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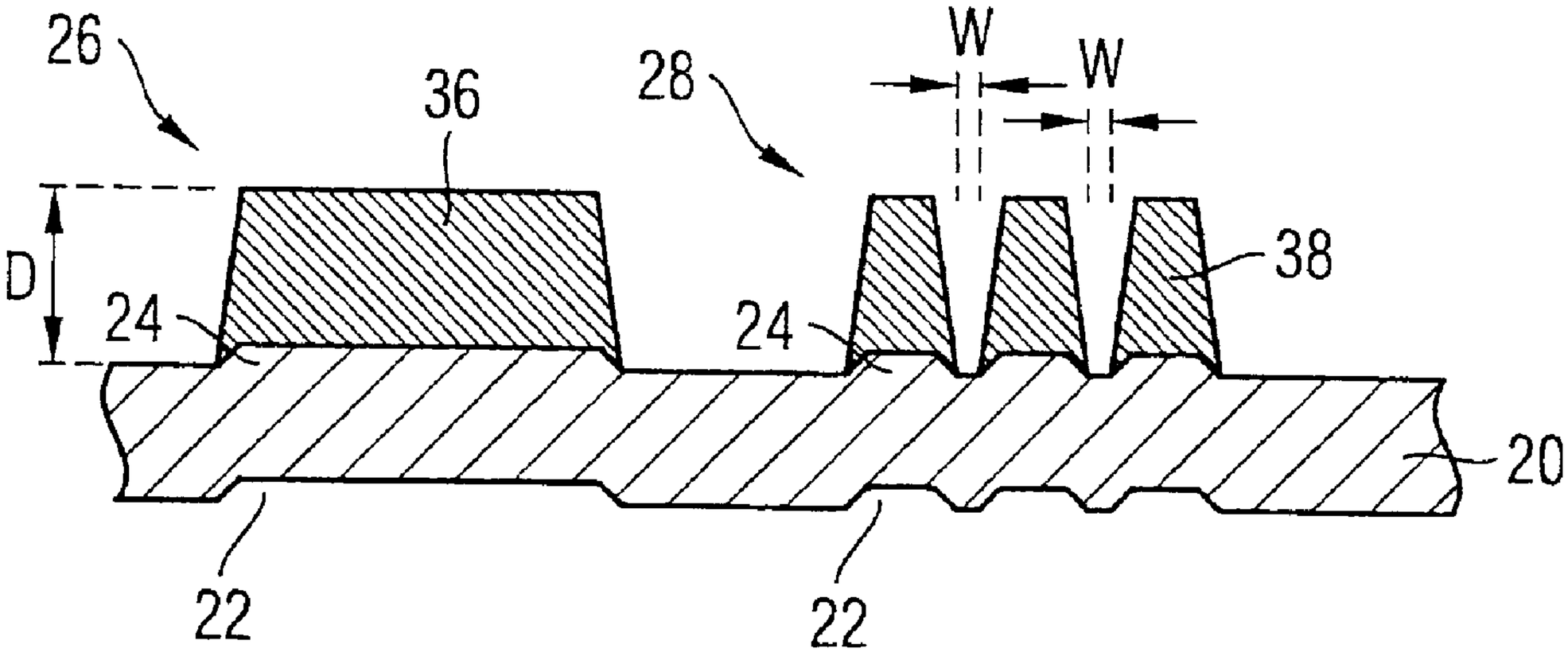

(57) Abrégé/Abstract:
The present invention relates to a data carrier (20) having, produced by intaglio printing, a halftone image that exhibits printed sub-areas (26, 28) having certain tonal values, at least three printed sub-areas having different tonal values. According to the present invention, it is provided that one or more of the different tonal values are formed by printed sub-areas (28) appearing fully printed to the naked eye and having a certain portion of unprinted white areas (W).

Abstract

The present invention relates to a data carrier (20) having, produced by intaglio printing, a halftone image that exhibits printed sub-areas (26, 28) having certain tonal values, at least three printed sub-areas having different tonal values. According to the present invention, it is provided that one or more of the different tonal values are formed by printed sub-areas (28) appearing fully printed to the naked eye and having a certain portion of unprinted white areas (W).

Data Carrier Having a Halftone Image

The present invention relates to a data carrier having, produced by intaglio printing, a halftone image that exhibits printed sub-areas having certain tonal values, at least three printed sub-areas having different tonal values. The present invention further relates to an intaglio printing plate and an intaglio printing process for printing halftone images having three or more different tonal values and a method for manufacturing such an intaglio printing plate.

Data carriers within the meaning of the present invention are especially security or value documents, such as banknotes, passports, identity documents, check forms, stocks, certificates, stamps, vouchers, airline tickets and the like, as well as labels, seals, packaging and other elements for product protection. In the following, the term "data carrier" encompasses all such documents and product protection means.

Normally, security and value documents whose commercial or utility value far exceeds their material value are, through suitable measures, made recognizable as authentic and distinguishable from imitations and counterfeits. For this, they are generally provided with special security elements that ideally cannot be imitated, or only with great effort, and are not counterfeitable.

In the past, particularly those security elements have proven successful that can be identified by the viewer and recognized as authentic without aids, but at the same time can be fabricated only with extensive technical or financial outlay. This includes, for example, watermarks that can be introduced into the data carrier only during paper manufacturing, or images produced in an intaglio printing process that feature a characteristic tactility that is easily

recognizable, also for the layperson, and that cannot be reproduced by other printing processes and especially by copiers or scanners.

Line or intaglio printing technology, especially steel intaglio printing technology, is of great importance for the printing of data carriers, especially security papers, such as banknotes and the like. What distinguishes intaglio printing is that linear depressions are introduced into the printing plates to produce an image. The ink-transferring regions of the printing plate are thus present as depressions in the printing plate surface. These depressions are produced by a suitable engraving tool or by etching. In mechanically produced printing plates for intaglio printing, a wider line is produced with increasing engraving depth as a result of the usually conically tapered engraving tools. Furthermore, the ink absorption capacity of the engraved line, and thus the opacity of the printed line, increases with increasing engraving depth.

In etching intaglio printing plates, the non-printing regions of the printing plate are covered with a chemically inert coating. Subsequent etching produces the engraving in the exposed plate surface, the depth of the scribe lines depending especially on the etching time.

Before the actual printing process, ink of a pasty consistency is applied to the engraved printing plate and the excess printing ink is removed from the surface of the printing plate with a doctor blade or a wiper cylinder so that the ink remains only in the depressions. Thereafter, a substrate, normally paper, is pressed against the printing plate, and thus also into the ink-filled depressions of the printing plate, and removed again, the ink being drawn out of the depressions of the printing plate, sticking to the substrate surface and forming an image there. If transparent inks are used, the thickness of the

inking determines the color tone. Thus, a light color tone is obtained when printing a white data carrier with small ink film thicknesses, and darker color tones when printing with thick ink films. The ink film thickness, in turn, is dependent to a certain extent on the engraving depth.

Line intaglio printing technology permits relatively thick inking on a data carrier compared with other common printing technologies, such as offset printing. The comparatively thick ink film produced in line intaglio printing technology, together with the partial deformation of the paper surface resulting from the paper being pressed into the engraving of the printing plate, is easily feelable manually, even for the layperson, and thus also readily recognizable as an authenticating feature based on its tactility. The tactility cannot be imitated with a copier, so that line intaglio printing technology offers valuable protection against counterfeits.

However, conventional line intaglio printing methods exhibit the disadvantage that tactility in the image and simultaneous full-surface printing cannot be realized in one printing operation. To remedy this, it was suggested in publication WO 03/052702 A2 to provide a data carrier with a halftone image produced by intaglio printing and including directly adjacent printed partial surfaces in at least a partial area of the image, the partial surfaces having certain tonal values, and at least a partial area of the image being tactilely perceptible. Here, the term "halftone image" refers, as in the present description, to an image having intermediate tones between the lightest and the darkest places of the image. If a black-and-white image is involved, "tonal value" is understood, as usual, to be a value on a gray scale from white to black. However, the present invention relates not only to black-and-white halftone images containing achromatic colors, namely white, black and gray, but also one- or multicolor halftone images including

so-called chromatic inks. In the case of chromatic halftone images, "tonal value" is understood to be the brightness of the color in question.

To produce such an image, in WO 03/052702 A2, an original, such as a portrait, is subdivided into partial surfaces based on halftone values, and the individual tonal values or groups of tonal values are assigned, in line with the printing ink used, different engraving depths for the printing plate to be produced. Here, the tonal values of the original are translated into corresponding engraving depths on the printing plate, whereby the engraving depth required to produce special tonal values can vary from printing ink to printing ink.

Based on that, the object of the present invention is to create a data carrier having greater counterfeit security and exhibiting, produced by intaglio printing, a halftone image having a large number of available halftone values.

This object is solved by the data carrier having the features of the main claim. An intaglio printing process and an intaglio printing plate for manufacturing a data carrier according to the present invention, and a method for manufacturing such an intaglio printing plate are specified in the coordinated claims. Developments of the present invention are the subject of the dependent claims.

According to the present invention, in a data carrier of the kind mentioned above, one or more of the different tonal values are formed by printed sub-areas appearing fully printed to the naked eye and having a certain portion of unprinted white areas. Through the use of such white areas, the number of

available halftone values can be significantly increased and, at the same time, selective halftone control achieved.

For example, if three different engraving depths are employed, through the use of different amounts of white, eight different tonal values can easily be realized that already allow an extraordinarily realistic rendering of halftone images, such as portraits. Furthermore, it has been shown that the use of the white areas according to the present invention leads to a stabilization of the color tone of the printed sub-areas, which makes itself advantageously noticeable particularly when poorly transparent printing inks are employed.

In a preferred embodiment, it is provided that the unprinted white areas of at least one of the different tonal values are formed by a family of parallel whitelines. Alternatively or additionally, according to a further, likewise preferred embodiment, the unprinted white areas of at least one of the different tonal values are formed by a regular crossline screen. Here, the white areas result, for example, from the rhombic spaces remaining between two intersecting families of parallel printing lines.

According to a further advantageous embodiment of the invention, the unprinted white areas of at least one of the different tonal values form a hidden piece of information, such as a pattern or a character string. The counterfeit security of the data carrier can be further increased through such an additional piece of information in the microstructure of the image, imperceptible to the naked eye. Here, the information of the white areas can be present as positive or negative information. It can also be provided in only a sub-area of the halftone image.

Advantageously, at least one of the printed sub-areas of the halftone image is tactilely perceptible or includes a tactilely perceptible structural element and in this way forms effective protection against imitation, e.g. through copying.

The measure of the unprinted white areas is, in at least one dimension, less than 100 µm, preferably less than 80 µm, particularly preferably less than 60 µm, even more preferably less than 40 µm and especially preferably less than 20 µm. To meet this condition, the white areas can, for example, be lines having a width less than 100 µm (or less than 80 µm or 60 µm or 40 µm or 20 µm) or be formed by surface regions of any shape having a surface measure less than 100 µm x 100 µm (or less than 80 µm x 80 µm or 60 µm x 60 µm or 40 µm x 40 µm or 20 µm x 20 µm).

In a preferred embodiment, at least six, for example, eight, printed sub-areas have different tonal values and are each formed by printed sub-areas appearing fully printed to the naked eye and having a certain portion of unprinted white areas. With such a fine resolution of the tonal values, nearly photorealistic representations can be achieved in intaglio printing.

The sub-areas of the halftone image can especially be derived from a screen superimposed on an original halftone image, as described in international application WO 03/052702. Also, the halftone image can, as described in WO 03/052702, exhibit additional tactile structural elements, or at least be superimposed in sub-areas with microstructures that influence its visual appearance and that exhibit a different orientation in individual sub-areas. WO 03/052702 also describes various possibilities for translating a halftone original into an intaglio print image that can likewise be employed in the present invention. With respect to the cited objects, the disclosure of WO 03/052702 is incorporated herein by reference.

The present invention further includes an intaglio printing plate for printing a halftone image, having in the printing plate surface at least three differently engraved regions that serve to print different tonal values. Here, one or more of the at least three engraved regions exhibit a certain portion of non-printing white areas that are formed by, lying at the level of the printing plate surface, patches whose measure in at least one dimension lies below the resolution limit of the naked eye.

Advantageously, the non-printing white areas of at least one of the engraved regions of such a printing plate can result from a family of parallel scribe lines whose spacing is greater than the line width of the scribe lines. Here, spacing is not understood as the non-printing space between the scribe lines, but rather the distance e.g. from the left flank of one scribe line to the left flank of the next scribe line. Alternatively or additionally, the non-printing white areas of at least one of the engraved regions can also result from two families of scribe lines, each of which is parallel, intersecting at an angle. Here, too, the spacing of the scribe lines within each family is greater than the line width of the scribe lines, so that rhombic white areas result. Advantageously, the two families intersect at an angle lying between 40° and 80°, preferably between 50° and 70°, for example, around 60°.

The scribe lines of the intaglio printing plate or the printed lines preferably exhibit a width below 60 µm, particularly preferably below 50 µm, especially preferably below 30 µm.

According to a development of the invention, the non-printing white areas of at least one of the engraved regions form a hidden piece of information, such as a pattern or a character string, to further increase the counterfeit security

of the halftone images produced. Here, the hidden piece of information can be present as positive or negative information and can also be provided in only a sub-area of the halftone image.

The white area patches lying at the level of the printing plate surface preferably continue into the depth of the printing plate at an included angle α lying between 15° and 60°, preferably between 30° and 50°, based in each case on the surface normal of the printing plate. Advantageously, at least one of the engraved regions exhibits a base area having a basic roughness pattern like that, for example, which can be produced according to the method described in publication WO 97/48555.

The present invention also includes a method for manufacturing an intaglio printing plate for printing a halftone image having three or more different tonal values, having the process steps:

- providing a printing plate having a printing plate surface,

- engraving at least three different regions in the printing plate, wherein in one or more of the three regions is left a certain portion of non-printing white areas that are formed by, lying at the level of the printing plate surface, patches whose measure in at least one dimension lies below the resolution limit of the naked eye.

The white area patches lying at the level of the printing plate surface are advantageously formed such that they extend into the depth of the printing plate at an included angle α lying between 15° and 60°, preferably between 30° and 50°, based on the surface normal of the printing plate. Here,

expediently, an engraving tool having an appropriate included angle α is employed for engraving.

Preferably, the intaglio printing plates according to the present invention are manufactured by engraving with a stylus, particularly preferably with a quickly rotating, conically tapered stylus, as described in publication WO 97/48555. In this way, especially colorful, in other words for example monochrome blue or red halftone images with brilliant, intensive colors can be produced that show no sign of gray or brown admixtures in the various tone gradations. In principle, however, the engravings can also be produced by laser engraving or etching or any other suitable abrasion method.

By employing intaglio printing technology, especially steel intaglio printing technology, for the halftone images according to the present invention, a characteristic print and embossing image is achieved that is easily recognizable even for laypersons and that cannot be reproduced by other common printing methods. Intaglio printing technology and the innovation disclosed here are thus particularly suitable for printing valuable or security-relevant data carriers, such as security or value documents, which must satisfy high requirements with respect to counterfeit security.

Further exemplary embodiments and advantages of the present invention are explained below by reference to the drawings, in which a depiction to scale and proportion was omitted in order to improve their clarity.

Shown are:

Fig. 1 a schematic diagram of a banknote having, produced by intaglio printing, a halftone image according to an exemplary embodiment of the present invention,

Fig. 2 a view of a section of the banknote in fig. 1 in the area of the halftone image, in cross-section,

Fig. 3 a corresponding section of the profile of the intaglio printing plate used to manufacture the halftone image in fig. 2, likewise according to an exemplary embodiment of the invention, and

Fig. 4 in (a) to (e), various top views of sub-areas of a data carrier printed according to the present invention, viewed with a magnifier or a microscope.

The present invention will now be explained using a banknote as an example. Fig. 1 shows a banknote 10 that is provided with, produced by intaglio printing, a halftone image 12 that is represented schematically in the drawing as a black-and-white portrait. Typically, the entire image of the banknote is comprised of a superimposition of multiple images that are produced with different printing methods. In addition to or instead of the portrait 12, a further graphic theme 14 can also be executed as the intaglio halftone image according to the present invention. In the last case, the portrait 12 can also be produced with conventional intaglio printing.

Furthermore, the banknote 10 can include a pattern 16 produced by offset printing, for example a Guilloché pattern of regularly interlaced lines or another finely structured pattern, and a serial number 18 imprinted by

letterpress printing. Regions produced by screen printing or other printing methods can also be provided.

Fig. 2 shows, for illustration, a view of a section of the banknote 10 in the area of the intaglio halftone image 12, in cross-section. The section pictured shows the banknote paper 20, which is deformed by the contact pressure in the printing process and which exhibits depressions 22 on the back of the banknote and elevations 24 on the front of the banknote. In the printed sub-areas 26 and 28, of which only a portion is pictured in the drawing, the elevations 24 are each covered with ink films 36 or 38 that were absorbed, in the printing process, from the engraved regions 46 and 48 (fig. 3) of the printing plate 40.

The first printed sub-area 26 is covered with an ink film 36 of a certain ink film thickness D and appears within the halftone image 12 in a first tonal value that is determined by the consistency of the printing ink and the banknote paper used.

The second printed sub-area 28 is covered with an ink film 38 exhibiting the same thickness D as the ink film 36 of the first sub-area 26. In contrast to the first sub-area, however, the image of the second sub-area 28 is formed having a certain portion of unprinted white areas W. The measure of the white areas W in at least one dimension lies below the resolution limit of the naked eye, so that it cannot be resolved without aids.

The second printed sub-area 28 thus appears to the naked eye as a uniform, fully printed surface. However, due to the existing amount of white, it appears within the halftone image 12, despite the identical ink film thickness

D, in a second tonal value that is lighter than the first tonal value of the sub-area 26.

In this way, if ink film thickness is constant, the amount of white can be used to set each of multiple different tonal values, each ranging up to the brightness of the continuous ink film 36 of the first sub-area 26. Thus, through a combination of various ink film thicknesses D and different amounts of white, a multitude of tonal values between "white" and "black" (or the value for complete coverage of the printing ink used) can be obtained. It is understood that, in a halftone image, there need not necessarily be a tonal value that is represented by a full-surface ink film 36. Rather, it can be advantageous to represent all occurring tonal values through sub-areas having a certain amount of white.

Fig. 3 shows the section of the profile of the associated intaglio printing plate 40 that corresponds to the illustration in fig. 2. In the printing plate surface 42 are engraved a first engraving area 46 and a second engraving area 48, each having the same engraving depth T. While the first engraving area 46 is formed continuously and thus leads to a continuous ink film 36 in the printing process, the second engraving area 48 is equipped with, reaching to the printing plate surface 42, partitions 50 whose faces 52 lying at the level of the printing plate surface 42 form non-printing white areas.

The partitions 50 continue from the faces 52 lying at the surface 42 of the printing plate into the depth of the printing plate at an included angle α that is defined substantially by the engraving tool used. In the exemplary embodiment, the engraving areas of the intaglio printing plate 40 are engraved with a rotating stylus whose included angle corresponds to the included angle to be produced in the partitions 50.

To produce, at the same engraving depth, different white areas or different amounts of white, the engraving tool can be guided along different tracks for the various sub-areas. Fig. 4 shows, in (a) to (e), some exemplary embodiments for this. Shown in each case is a top view of a uniformly printed sub-area of a data carrier as seen when viewed with a magnifier or a microscope.

Fig. 4(a) shows a first section 60 in which the associated intaglio printing plate includes a family of parallel scribe lines whose spacing is greater than the line width of the scribe lines. Produced in the exemplary embodiment at, for example, an engraving depth of 15 µm were approximately 30-µm-wide scribe lines having a spacing of 60 µm. In the image, this results in a relatively light sub-area that appears fully printed to the naked eye and that shows, under a magnifier or a microscope, the structure illustrated here in fig. 4(a) comprising a family of parallel printing lines 62 and parallel whitelines 64 lying there between.

Very good results are also produced by the use of cross-grating, such as that resulting from two families of parallel scribe lines intersecting at a certain angle β. As shown in section 70 in fig. 4(b), the intersecting line families 72 produce small, rhombic white areas 74 in the image. On the corresponding intaglio printing plate, the intersecting scribe lines leave small pyramid stumps that extend to the printing plate surface and whose non-printing top surface, in intaglio printing, results in just the rhombic white areas 74 shown.

The scribe lines of the printing plate need not necessarily run straight, as illustrated in section 80, shown in fig. 4(c), which shows two intersecting, curved line families 82 and white areas 84 enclosed thereby.

The white areas can also form a hidden piece of information, such as a pattern or a character string that is recognizable only with appropriate magnification. Purely as an example, sections 90 and 94 of figures 4(d) and (e) show simple variants of such designs, in which the white areas in the form of the letter "D" form positive information (reference number 92, fig. 4(d)) or negative information (reference number 96, fig. 4(e)). Here, too, different tonal values can be set by the line width of the scribe lines and/or the spacing of the individual information elements (here the letter "D"). Substantially more complex information can, of course, also be introduced into the image in this way.

Claims

1. A data carrier having, produced by intaglio printing, a halftone image that exhibits printed sub-areas having certain tonal values, at least three printed sub-areas having different tonal values, **characterized in that** one or more of the different tonal values are formed by printed sub-areas appearing fully printed to the naked eye and having a certain portion of unprinted white areas and where the measure of the unprinted white areas is, in at least one dimension, less than 100 µm.

2. The data carrier according to claim 1, **characterized in that** the unprinted white areas of at least one of the different tonal values are formed by a family of parallel whitelines.

3. The data carrier according to claim 1 or 2, **characterized in that** the unprinted white areas of at least one of the different tonal values are formed by a regular crossline screen.

4. The data carrier according to at least one of claims 1 to 3, **characterized in that** the unprinted white areas of at least one of the different tonal values form a hidden piece of information.

5. The data carrier according to at least one of claims 1 to 4, **characterized in that** the at least one of the printed sub-areas of the halftone image is tactilely perceptible.

6. The data carrier according to at least one of claims 1 to 5, **characterized in that** the measure of the unprinted white areas is, in at least one dimension, less than 80 µm.

7. The data carrier according to at least one of claims 1 to 5, **characterized in that** the measure of the unprinted white areas is, in at least one dimension, less than 60 µm.

8. The data carrier according to at least one of claims 1 to 7, **characterized in that** at least six printed sub-areas have different tonal values, each of which is formed by a printed sub-area appearing fully printed to the naked eye and having a certain portion of unprinted white areas.

9. The data carrier according to at least one of claims 1 to 8, **characterized in that** the halftone image constitutes a portrait.

10. An intaglio printing plate for printing a halftone image, having at least three differently engraved regions in the printing plate surface for printing different tonal values, **characterized in that** one or more of the at least three engraved regions exhibits a certain portion of non-printing white areas formed by, lying at the level of the printing plate surface, patches whose measure in at least one dimension lies below the resolution limit of the naked eye, and where the measure of the unprinted white areas is, in at least one dimension, less than 100 µm.

11. The intaglio printing plate according to claim 10, **characterized in that** the non-printing white areas of at least one of the engraved regions result from a family of parallel scribe lines whose spacing is greater than the line width of the scribe lines.

12. The intaglio printing plate according to claim 10 or 11, **characterized in that** the non-printing white areas of at least one of the engraved regions result from two families of scribe lines, each of which is parallel and each of whose spacing is greater than the line width of the scribe lines, intersecting at an angle.

13. The intaglio printing plate according to claim 12, **characterized in that** the two families intersect at an angle between 40° and 80°, preferably between 50° and 70°.

14. The intaglio printing plate according to at least one of claims 11 to 13, **characterized in that** the scribe lines exhibit a width below 60 µm, preferably below 50 µm.

15. The intaglio printing plate according to at least one of claims 10 to 14, **characterized in that** the non-printing white areas of at least one of the engraved regions form a hidden piece of information, such as a pattern or a character string.

16. The intaglio printing plate according to at least one of claims 10 to 15, **characterized in that** the white area patches that lie at the level of the printing plate surface continue into the depth of the printing plate at an included angle α lying between 15° and 60°, based on the surface normal of the printing plate.

17. The intaglio printing plate according to at least one of claims 10 to 16, **characterized in that** at least one of the engraved regions exhibits a base area having a basic roughness pattern.

18. The intaglio printing plate according to at least one of claims 10 to 17, **characterized in that**, for printing different tonal values, at least six differently engraved regions are provided that each exhibit a certain portion of non-printing white areas that are formed by, lying at the level of the printing plate surface, patches whose measure in at least one dimension lies below the resolution limit of the naked eye.

19. An intaglio printing process for printing a halftone image having three or more different tonal values, in which an intaglio printing plate according to one of claims 10 to 18 is employed.

20. A method for manufacturing an intaglio printing plate for printing a halftone image having three or more different tonal values, having the process steps:

- providing a printing plate having a printing plate surface,

- engraving at least three different regions in the printing plate, wherein in one or more of the three regions is left a certain portion of non-printing white areas that are formed by, lying at the level of the printing plate surface, patches whose measure in at least one dimension lies below the resolution limit of the naked eye.

and where the measure of the unprinted white areas is, in at least one dimension less than 100 µm.

21. The method according to claim 20, **characterized in that** the non-printing white areas of at least one of the engraved regions is produced from

a family of parallel scribe lines whose spacing is greater than the line width of the scribe lines.

22. The method according to claim 20 or 21, **characterized in that** the non-printing white areas of at least one of the engraved regions is produced from two families of scribe lines, each of which is parallel and each of whose spacing is greater than the line width of the scribe lines, intersecting at an angle.

23. The method according to claim 22, **characterized in that** the two families intersect at an angle between 40° and 80°, preferably between 50° and 70°.

24. The method according to at least one of claims 21 to 23, **characterized in that** the scribe lines are produced having a width below 60 µm, preferably below 50 µm.

25. The method according to at least one of claims 20 to 24, **characterized in that** the non-printing white areas of at least one of the engraved regions are produced in the form of a hidden piece of information, such as a pattern or a character string.

26. The method according to at least one of claims 20 to 25, **characterized in that** the white area patches that lie at the level of the printing plate surface are produced continuing into the depth of the printing plate at an included angle α lying between 15° and 60°, preferably between 30° and 50°, based on the surface normal of the printing plate.

27. The method according to claim 26, **characterized in that** an engraving tool having an included angle α is employed for engraving.

28. The method according to at least one of claims 20 to 27, **characterized in that** a rotating stylus is employed for engraving.

29. The method according to at least one of claims 20 to 27, **characterized in that** the engraving is carried out by means of a laser beam or through etching.

30. The method according to at least one of claims 20 to 29, **characterized in that** a base area having a basic roughness pattern is produced in at least one of the engraved regions.

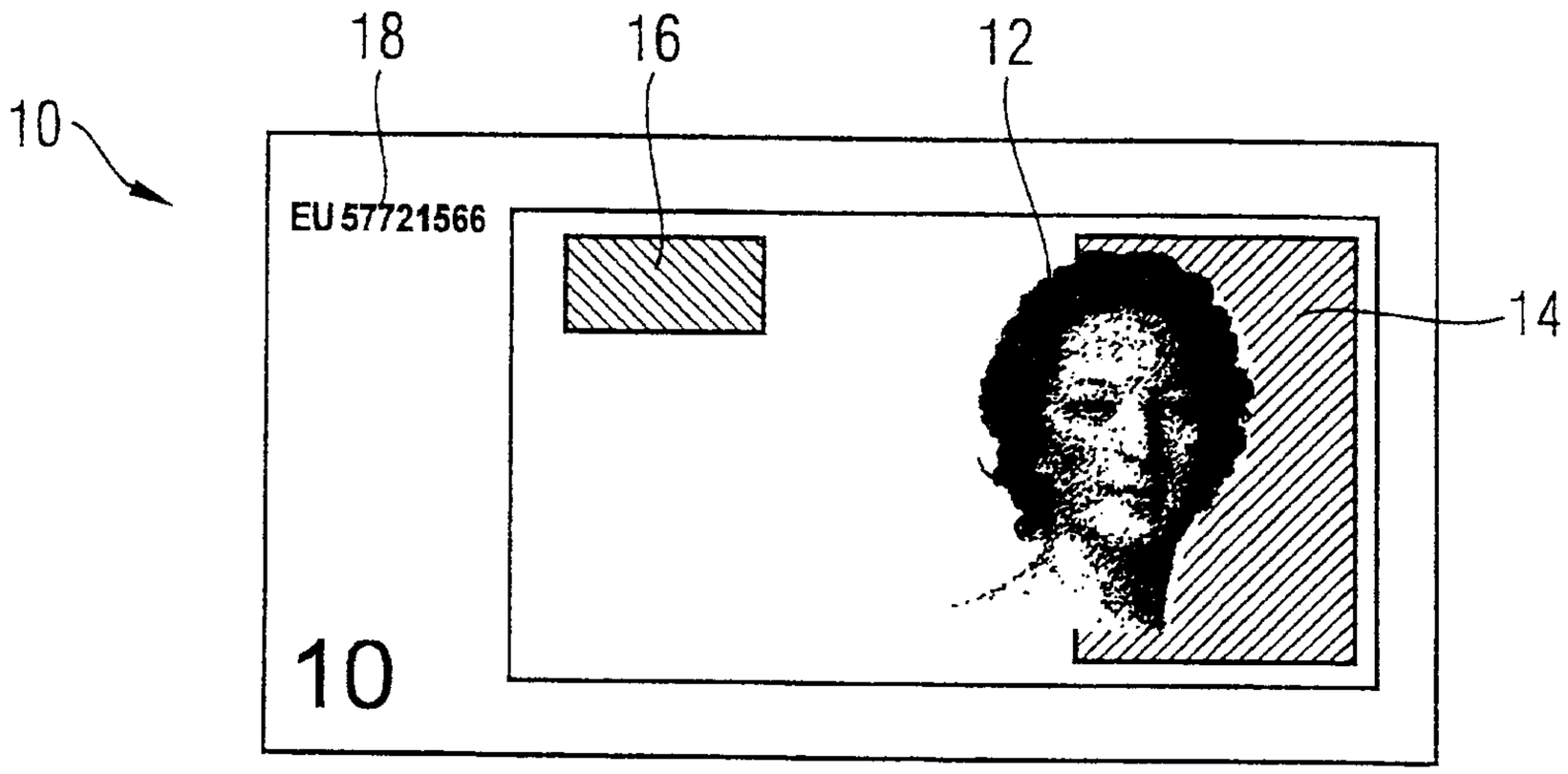

Fig. 1

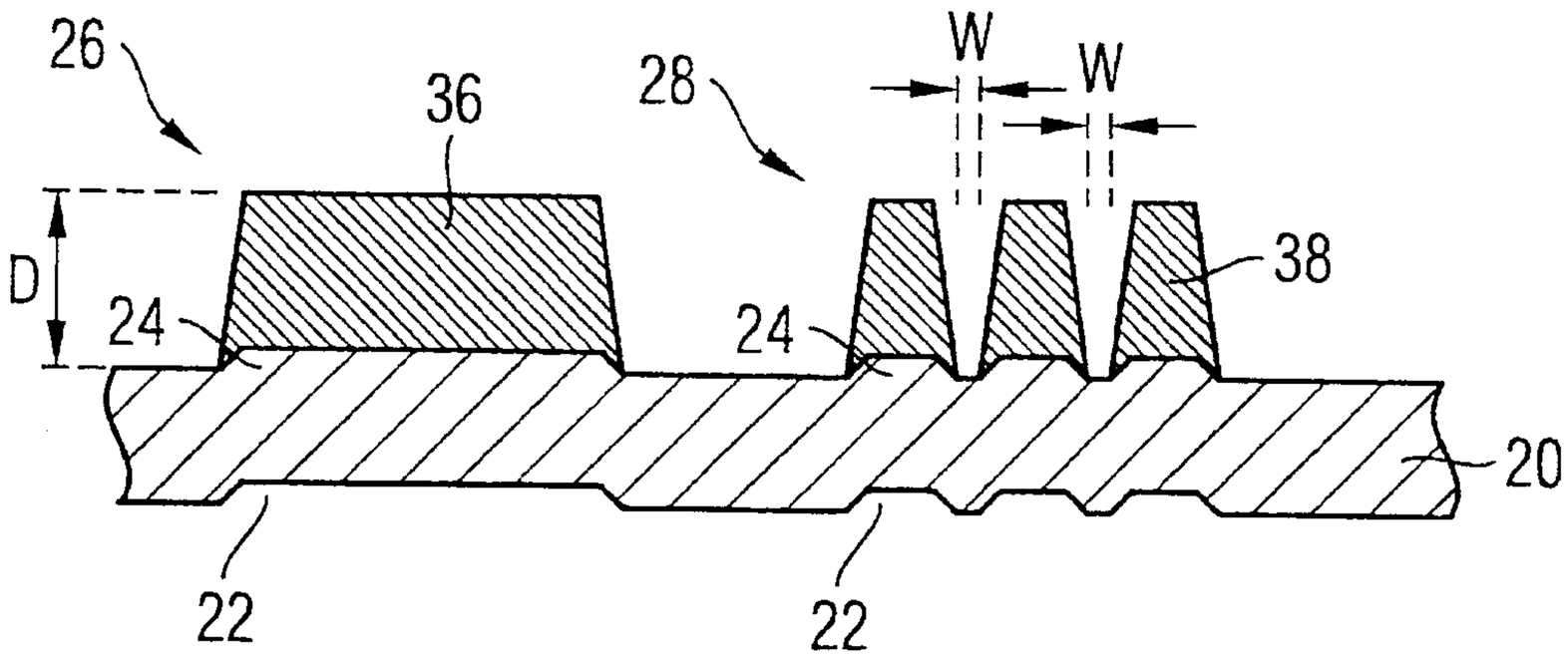

Fig. 2

Fig. 3

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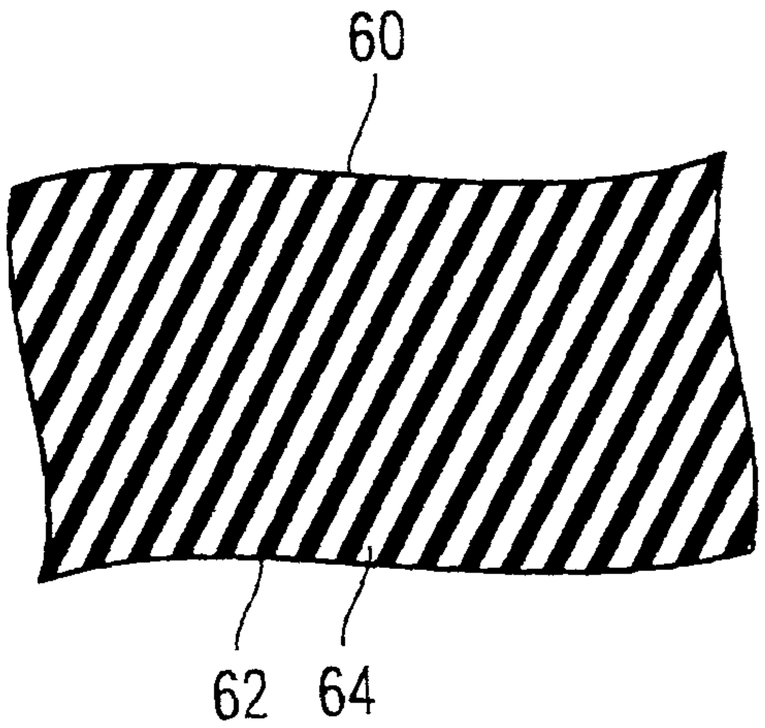

Fig. 4a

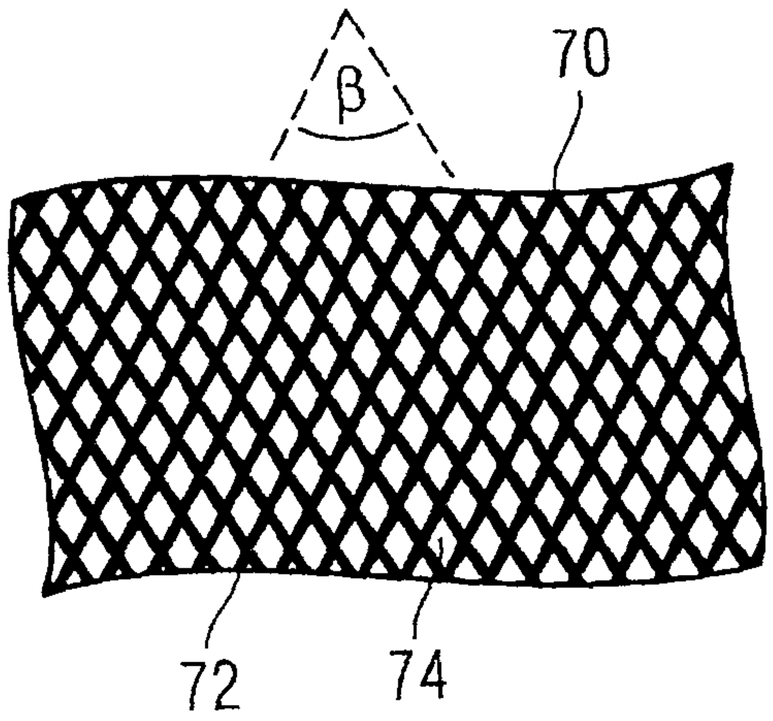

Fig. 4b

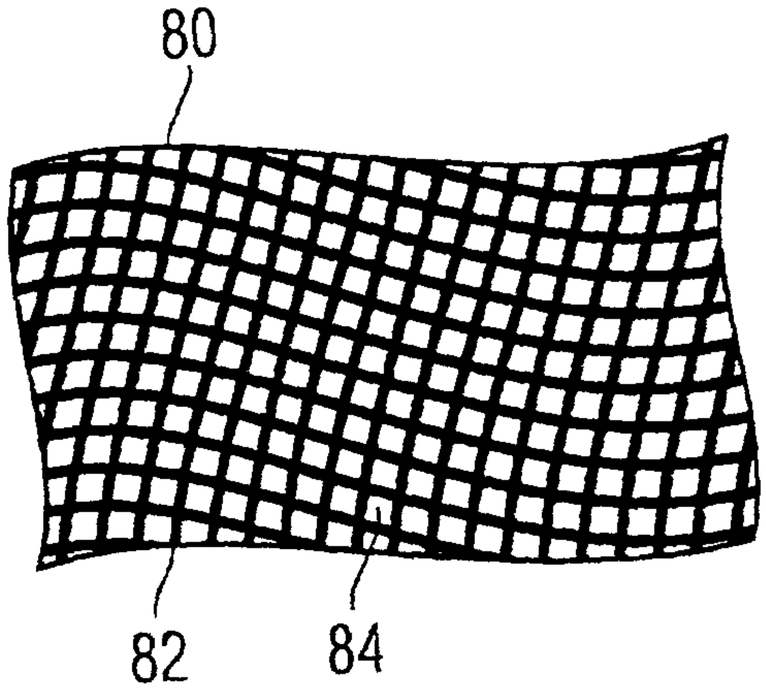

Fig. 4c

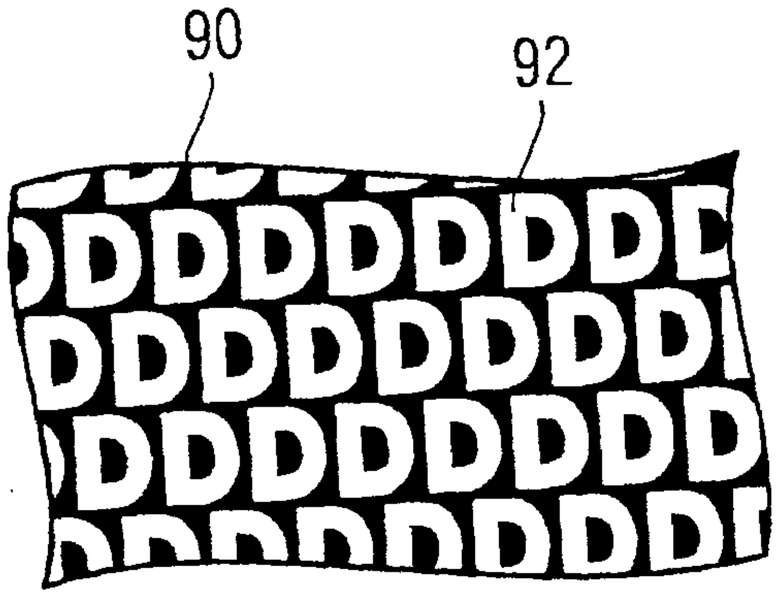

Fig. 4d

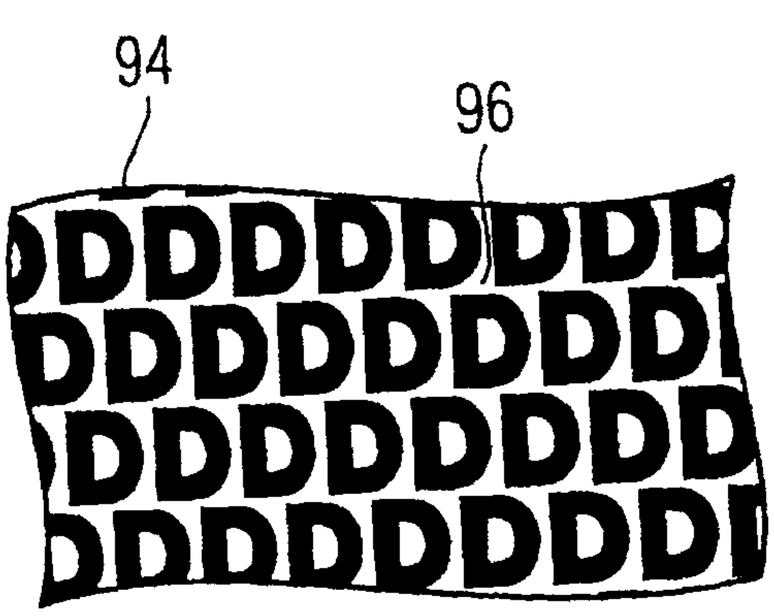

Fig. 4e

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

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(54) Title: METHOD FOR PRODUCING MICROPOROUS SHEET

(57) Abstract: Provided is a method of producing a microporous sheet material of a polymeric matrix of polyolefin, with finely divided and substantially water-insoluble filler distributed throughout the matrix, and a network of interconnecting pores communicating throughout the microporous material. The method includes: (a) forming a mixture of polyolefin, filler and a processing plasticizer composition; (b) extruding the mixture to form a continuous sheet; and (c) contacting the continuous sheet with a non-flammable extraction fluid composition to extract the processing plasticizer composition from the continuous sheet. The extraction fluid has a boiling point of 75°C or less, and is essentially free of trichloroethylene. The microporous sheet material has Tensile Strength equal to or greater than 800 kPa. A microporous sheet material also is provided.

Abstract

The present invention relates to a data carrier (20) having, produced by intaglio printing, a halftone image that exhibits printed sub-areas (26, 28) having certain tonal values, at least three printed sub-areas having different tonal values. According to the present invention, it is provided that one or more of the different tonal values are formed by printed sub-areas (28) appearing fully printed to the naked eye and having a certain portion of unprinted white areas (W).

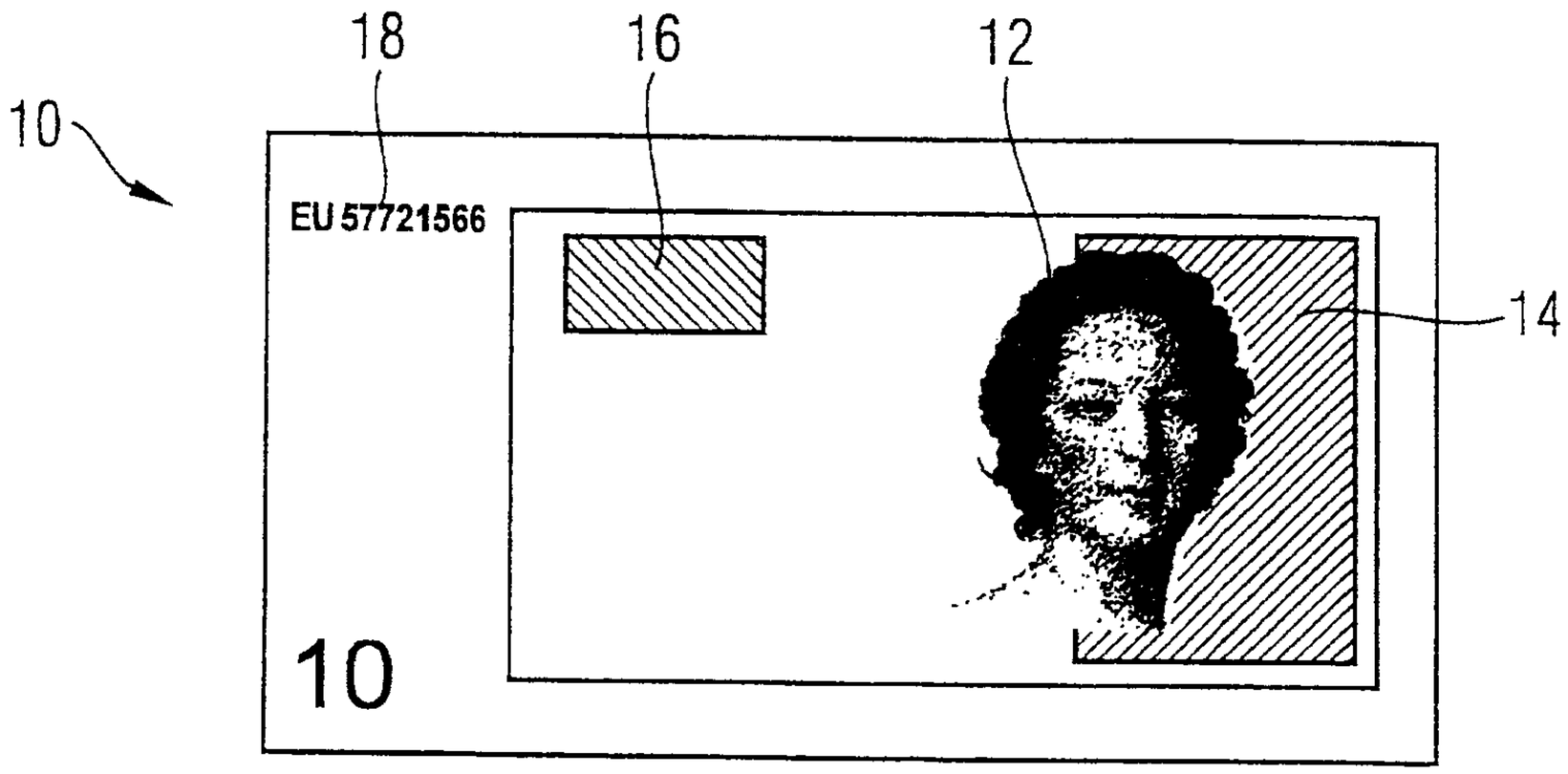

Fig. 1

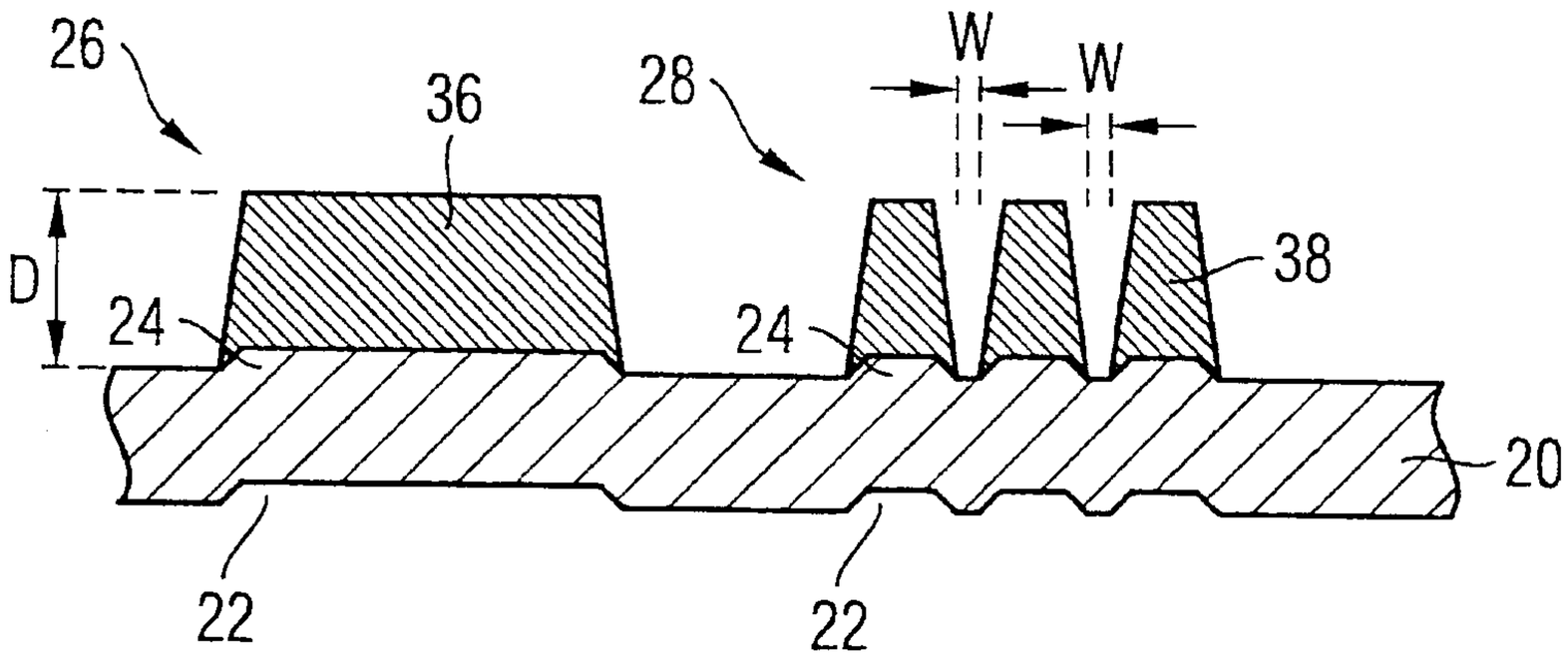

Fig. 2

Fig. 3

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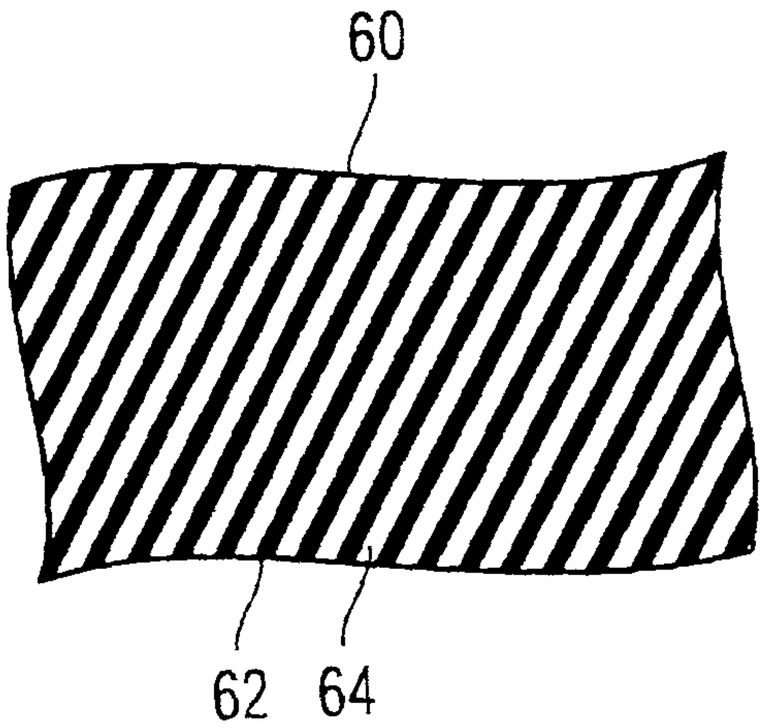


Fig. 4a

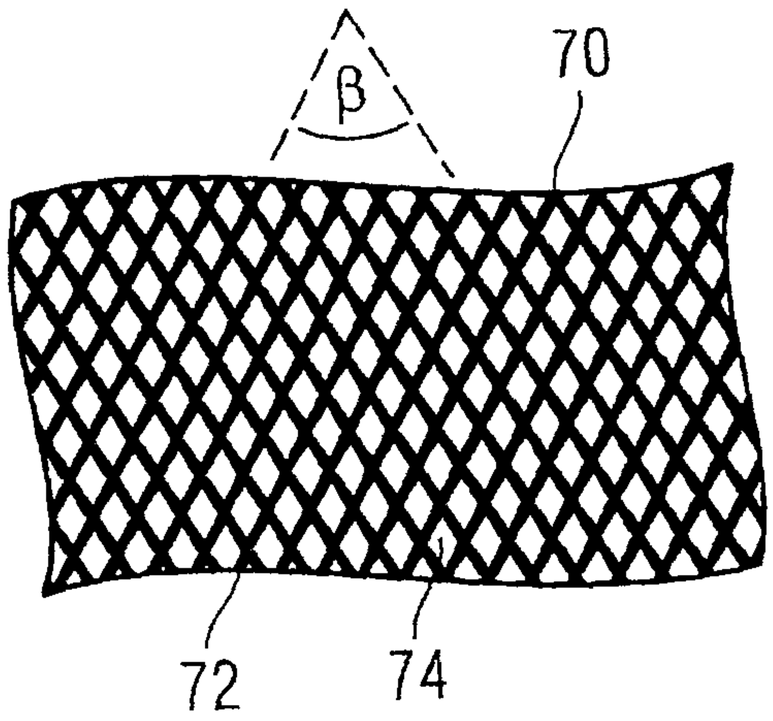


Fig. 4b

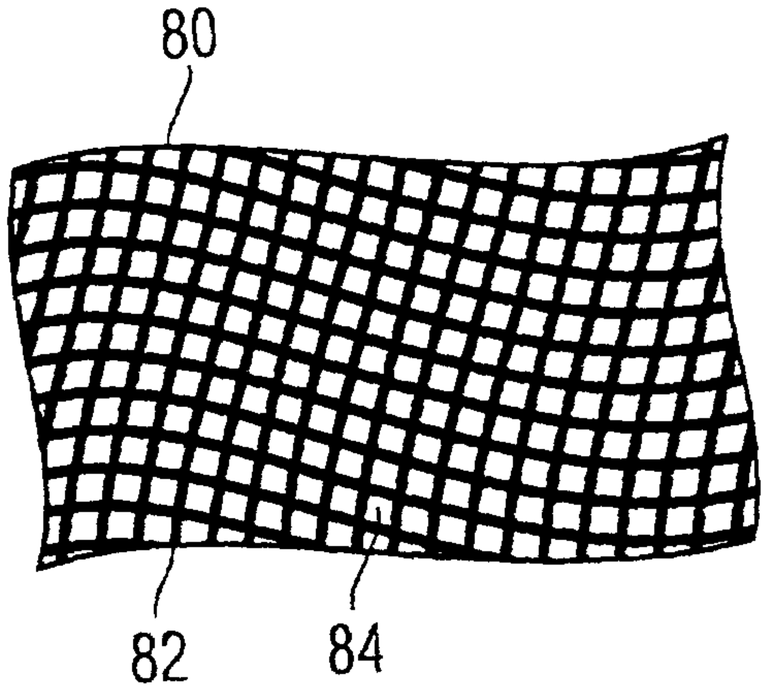


Fig. 4c

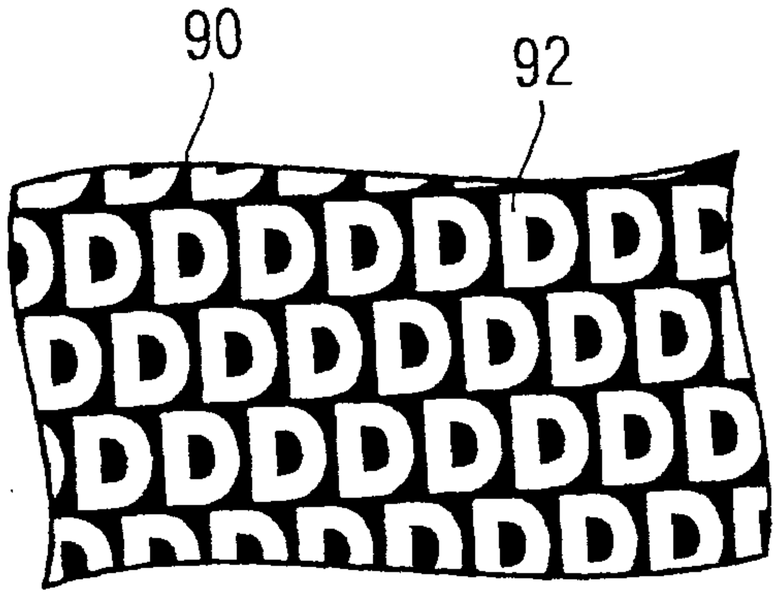


Fig. 4d

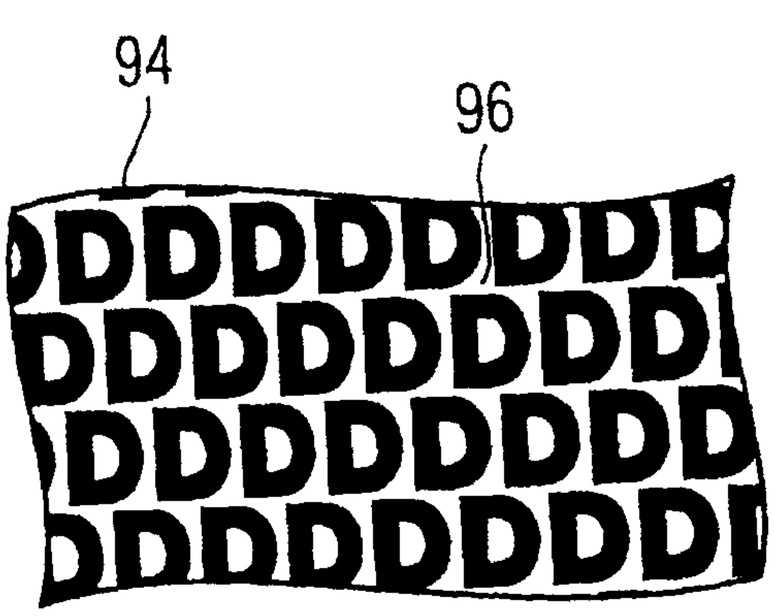
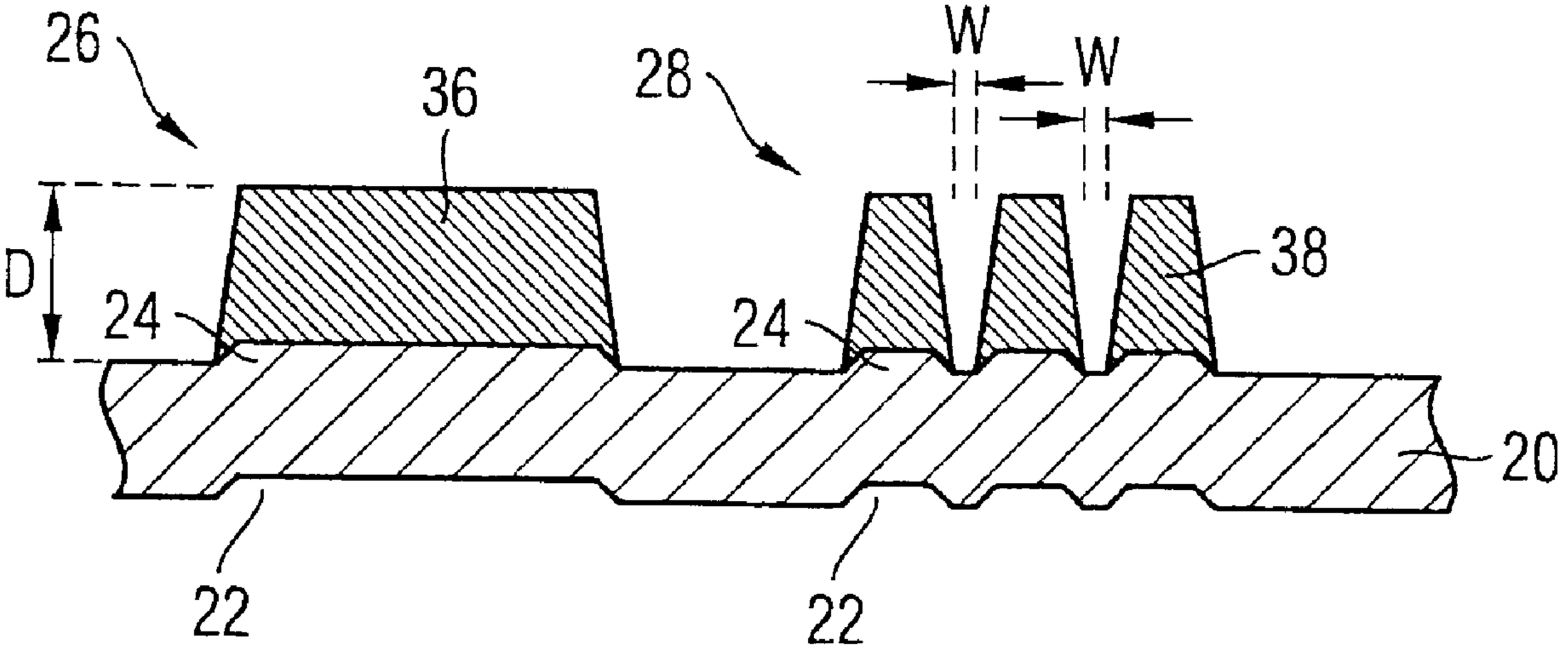


Fig. 4e


26
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