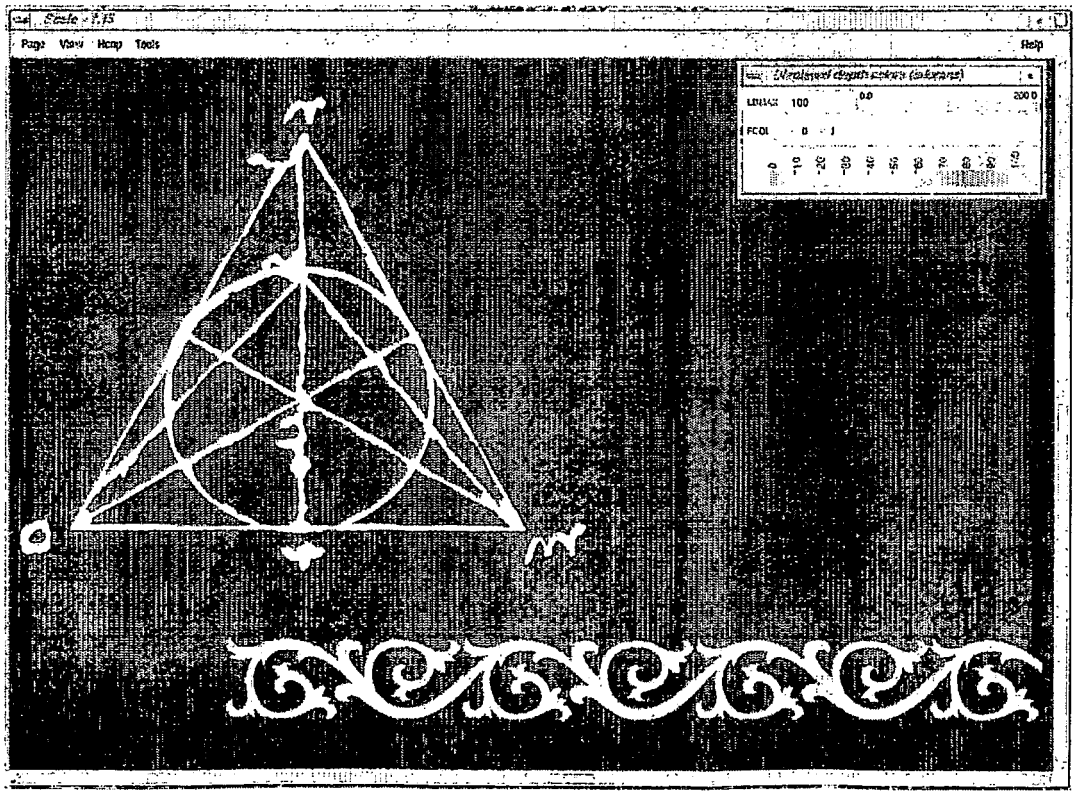

Figure 5

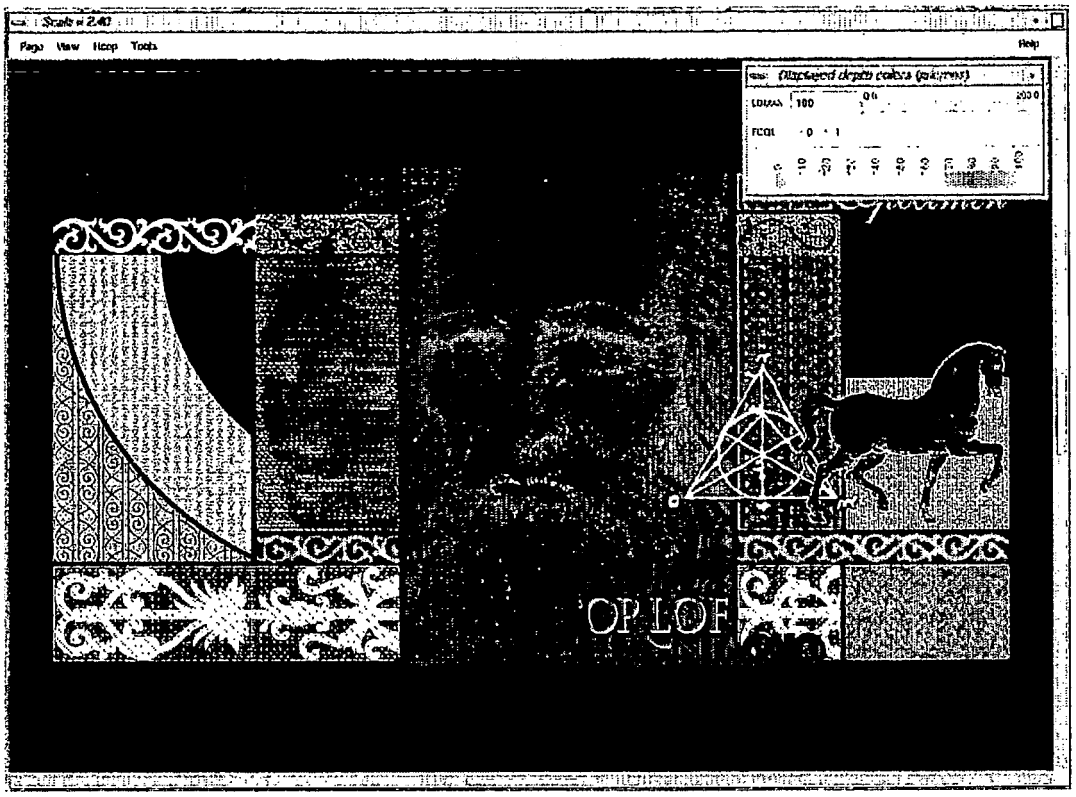

Figure 6

Figure 7a

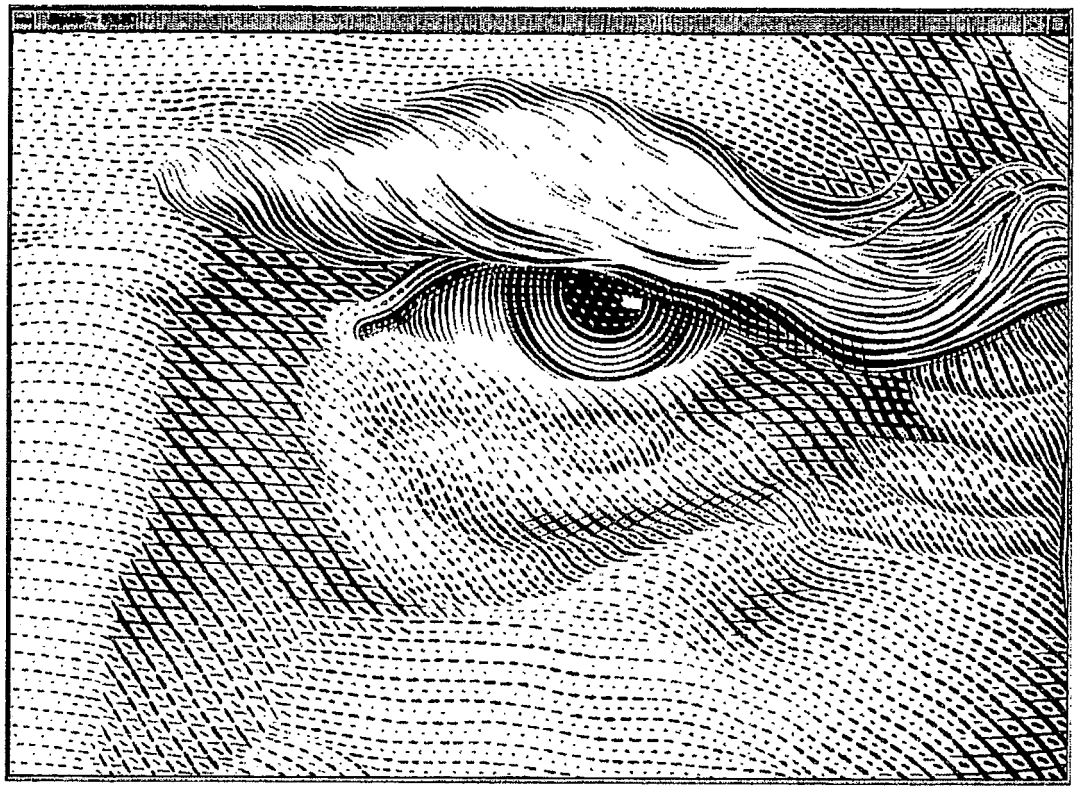

Figure 7b

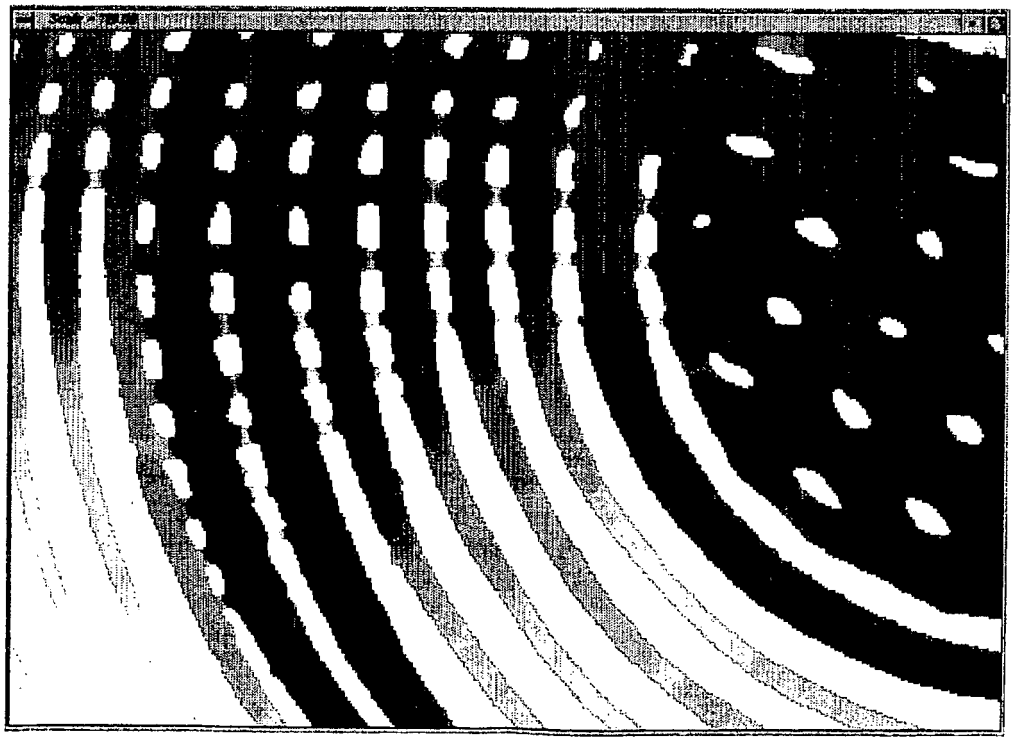

Figure 7c

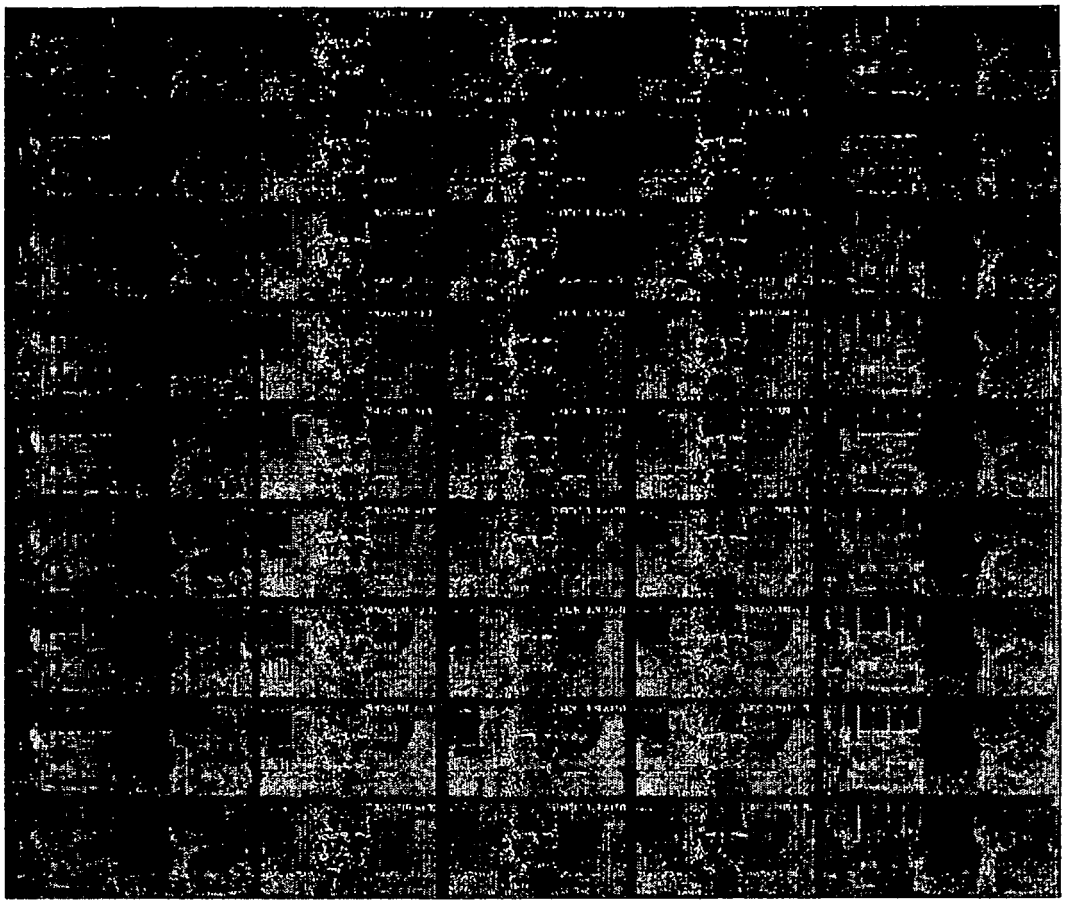

Figure 8

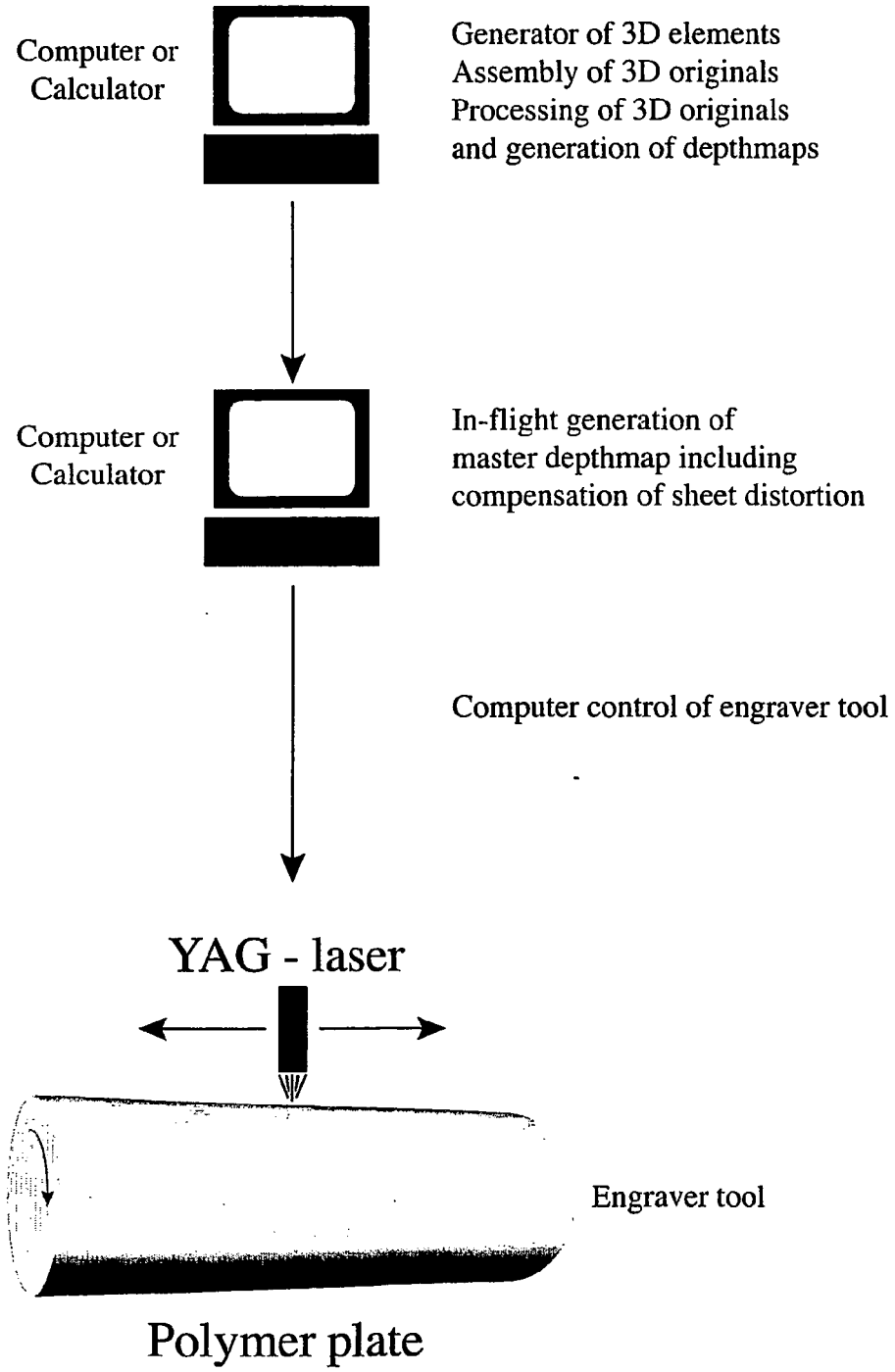
Computer or Calculator
Generator of 3D elements
Assembly of 3D originals
Processing of 3D originals
and generation of depthmaps
Computer or Calculator
In-flight generation of
master depthmap including
compensation of sheet distortion
Computer control of engraver tool
YAG - laser
Engraver tool
Polymer plate

Figure 9a.

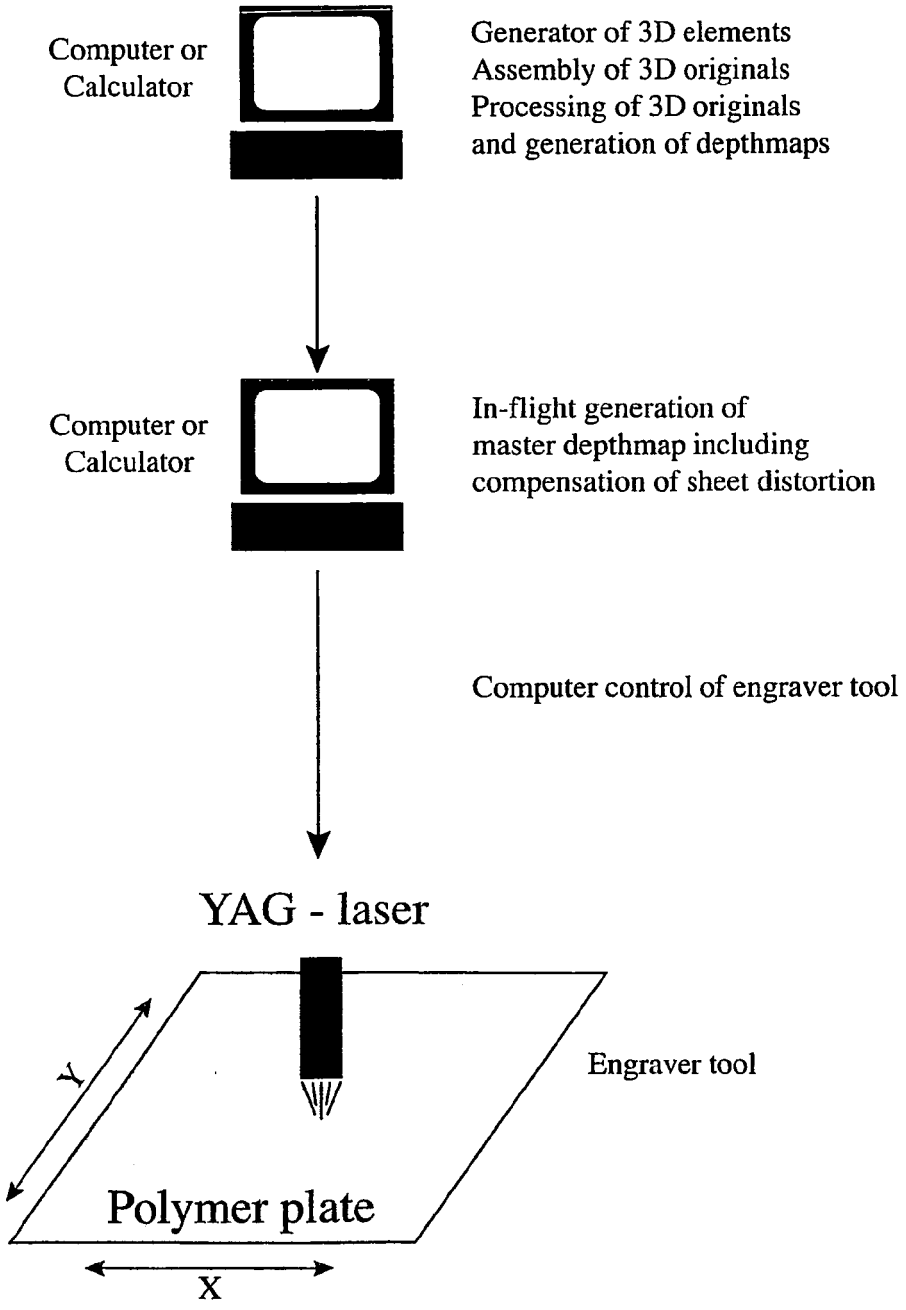
Computer or Calculator
Generator of 3D elements
Assembly of 3D originals
Processing of 3D originals
and generation of depthmaps
Computer or Calculator
In-flight generation of
master depthmap including
compensation of sheet distortion
Computer control of engraver tool
YAG - laser
Engraver tool
Y
Polymer plate
X

Figure 9b.

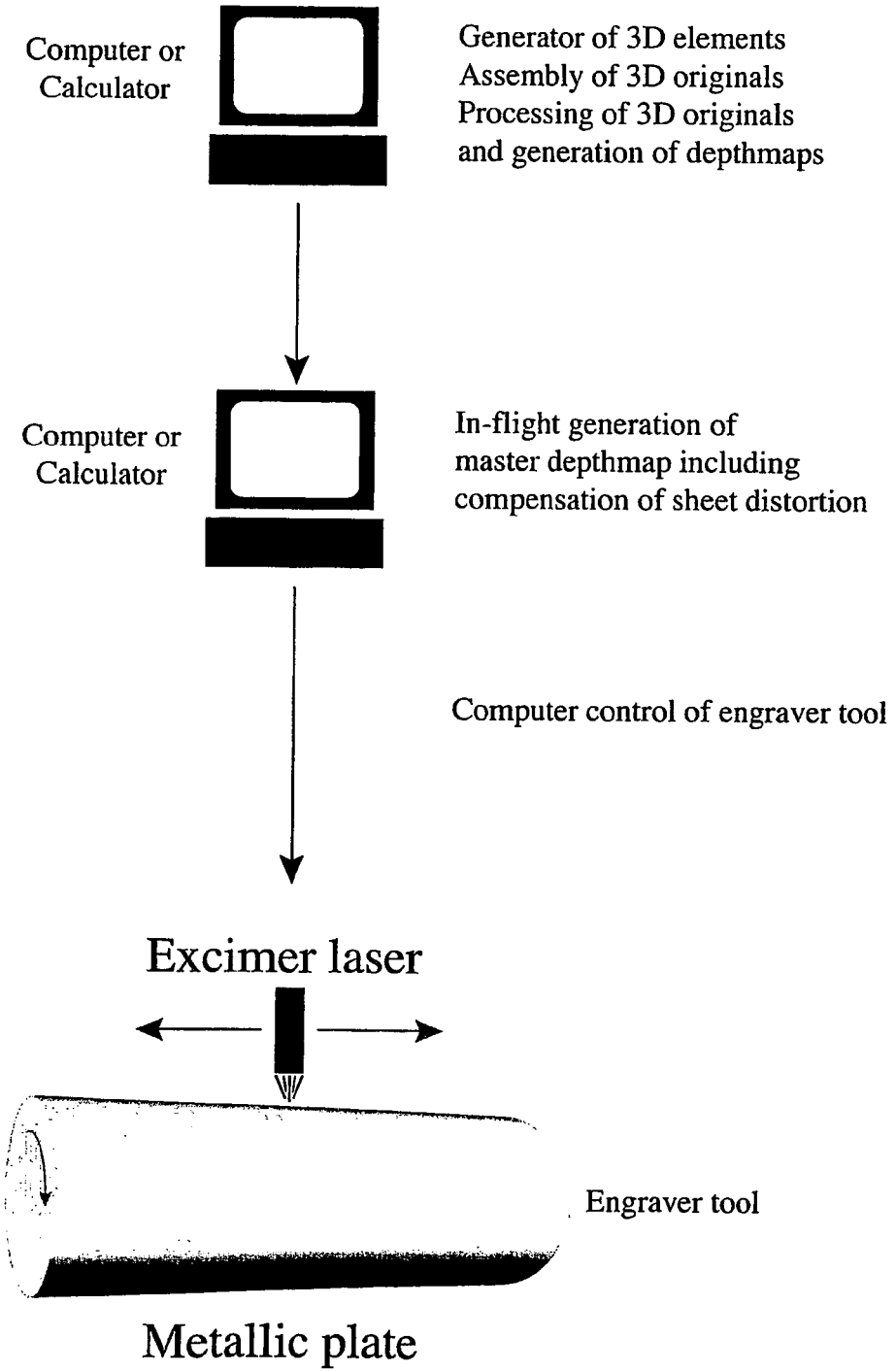
Computer or Calculator
Generator of 3D elements
Assembly of 3D originals
Processing of 3D originals
and generation of depthmaps
Computer or Calculator
In-flight generation of
master depthmap including
compensation of sheet distortion
Computer control of engraver tool
Excimer laser
Engraver tool
Metallic plate

Figure 9c.

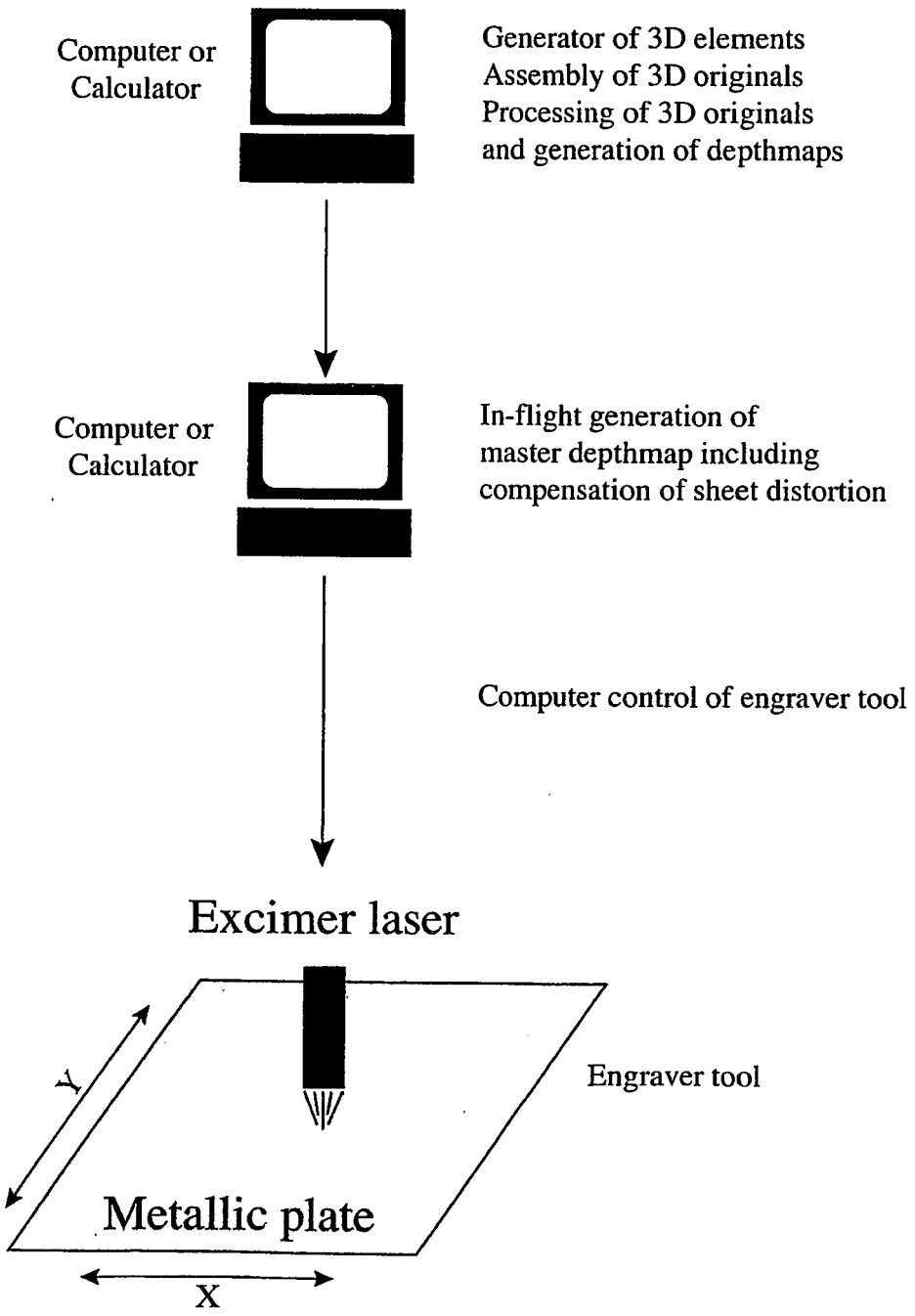
Computer or Calculator
Generator of 3D elements
Assembly of 3D originals
Processing of 3D originals
and generation of depthmaps
Computer or Calculator
In-flight generation of
master depthmap including
compensation of sheet distortion
Computer control of engraver tool
Excimer laser
Engraver tool
Y
Metallic plate
X

Figure 9d.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0322301 A **[0004]**
- WO 9748555 A **[0005]**
- WO 9626466 A **[0006]**
- DE 10044403 **[0007]**