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(54) **PRINTED SECURITY FEATURE AND METHOD OF MANUFACTURE**

GEDRUCKTES SICHERHEITSELEMENT UND VERFAHREN ZU DESSEN HERSTELLEN

ÉLEMENT DE SÉCURITÉ ET SA MÉTHODE DE FABRICATION

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Description

[0001] This invention relates to printed security features which may be used for example on security articles including security documents such as banknotes, cheques and the like. Also disclosed are methods of manufacturing the printed security feature.

[0002] In the field of secure documents, there is a constant need to develop security features which increase the difficulty of counterfeiting or fraudulently altering the document. Examples of such security features include holographic elements, watermarks, security threads, foils, patches, embossing, security inks and the like, which may be applied to and/or incorporated into the document. Printed security features are an important example, since they can if desired be arranged to cover a significant portion of the document's area and thus have a significant effect on the overall appearance of the document. If the printed feature is sufficiently difficult for a counterfeiter to reproduce, counterfeited notes can be relatively easily detected by a trained or untrained person. Examples of the security features which we have developed are described in WO-A-2005/047013, WO-A-01/66360 and EP-A-1880865. However, ever more sophisticated security features are desired as counterfeiters' abilities increase.

[0003] GB 402 028 A discloses a printed security feature comprising first and second printed workings which are in register with each other.

[0004] In accordance with the present invention, a printed security feature is provided comprising at least a first and a second printed working, wherein the first printed working is a screened working defined by a grid of screen elements having the form of indicia carrying information, and the second printed working is a screened working in register with the first printed working, the first and second printed workings appearing, in combination, as a multi-tonal image, whereby the information carried by the indicia is at least partially concealed by the second printed working, wherein the first and second printed workings each vary in tone gradually across the image, the tone of the first printed working varying less or more gradually across the image than the tone of the second printed working.

[0005] The invention further provides a method of manufacturing a printed security feature, comprising printing a first working on to a substrate in the form of a screened working defined by a grid of screen elements having the form of indicia carrying information; and printing a second working on to the substrate in register with the first working, in the form of a screened working; such that the first and second printed workings appear, in combination, as a multi-tonal image, whereby the information carried by the indicia is at least partially concealed by the second printed working, wherein the first and second printed workings each vary in tone gradually across the image, the tone of the first printed working varying less or more gradually across the image than the tone of the second printed working.

[0006] By providing two registered printed screen workings (which at least partially overlap one another) in this way, an aesthetically complex multi-tonal image, such as a portrait or other photo-quality graphic can be produced. During normal handling, the image thus appears as a high-quality but otherwise conventional print. However, when examined in detail, for example at increased magnification, the information carried by the indicia of the first printed working becomes apparent. As such, the image can be used to carry additional information by means of the indicia, which is not readily apparent to the casual observer yet can be identified on closer examination. This provides increased security since the authenticity of the note can be checked by examining the feature to confirm that the expected information is present in the image. The difficulty of counterfeiting is also significantly enhanced since, in practice, it is extremely difficult for a counterfeiter without specialised equipment to register two printed workings to the degree required to produce images of sufficient quality. Even a small degree of misalignment between the two workings will typically lead to blurring and/or changes in interference patterns such as Moiré effects which are easily observed. Photocopying will also not produce a successful result due to the high resolution of the feature.

[0007] By "screened working", it is meant a print layer formed of an array of screen elements whose characteristics may be spatially modulated across the layer so as to provide regions of visual contrast. For example, the screen elements (or analogously the background surrounding the elements) may vary in their size, thickness, spacing, ink density, colour, tone, hue and/or saturation. Preferably, each of the screened workings is multi-tonal, i.e. the tone of both workings (individually) varies across the image. The screen elements of the first working have the form of indicia such as letters, numbers, symbols, punctuation marks and the like. The second printed working can have screen elements of any form such as lines, dots, or otherwise. Screen workings based on lines and/or dots are well-known in the art. In preferred embodiments, the shape of the screen elements making up the first working is different from the shape of the screen elements making up the second working.

[0008] The at least partial concealment of the information by the second printed working (arising from the at least partial overlapping of the two workings) can occur as a result of different mechanisms. If the first printed working is located underneath the second working (relative to the viewer), the ink of the second working can physically obstruct the view of the underlying indicia. However, in addition, the second printed working has the effect of confusing the eye which in itself conceals the presence of the indicia from the viewer. This latter effect applies whichever the order of the two workings relative to the viewer.

[0009] Nonetheless, in general, for maximum concealment of the information, it is preferred that the first printed

working is located so as to be viewable through the second printed working. That is, the second printed working is located between the viewer and the first printed working. In a first preferred implementation, this is achieved by arranging that the second printed working overlays the first printed working on a substrate. This can be achieved for example by printing the first and second workings in sequential steps. In another preferred implementation, the first and second printed workings are disposed on opposite sides of a substantially transparent substrate, such as a window in a polymer banknote, for example. This could be achieved by printing the two workings onto the opposite sides of the substrate simultaneously.

[0010] The indicia could take any desirable form able to carry information. However, in particularly preferred embodiments, the indicia comprise alphanumeric symbols. These include letters and number of any alphabet or script, Roman or non-Roman, including (but not limited to) Chinese, Japanese, Sanscrit, Arabic and Russian as well as Latin-based languages such as English, French, German etc. The use of alphanumeric symbols enables the information to be intelligible to a human reader as is the preferred implementation. However, the grid could additionally include other indicia types such as symbols, e.g. punctuation marks and/or currency symbols (£, $ etc). The grid spacing between the centres of the indicia may or may not be constant across the working.

[0011] The grid could be formed entirely of a single element type. That is, for example, every element in the grid may represent the same indicium such as the numeral "10" or the letter "A". However, to increase the amount of information that can be incorporated into the printed feature, it is preferred that the grid of screen elements comprises screen elements of at least two different indicia values. For example, the grid could comprise a symbol element, such as a currency symbol (e.g. "£" or "$"), and a numeral, e.g. "5", in alternating or random positions across the grid. The amount of data may be further increased by using a repeating pattern of elements within the grid to convey data. Thus, in this case, the grid of screen elements preferably comprises a plurality of subsets of screen elements, each of the subsets comprising screen elements of at least two indicia values configured to convey a code. For example, each subset of three elements within the array could be designed to carry the indicia "T", "E", "N" thus forming the word "ten" repeatedly across the grid. The greater the number of screen elements included in each of the subsets, the greater the data capacity.

[0012] The nature of the information carried by the indicia can be selected as desired. In some examples, it could relate to the image itself. For example, a portrait of the Queen could incorporate indicia forming the code "ER II". However, in particularly preferred embodiments, the information carried by the indicia is information relating to a document to which the printed security feature is (or will be) applied, preferably denomination, currency, issue, bank and/or country information. Thus, where the printed security feature is applied to a banknote for example, the indicia may be used to identify the denomination of that banknote, e.g. "5" or "five". In this way, the same portrait could be applied to each of a series of related documents, such as different denominations of a banknote series, with the indicia incorporated in each portrait varied to reflect the relevant document information.

[0013] The grid itself (i.e. the pattern in which the indicia are arrayed) will typically be orthogonal, having rows and columns at approximately 90 degrees to each other, but in practice could take any desired form, such as a hexagonal grid, a circular grid or a sinusoidal grid. In hexagonal grids, the straight "rows" and "columns" are arranged at around 60 degrees to each other (though a grid based on any other angle could be selected); in circular grids, the indicia are positioned at intersections between concentric circles and radial lines; and in sinusoidal grids either the "rows" and/or the "columns" of indicia follow a sinusoidal path. In particular preferred implementations, the grid is "regular" such that the spacing between elements does not vary across the screen. However, this is not essential, as described further below.

[0014] It should be noted that either of the first and second printed workings could be formed as positive or negative screened workings. In a positive screen working, the screen elements themselves are filled with ink, and their surroundings left blank. In a negative screen, the opposite is true. In order to achieve a smooth and high quality multi-tonal image, it is preferred that the first printed working is a negative screen, the indicia being formed of unprinted regions surrounded by ink. However, this is not essential.

[0015] Various printing techniques can be used to form the first and second printed workings, provided the two workings can be precisely registered. In particularly preferred implementations, the first printed working is formed by lithographic, gravure or flexographic printing.

[0016] As noted above, the screen elements forming the second printed working can take various different forms and are preferably different in shape from those making up the first printed working. However, in particularly preferred implementations, the second printed working is a line working, defined by continuous or non-continuous lines of varying thickness. This has been found to produce a particularly effective concealment of the indicia. Preferably, the lines of the working are parallel to one another and straight, curved, sinusoidal or zig-zagged. The spacing between the screen elements is preferably constant across the working but, as for the first working, this is not essential.

[0017] Again, the second printed working may be formed by a number of printing techniques but is preferably formed by lithographic, gravure or flexographic printing.

[0018] In general, it is preferred that the printed security feature does not exhibit any Moiré patterns caused by

interference between the two workings, since this diminishes the appearance of the image. That being said, in certain applications, it may be desirable to intentionally include a particular Moiré effect as an additional feature superimposed on the image. In order to reduce or eliminate Moiré patterns, it is preferred that the grid spacing of the first printed working at any one location is substantially equal to a multiple of the spacing of the screen of the second printed working at the same location, or vice versa. In other words, the pitch of the screen elements in the first and second workings is preferably near-identical, or one corresponds to a "harmonic" of the other, at any particular part of the feature (though the spacing of both workings could vary across the feature). What is important is that the periodicity of each grid should match at any particular location. The first and second workings need not be aligned with each other in the sense that the line elements (or other screen elements) of the second working follow the gridlines of the first, but preferably the first and second printed workings are arranged relative to one another so as to eliminate Moiré effects. Typically this may involve a rotation of the second grid relative to the first. Methods for eliminating Moire effects caused by interference between two screens are well known in the art.

[0019] The size parameters of the two screened workings can be selected as appropriate for the printed security feature in question. In a particularly preferred implementation, the grid spacing of the first printed working (either at a particular location or across the full grid) is between 0.5 mm to 1.5mm, preferably between 0.8 and 1.2 mm, still preferably around 0.9 to 1.0 mm, measured between the centres of two adjacent indicia. This measurement is taken along the directions parallel to the rows and columns of the grid. It will be appreciated that the maximum dimensions of each indicium therefore falls within the same specified ranges. Indicia of such sizes have been found to provide a good balance between smoothness of the image, ensuring concealment of the information during normal handling, and the ability to view the indicia when the feature is examined at close proximity, possibly under magnification of 2 or 5 times.

[0020] Similarly, it is preferred that the spacing of the screen in the second printed working (either at a particular location or across the full screen) is between 0.5 mm to 1.5mm, preferably between 0.8 and 1.2 mm, still preferably around 0.9 to 1.0 mm, measured between the centres of two adjacent screen elements. In this example, spacing of the screen elements in the second working is substantially equal to the grid spacing in the first working, and this is preferred to achieve a high level of concealment whilst ensuring the indicia can still be viewed on close inspection. However, the pitch of the second printed working could, for example, be n or 1/n times the pitch of the first working (where n is a positive integer). Increasing the pitch of the second printed working to a multiple of that of the first will decrease the concealing effect, whereas reducing it will have the opposite effect.

[0021] The first and second printed workings can be laid down using different printing techniques provided adequate registration between the two workings is achieved. However, in particularly preferred examples, the first and second printed workings are printed using the same printing technique, preferably lithographic printing, still preferably in a single print pass. Lithographic printing is believed to offer the highest degree of registration between the two workings since the two workings are applied in sequence by highly accurately controlled plates onto an intermediary "blanket" from which the two workings can be applied in one step to the substrate which is to carry the feature. As such, there is no relative movement between the substrate and the printing apparatus between the application of each working, which leads to an extremely high degree of registration.

[0022] The first and second printed workings could be of the same coloured ink and this may be particularly appropriate where the second printed working underlies the first. However, in general the appearance of the image is enhanced, and the concealment of the information improved, if the first and second printed workings are printed in inks of different colour. This different colour may be more accurately referred to as a difference in tone, resulting from a change in any of the hue, purity and/or lightness of the ink. In particularly preferred examples, the second printed working is darker than the first printed working in terms of tone, hue, lightness or ink density, for example. In this way, the second printed working dominates the initial appearance of the image and further assists in concealment of the information.

[0023] Preferably, the first printed working is configured to represent shading in the image and the second printed working is configured to represent outlines of the image. For example, in the case of a portrait, the variation in tone across the first printed working may provide contouring and/or shadowing to the person's features, whereas the second printed working clearly marks out lines in the image, e.g. around the person's eyes, nose and mouth, etc. In preferred implementations, the tone of the first printed working therefore varies less and/or more gradually across the feature than does the tone of the second printed working, although this will typically be decided on a job-by-job basis. In general terms it is often preferred that the first working presents a "softer" appearance than that of the second working.

[0024] The invention further provides a security article provided with a printed security feature as described above.

[0025] In certain preferred implementations, the security feature is printed directly onto the article. In other preferred cases, the security feature is provided on a label adhered to the article. Thus, the security feature may be manufactured in an intermediary form such as a transfer element.

[0026] Preferably, the security article comprises a security document, such as a banknote, travellers cheque, certificate of authenticity, stamp, bond, tax disc, physical

stamp, a secure label, passport or voucher.

[0027] Examples of security features, methods of manufacture thereof, and security articles to which the security features are applied will now be described with reference to the accompanying drawings, in which:

Figure 1 shows an embodiment of a security article provided with a security feature;
Figure 2 shows a cross-section through the security document of Figure 1;
Figure 3 shows a cross-section through a second embodiment of a security article provided with a security feature;
Figure 4 schematically depicts part of an exemplary first printed working;
Figure 5 schematically depicts part of an exemplary second printed working;
Figure 6 illustrates a first embodiment of a security feature;
Figure 7 shows enlarged details of the security feature of Figure 6;
Figure 8 illustrates a second embodiment of a security feature;
Figure 9 illustrates a third embodiment of a security feature; and
Figures 10, 11 and 12 illustrate three examples of first printed workings for use in further embodiments of security features.

[0028] The description below will mainly focus on the application of printed security features to security documents such as banknotes. However, it will be appreciated that the same printed security features can be applied to many other types of security document, or other articles whose authenticity is of importance. The security feature may be printed directly onto the article, as in the examples described below, or printed onto an intermediary substrate which can then be applied to an article. For example, the security feature may be manufactured as a label and then adhered to a security document using a layer of adhesive or via a transfer technique.

[0029] Figure 1 shows a document 2, such as a banknote, carrying a security feature 1. Whilst not shown in the Figure, the security feature 1 has the appearance of an image, typically a pictorial image such as a portrait or landscape or other graphic. Figure 2 shows a cross-section through the document of Figure 1, from which it is apparent that the printed security feature 1 is formed of at least two print layers, or "workings", 3 and 4 which at least partially overlap one another. The thicknesses of the workings are greatly exaggerated in the Figure for clarity. In practice, the thicknesses of the workings will typically be very small compared to the thickness of the document 2 and, at least in areas, there may be no physical distinction in real terms between the two print layers. However, each is formed in a separate working as will be described further below.

[0030] The first printed working 3 is defined by a screened working comprising a grid of indicia which carry information. The second printed working 4 is also a screened working but need not carry information and, typically, the screen elements will be of conventional form, such as line or dot elements. In preferred examples, as shown in Figure 2, when the feature 1 is viewed (from above in the present example) the second printed working 4 lies in front of the first printed working 3, although this is not essential. The two printed workings are formed in register with one another and, when viewed in combination, appear as an image of varying tone. Typically, the first printed working 3 provides the image with gradual shading, giving it colour and a realistic three-dimensional appearance, whilst the second printed working 4 defines the sharp edges and outlines of the image. In combination, the two layers produce an effective, high-quality graphic.

[0031] The presence of the second printed working 4 has the effect of reducing the visibility of the indicia incorporated into the first printed working 3. This is achieved primarily by the second printed working 4 confusing the eye such that the indicia of the first printed working 3 are not readily apparent. Where the second printed working lies over the first, as in the present example, this effect is enhanced by the physical masking of the first printed working by the second. Thus, during normal handling, the feature 1 appears simply as a high-quality multi-tonal graphic. However, when the feature is examined closely, for instance as at increased magnification, the presence of the indicia in the first printed working 3 becomes apparent. Checking for the presence of the indicia, and confirming that they carry the expected information can thus be used to test the authenticity of the feature. This check could be performed by a machine or, preferably, by a person.

[0032] The same effects can be achieved using an alternative construction as depicted in Figure 3 which shows a cross-section through another security document 2'. In this case, the at least partially overlapping first and second printed workings 3, 4 forming the security feature 1 are located on opposite sides of a transparent portion 5 of the substrate. This could correspond, for example, to a transparent window in a polymer banknote, or the entire substrate could be transparent. Once again, the first and second printed workings 3, 4 are in register with one another and when the feature 1 is viewed from above the article, as depicted in Figure 3, the same effects will be achieved. If the degree of confusion caused by the second working is sufficient, the effects may also be apparent when the feature is viewed from underneath (although potentially to a lesser extent).

[0033] Figures 4 and 5 schematically depict exemplary first and second printed workings which could be used to form the security feature 1. Figure 4 shows part of a first printed working 3 which comprises a screen formed of an orthogonal grid of indicia 3a. In this example, each indicium takes the form of the numeral "5". The indicia are arranged on a regular grid of spacing P in both or-

thogonal directions along the grid rows and columns. In other implementations, a different style of grid could be used, such as a circular or sinusoidal grid. In this example, the working is a negative screen, meaning that the indicia themselves are ink-free, whilst their surroundings are printed with ink. The appearance of the working is varied as required across the feature in order to render the desired image, and this is achieved by adjusting the tone and/or saturation of the screen elements 3a (or, analogously, their background) across the grid. For example, in the schematic diagram of Figure 4, in the region to the left of the dashed line X-X', the indicia "5" have a greater thickness (line weight) than those to the right of the same line. As such, the ink saturation (amount of ink per unit area) is less in the region to the left of the line X-X' (since this is a negative screen) and the resulting visual effect is that this region will appear lighter in tone than that to the right of the line X-X'. Similar variations can be achieved by adjusting the size or spacing of the screen elements and/or by adjusting the tone of the ink itself across the grid, for example, by varying one or more of its hue, purity or lightness. Where the element spacing is used to vary the tone, if Moiré effects are to be avoided, unless the periodicity of the different tonal regions of the first working can be made to match that of the second working (i.e. the spacing is n times or 1/n times that of the second grid, where n is a positive integer), the spacing of the second working should vary similarly to that of the first. In some cases, the printed working could have a varying colour such as a rainbow variation.

[0034] The grid spacing P (which is constant in this example) is preferably sufficiently small that the structure imposed on the image by the first working 3 is not overly apparent to the viewer. If the spacing were too large, relative to the features depicted by the image, the quality of the image would be decreased. In general it has been found that grid spacings of between 0.5 and 1.5 mm, preferably 0.8 to 1.2mm, more preferably around 0.9 to 1 mm provide the best results. This grid spacing P also dictates the maximum size of the indicia 3a.

[0035] Figure 5 schematically depicts a second working 4 which may be used in conjunction with the first working 3 of Figure 4. The second working 4 is also a screen which, in this example, is conveniently defined by screen elements in the form of parallel printed lines 4a. It is preferred that the screen elements making up the second working 4 are of a different shape to those forming the first working 3, although this is not essential. The tone of the second working is varied as required across the area forming the feature to define the desired image and this is typically achieved by varying the thickness of the line elements 4a, inserting discontinuities in the lines when no ink is to be laid down and/or varying the spacing of the elements (in which case the periodicity should be arranged to match the local periodicity of the first working as mentioned above). In this example, the second working is a positive screen although a negative screen could be used if desired. Non-linear screens are also envisaged as will be described below. For example, a circular or sinusoidal screen could be used. Furthermore, the screen elements do not have to be continuous and could comprise dots.

[0036] The spacing P between the screen elements 4a of the second working 4 is, in this example, constant and substantially equal to the grid spacing P of the first printed working 3 in both orthogonal directions. This has the advantage of reducing or eliminating Moire effects if the two workings are appropriately aligned rotationally with one another. However, as will be described below, this can also be achieved by arranging the pitch of one of the workings to be a multiple of the other. The first and second workings 3 and 4 are superimposed one another, preferably at a rotational relationship in which there is substantially no visible Moiré effect caused by interference between the two screens. Methods for achieving such a rotational alignment between the two screens are well-known in the art.

[0037] Figure 6 shows a first embodiment of a printed security feature and its constituent workings. Figure 6(a) shows the security feature 10 at "normal" magnification (i.e. as viewed by the naked eye). In this example, the printed feature 10 has three distinct regions, labelled 17, 18 and 19. Region 17, at the top of the page, is printed with the second printed working only. This is labelled "Working - A", and a magnified view of a region of this working is shown in Figure 6(i), labelled 14. Region 19 at the bottom of the page is printed with the first printed working, comprising a grid of indicia, only. This is labelled as "Working - B" and a region is shown at higher magnification in Figure 6(ii), labelled 13. In the intervening region 18, both the first and second printed workings are present, and this labelled as "Working - A + B". A magnified portion of this region is shown in Figure 6(iii), and labelled 15. In practical implementations, it is generally preferred that the first and second workings will entirely overlap one another to produce the combined effect across the whole printed feature. However, this is not essential and the printed feature could include regions of only one or other of the workings, as depicted in the present example. However, in all examples, at least a portion of the security feature will be provided with both of the printed workings, in register with one another (as per region 18 in the present example).

[0038] As described above, the first printed working 13 takes the form of a screen of indicia elements arranged in a grid. In the Figure 6 embodiment, as shown in Figure 6(ii), all of the indicia are symbols of the same sort, namely the pound sign (£). The screen is a negative screen, hence the pound symbol appearing white against an inked background. As shown in Figure 6(ii), the centre of each pound sign is spaced from the next on a regular orthogonal grid, with the size and weight of the indicia varying across the working. For example, in the enlarged region of the first working 13 shown in Figure 6(ii), the pound signs are relatively small and finely resolved towards the centre of the region, whereas at the lower edge,

the thickness of each indicium increases, resulting in less ink being laid down (since this is a negative screen). Hence, the centre of the depicted region appears generally darker in tone than does the lower portion. These variations are modulated across the working in order to provide lightness and shading for the final image.

[0039] The second printed working in this embodiment is a dot screen of which an enlarged region is shown in Figure 6(i) labelled 14. The screen elements have the form of regular dots arranged along lines running at an approximately 45° angle to the horizontal direction. The size and weight of each dot element is modulated across the working so as to produce variation in tone as is well-known in conventional screen workings. The second working is generally configured to provide fine details such as outlines within the image and, as such, the amount of tonal variation across the working is typically greater than that of the first working 13.

[0040] The second working 14 could be printed in the same colour ink as the first printed working 13 if desired. However, in general it is preferred for the two workings to be printed in different colours and particularly good results are achieved where the second working 14 is printed in a darker colour than that of the first working 13.

[0041] The combination of the two printed workings 13 and 14 is shown in Figure 6(iii). It will be seen that, in this example, the screen elements of the second working (which appear as diagonal lines due to the weight of the screen elements in this region) overlay the indicia of the first working. At normal magnification, as shown in Figure 6(a), the presence of the indicia is not readily apparent and the combination of the two workings produces a high-quality multi-tonal image, here a portrait of Albert Einstein. However, when the portrait is closely examined, as illustrated by the enlarged region of Figure 6(iii), it becomes possible to identify the pound signs carried by the first printed working 13, at least in certain portions of the image. It should be noted that, due to the low-resolution printing and photocopying techniques used to produce the accompanying Figures, this effect may not be readily apparent from an inspection of Figure 6(a) itself, hence the provision of a magnified representation in Figure 6(iii). In practice, a person wishing to check the feature's authenticity can inspect the portrait closely, for example using a low power magnifying glass (e.g. two times or five times magnification) and, if the feature is genuine, will be able to identify pound signs in the image at least in regions where the concealment by the second printed working is not overly dominant.

[0042] Figure 7 shows selected portions of Figures 6(i), (ii) and (iii) at even greater magnification. Figure 7(i) shows a portion of the second printed working 14 in which the individual line or dot screen elements 14a are clearly visible. In this example, the horizontal and vertical spacing between the centres of the elements (P_i) is about 0.45mm. It should be noted that Figure 7(i) is shown at a higher magnification than Figures 7(ii) or 7(iii). Figure 7(ii) shows a portion of the first printed working 13 incorporating a grid of indicia 13a. The horizontal and vertical grid spacing (P_{ii}) is approximately 0.9mm, i.e. twice that of the spacing P_i between the elements in the second screen 14. When the two workings are combined, as shown in Figure 7(iii), it is apparent that the two screens have the same periodicity which is a result of the relationship between the screen spacings P_i and P_{ii}. Since one is a multiple of the other ($2P_i = P_{ii}$) the positional relationship between the two sets of screen elements does not change across the image. This is desirable in order to avoid the generation of Moiré effects caused by interference between the two screens. Additionally, the relative rotational position between the two screens is selected so as to reduce or eliminate Moiré effects. This rotational relationship can be determined by trial and error or using any other technique known to the skilled man. In the present example, the dot or line elements of the second printed working 14 follow a direction that sits at approximately 45° to the column and row directions of the first printed working 13.

[0043] In the embodiment shown in Figures 6 and 7, both screens are based on an orthogonal grid pattern in which the rows and columns of indicia are arranged at approximately 90 degrees to each other. However, this is not essential and either or both of the workings could take another grid form, such as a circular or sinusoidal screen. Furthermore, the repetition distance in both screens could vary across the feature, either to produce tonal variation or to increase the complexity of the print. However, in this case, the element spacing should vary in both workings in the same manner (ensuring the periodicity of each screen matches at all points), if Moiré effects are to be avoided.

[0044] Figure 8 shows a second embodiment of a printed security feature 20 including regions 27, 28 and 29 which are comparable to regions 17, 18 and 19 of Figure 6(a). In region 27, only the second printed working 24 is present, of which a magnified region is shown in Figure 8(i); in region 29 only the first printed working 23 is present as shown in the magnified region in Figure 8(ii); and in the intervening portion 28, both workings are present as shown in magnified form in Figure 8(iii).

[0045] This example is based on the same principles as those discussed in relation to Figures 6 and 7, but alternative workings are used to form the image. The first working 23, shown in Figure 8(ii), comprises a negative screen in which four different indicia types are arranged to form the grid. The indicia "2", "E", "M" and "C" are arranged in a regular pattern across the grid and their weight and dimensions modulated across the image so as to provide the desired tonal variation.

[0046] The second printed working 24, shown in Figure 8(i), is again a screened working formed of line and dot elements, but in this example has a coarser pitch than that of the Figure 6 embodiment. As shown in Figure 8(iii), when the workings are combined, the pitch of the second working 24 is the same as that of the first working 23 (i.e. $P_i = P_{ii}$).

[0047] As before, when the portrait is viewed at normal magnification as shown in Figure 8(a) the indicia are not immediately apparent, but become visible when the feature is examined in more detail as illustrated in Figure 8(iii). In general, the indicia will be most readily identified at a location in the image at which the shading by the first printed working is relatively dark whilst that of the second working is relatively light, such as may be found in a relatively "flat" area of the portrait such as the person's forehead or chin. The indicia need not be identifiable at all points of the image. This applies to all embodiments.

[0048] Figure 9 shows a third embodiment of a printed security feature 30 which again has three distinct regions 37, 28 and 39 corresponding to regions 27, 28 and 29 of the previous embodiment. In region 37, only the second printed working 34 is present, of which a magnified portion is shown in Figure 9(i), in region 39, only the first printed working 33 is present, as shown in increased magnification in Figure 9(ii), and in the intervening portion 38, both workings are present, as shown in magnified form in Figure 9(iii).

[0049] In this embodiment, the first printed working 33, shown in Figure 9(ii), is identical to that of the second embodiment discussed above with reference to Figure 8(ii), comprising a grid of indicia "2", "E", "M" and "C".

[0050] The second printed working 34 is again a line screen, but in this case the line elements are sinusoidal and discontinuous. In this example, the lines are also arranged horizontally so as to align with the direction of the rows in the indicia grid of first working 33. The vertical spacing between the line elements is half that of the grid spacing between the indicia in the first printed working. As shown in Figure 9(iii), when the two workings are combined, the periodicity of the two screens is the same at all locations.

[0051] As in the previous examples, when the feature 30 is viewed at normal magnification as shown in Figure 9(a), the indicia of first working 33 are not readily apparent and the feature appears as a high-quality multi-tonal portrait. However, when the image is inspected more closely as represented by Figure 9(iii), the indicia become apparent.

[0052] In all of the above embodiments, the two printed workings can be formed using any desirable printing techniques provided that accurate registration between the two workings can be achieved. For example, either or both workings could be produced by lithographic, flexographic or gravure printing processes. In general, it is preferred that both of the two workings are produced using the same printing technique, since this will generally enable both prints to be produced on the same apparatus, which leads to more accurate registration. It is particularly preferred that both workings be produced by lithographic printing since in this process, the two workings can be applied to the substrate (such as a banknote) simultaneously. The two workings are applied sequentially to an intermediary "blanket" from which the two workings are transferred together to the substrate. This means that there is no possibility of any relative movement occurring between the substrate and the printing apparatus between workings. Similarly high accuracy registration can be achieved if the two workings are provided on opposite sides of a transparent portion of a document (as illustrated in Figure 3), since the two workings can be applied simultaneously without any opportunity for movement of the banknote. Printing registered workings on the front and back of a substrate is normally carried out with specialised lithographic presses which allow simultaneous front and back printing during one printing run. An example of such a printing press is a Super Simultan press manufactured by KBA Giori. Alternatively multi-unit gravure or flexographic presses may be used where the substrate is turned over by the use of a turning bar positioned between printing units.

[0053] The information contained in the indicia forming the first working can take any desirable form, of which three examples are shown in Figures 10, 11 and 12. In each of these Figures, the first working is illustrated as a positive screen although as noted above, in many cases it is preferred that a negative screen is used. Additionally, these Figures do not show a tonal variation across the screen, although this will usually be present in practice (at least one and preferably both of the screened workings must vary in tone across the image in order to result in a multi-tonal image) and is achieved by varying the size and weight of the indicia as described above (possibly in combination with varying the tone of the ink itself if desired). Figure 10 shows an exemplary first printed working 40 in which the screen elements 41 each comprise the number "10", arranged in a regular orthogonal grid pattern. As this example illustrates, it should be appreciated that more than one individual indicium could be located at each grid position if desired. Typically, this will require an increase in the pitch of the grid to accommodate the additional digits. For example, where the grid comprises an array of the number "100", the pitch will be required to be larger in order to accommodate three digits at each grid position. Preferred ranges for the grid spacing (which also dictates the size of the indicia) are 0.5 to 1.5mm, preferably 0.8 to 1.8mm, most preferably around 0.9 to 1 mm.

[0054] In the Figure 10 example, the indicia provided at each grid point are identical, i.e. each comprises the number "10". However, this is not essential and indeed the amount of information contained in the feature can be increased by using a variety of indicia types in the grid. As illustrated in the embodiments of Figures 8 and 9, a selection of indicia could be arranged in a repeating pattern across the grid or could be positioned at random. In particularly preferred embodiments subsets of screen elements are used to define codes within the grid. For example, Figure 11 shows an example of a first printed working 42 in which the grid comprises subset 43 containing three screen elements each. The three screen elements within each subset are arranged to display the

indicia "T", "E" and "N", thereby forming the word "TEN" repeatedly across the grid. In this example, the subsets are arranged horizontally along the grid but this need not be the case. For example, Figure 12 shows a further first printed working 44 in which subsets 45 are each formed of four screen elements, defining th e code "FIVE". Each block of four elements extends both horizontally and vertically. In other examples, each subset could be arranged vertically, diagonally or in any other convenient manner.

[0055] Any of the workings described above could alternatively be based on non-orthogonal grids, e.g. hexagonal, sinusoidal or circular screens.

[0056] In these examples, the information conveyed by the indicia, i.e. "10", "TEN" or "FIVE", preferably corresponds to a characteristic of the article to which the security feature is (or will be) applied. For instance, in the case of a banknote, the information may be representative of its denomination. In other cases, the information could take the form of currency information (e.g. "£" or "USD" or "DOLLARS"), bank information (e.g. "BANKOFENGLAND"), or issue information (e.g. "1996" or "ISSUE1"). Many alternatives are possible.

[0057] In the embodiments described above, the printed security features comprises only the two printed workings mentioned, and this is generally preferred. However, additional overlying and/or underlying print layers could be added if desired.

[0058] One or both of the workings could be printed using a security ink, such as a fluorescent, phosphorescent, luminescent, photochromic, optically variable, IR or UV responsive, or magnetic ink, to further enhance the secure nature of the feature. However both workings should be visible under normal ambient lighting conditions (e.g. daylight).

[0059] The security document or other article to which the security feature is ultimately applied may include additional security elements such as holograms, watermarks, security threads, magnetic features and the like.

Claims

1. A printed security feature comprising at least a first and a second printed working which at least partially overlap one another, wherein the first printed working is a screened working defined by a grid of screen elements having the form of indicia carrying information, and the second printed working is a screened working in register with the first printed working, the first and second printed workings appearing, in combination, as a multi-tonal image, whereby the information carried by the indicia is at least partially concealed by the second printed working, wherein the first and second printed workings each vary in tone gradually across the image, the tone of the first printed working varying less or more gradually across the image than the tone of the second printed working.

2. A printed security feature according to claim 1, wherein the first printed working is located so as to be viewable through the second printed working.

3. A printed security feature according to claim 2, wherein the second printed working overlays the first printed working on a substrate.

4. A printed security feature according to claim 2, wherein the first and second printed workings are disposed on opposite sides of a substantially transparent substrate.

5. A printed security feature according to any of the preceding claims,
wherein the grid of screen elements comprises screen elements of at least two different indicia values.

6. A printed security feature according to any of the preceding claims,
wherein the grid of screen elements comprises a plurality of subsets of screen elements, each of the subsets comprising screen elements of at least two indicia values configured to convey a code.

7. A printed security features according to any of the preceding claims,
wherein the grid of screen elements is an orthogonal or non-orthogonal grid, such as a hexagonal, circular or sinusoidal grid.

8. A printed security feature according to any of the preceding claims,
wherein the first printed working is a negative screen, the indicia being formed of unprinted regions surrounded by ink.

9. A printed security feature according to any of the preceding claims,
wherein the screen elements of the first printed working differ in shape from the screen elements of the second printed working.

10. A printed security feature according to any of the preceding claims,
wherein the second printed working is a line working, defined by screen elements in the form of continuous or non-continuous lines of varying thickness,
wherein preferably the lines are parallel to one another and straight, curved, sinusoidal or zig-zagged.

11. A printed security feature according to any of the preceding claims
wherein the grid spacing of the first printed working at any one location is substantially equal to a multiple of the spacing of the screen of the second printed working at the same location, or vice versa.

12. A security article provided with a printed security feature according to any of the preceding claims, wherein preferably the security article comprises a security document, preferably a banknote, travellers cheque, certificate of authenticity, stamp, bond, tax disc, fiscal stamp, secure label, passport or voucher.

13. A method of manufacturing a printed security feature, comprising:

printing a first working on to a substrate in the form of a screened working defined by a grid of screen elements having the form of indicia carrying information; and
printing a second working on to the substrate in register with the first working, in the form of a screened working;
such that the first and second printed workings at least partially overlap one another and appear, in combination, as a multi-tonal image, whereby the information carried by the indicia is at least partially concealed by the second printed working, wherein the first and second printed workings each vary in tone gradually across the image, the tone of the first printed working varying less or more gradually across the image than the tone of the second printed working.

14. A method according to claim 13 adapted to manufacture a printed security feature according to any of claims 1 to 12.

Patentansprüche

1. Gedrucktes Sicherheitselement, das wenigstens ein erstes und ein zweites Druckverfahren umfasst, die einander wenigstens teilweise überlappen, wobei das erste Druckverfahren ein Siebdruckverfahren ist, das durch ein Gitter von Siebelementen definiert ist, welche die Form von Zeichen tragender Information haben und das zweite Druckverfahren ein Siebdruckverfahren ist, das sich mit dem ersten Druckverfahren deckt, wobei die ersten und zweiten Druckverfahren, in Kombination, als ein multitonales Bild erscheinen, wodurch die von den Zeichen getragene Information wenigstens teilweise durch das zweite Druckverfahren verborgen wird, wobei die ersten und zweiten Druckverfahren jeweils in Tönung allmählich über das Bild variieren, wobei die Tönung des ersten Druckverfahrens weniger oder allmählicher als die Tönung des zweiten Druckverfahrens über das Bild variiert.

2. Gedrucktes Sicherheitselement nach Anspruch 1, wobei das erste Druckverfahren derartig positioniert ist, dass es durch das zweite Druckverfahren sichtbar ist.

3. Gedrucktes Sicherheitselement nach Anspruch 2, wobei das zweite Druckverfahren das erste Druckverfahren auf einem Substrat überlagert.

4. Gedrucktes Sicherheitselement nach Anspruch 2, wobei die ersten und zweiten Druckverfahren auf entgegengesetzten Seiten eines im Wesentlichen transparenten Substrats angeordnet sind.

5. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei das Gitter aus Siebelementen, Siebelemente von wenigstens zwei verschiedenen Zeichenwerten umfasst.

6. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei das Gitter aus Siebelementen eine Vielzahl von Untergruppen von Siebelementen umfasst, jede der Untergruppen Siebelemente von wenigstens zwei Zeichenwerten umfasst, die konfiguriert sind einen Code zu vermitteln.

7. Gedruckte Sicherheitselemente nach einem beliebigen der vorangehenden Ansprüche, wobei das Gitter aus Siebelementen ein orthogonales oder nicht orthogonales Gitter, wie beispielsweise ein hexagonales, kreisförmiges oder sinusförmiges Gitter ist.

8. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei das erste Druckverfahren ein negatives Sieb ist, wobei die Zeichen aus unbedruckten Bereichen umgeben von Tinte gebildet sind.

9. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei sich die Siebelemente des ersten Druckverfahrens in der Form von den Siebelementen des zweiten Druckverfahrens unterscheiden.

10. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei das zweite Druckverfahren ein Linienverfahren ist, definiert durch Siebelemente in Form von kontinuierlichen oder diskontinuierlichen Linien variierender Dicke, wobei die Linien vorzugsweise parallel zueinander und gerade, gekrümmt, sinusförmig oder zickzack sind.

11. Gedrucktes Sicherheitselement nach einem beliebigen der vorangehenden Ansprüche, wobei der Gitterabstand des ersten Druckverfahrens in irgendeiner Position im Wesentlichen gleich oder ein Vielfaches des Abstands des Siebs des zweiten Druckverfahrens in der gleichen Position oder umgekehrt ist.

12. Sicherheitsartikel, der mit einem gedruckten Sicher-

heitselement nach einem beliebigen der vorangehenden Ansprüche versehen ist, wobei der Sicherheitsartikel vorzugsweise ein Sicherheitsdokument, vorzugsweise eine Banknote, einen Reisescheck, ein Authentizitätszertifikat, eine Briefmarke, ein Bond, eine Steuerplakette, Steuermarke, eine Sicherheitsetikette, einen Reisepass oder einen Gutschein umfasst.

13. Verfahren zur Herstellung eines gedruckten Sicherheitselements, umfassend:

Drucken eines ersten Verfahrens auf ein Substrat in Form eines gerasterten Verfahrens, das durch ein Gitter aus Rasterelementen definiert ist, welche die Form von Zeichen tragender Information haben; und
Drucken eines zweiten Verfahrens auf das Substrat in Deckung mit dem ersten Verfahren in Form eines gerasterten Verfahrens;
derartig, dass die ersten und zweiten Druckverfahren wenigstens teilweise einander überlappen und, in Kombination, als ein multitonales Bild erscheinen, wodurch die von den Zeichen getragene Information wenigstens teilweise durch das zweite Druckverfahren verborgen wird, wobei die ersten und zweiten Druckverfahren jeweils in Tönung allmählich über das Bild variieren, wobei die Tönung des ersten Druckverfahrens weniger oder allmählicher als die Tönung des zweiten Druckverfahrens über das Bild variiert.

14. Verfahren nach Anspruch 13, das angepasst ist, ein gedrucktes Sicherheitselement in Übereinstimmung mit einem beliebigen der Ansprüche 1 bis 12 herzustellen.

Revendications

1. Elément de sécurité imprimé comprenant au moins une première et une deuxième couches imprimées qui se chevauchent l'une l'autre au moins en partie, **caractérisé en ce que** la première couche est une couche tramée définie par une grille d'éléments de trame qui ont la forme d'indications portant l'information, **en ce que** la deuxième couche est une couche tramée qui coïncidé exactement avec la première couche, la première et la deuxième couches donnant ensemble l'apparence d'une image multi-tonalités, **caractérisé en ce que** l'information que portent les indices est dissimulée du moins en partie par la deuxième couche imprimée, **caractérisé en ce que** la première et la deuxième couches imprimées varient chacune progressivement de tonalité à travers l'image, la tonalité de la première couche imprimée variant dans une moindre mesure ou bien plus progressivement à travers l'image que la tonalité de la deuxième couche imprimée.

2. Elément de sécurité imprimé selon la revendication 1, **caractérisé en ce que** la première couche imprimée est positionnée de manière à pouvoir être visible à travers la deuxième couche imprimée.

3. Elément de sécurité imprimé selon la revendication 2, **caractérisé en ce que** la deuxième couche imprimée recouvre la première couche imprimée sur un substrat.

4. Elément de sécurité imprimé selon la revendication 2, **caractérisé en ce que** la première et la deuxième couches imprimées sont disposées sur des côtés opposés d'un substrat qui est essentiellement transparent.

5. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que la grille d'éléments de trame comprend les éléments de trame d'au moins deux indications différentes.

6. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que la grille d'éléments de trame comprend une pluralité de sous-ensembles d'éléments de trame, chaque sous-ensemble comportant les éléments de trame d'au moins deux indications configurées de manière à communiquer un code.

7. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que la grille d'éléments de trame est une grille orthogonale ou non orthogonale, par exemple une grille hexagonale, circulaire ou sinusoïdale.

8. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que la première couche imprimée est une trame négative, les indications étant constituées de régions non imprimées entourées d'encre.

9. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que les éléments de trame de la première couche imprimée ont une forme qui est différente de celle des éléments de trame de la deuxième couche imprimée.

10. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que la deuxième couche imprimée est une couche au trait, définie par les éléments de trame sous forme de traits continus ou disconti-

nus d'épaisseur variable, **caractérisé en ce que** les traits seront de préférence parallèles les uns aux autres, et de forme rectiligne, recourbée, sinusoïdale ou en zig zag.

11. Elément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que l'espacement de la grille en n'importe quel endroit individuel de la première couche imprimée est essentiellement égal à un multiple de l'espacement de la grille de la deuxième couche imprimée au même endroit, ou vice versa.

12. Article de sécurité doté d'un élément de sécurité imprimé selon l'une quelconque des revendications précédentes,
caractérisé en ce que l'article de sécurité comporte de préférence un document de sécurité qui sera de préférence un billet de banque, un chèque de voyage, un certificat d'authenticité, un timbre, une obligation, une vignette automobile, un timbre fiscal, une étiquette sûre, un passeport ou un bon.

13. Procédé de fabrication d'un élément de sécurité imprimé qui consiste:

à imprimer une première couche sur un substrat sous forme de couche tramée définie par une grille d'éléments de trame qui ont la forme d'indications portant l'information; et
à imprimer sur le substrat une deuxième couche qui coïncide exactement avec la première couche, sous forme de couche tramée;
de sorte que la première et la deuxième couches imprimées se chevauchent l'une l'autre au moins en partie, et donnent ensemble l'apparence d'une image multi-tonalités, **caractérisé en ce que** l'information que portent les indices est dissimulée au moins en partie par la deuxième couche imprimée, **caractérisé en ce que** la première et la deuxième couches imprimées varient chacune de tonalité progressivement à travers l'image, la tonalité de la première couche imprimée variant dans une moindre mesure ou bien plus progressivement à travers l'image que la tonalité de la deuxième couche imprimée.

14. Procédé de fabrication selon la revendication 13, adapté pour la fabrication d'un élément de sécurité imprimé selon l'une quelconque des revendications 1 à 12.

Fig.1.

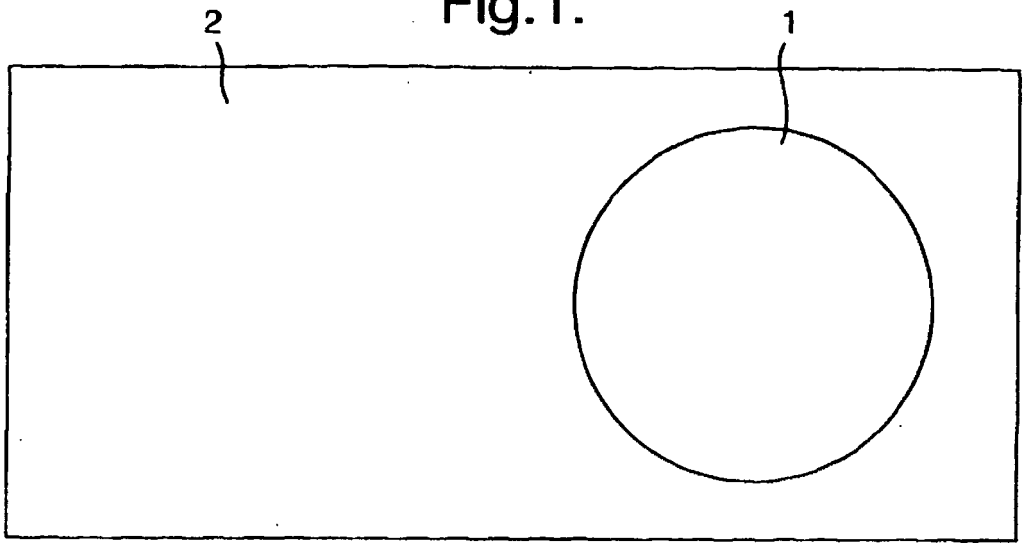


Fig.2.

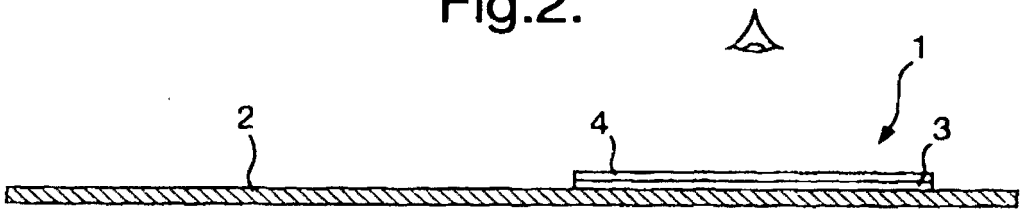


Fig.3.

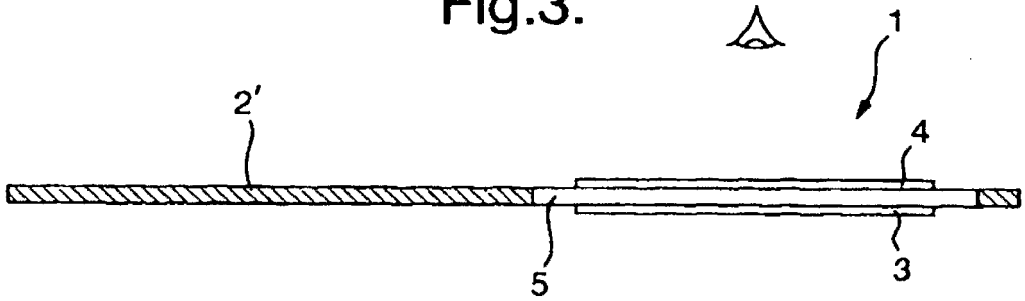


Fig.4.

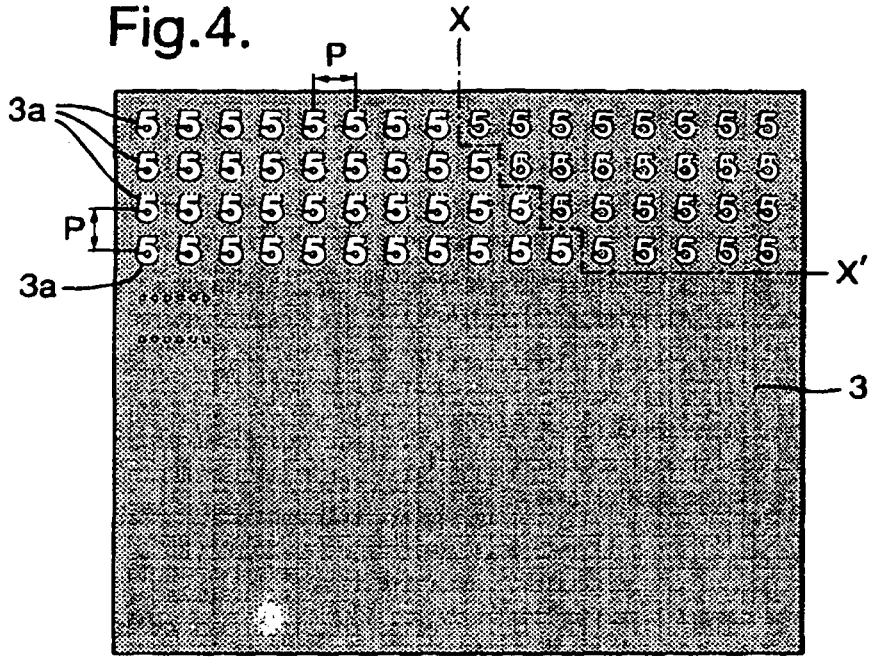


Fig.5.

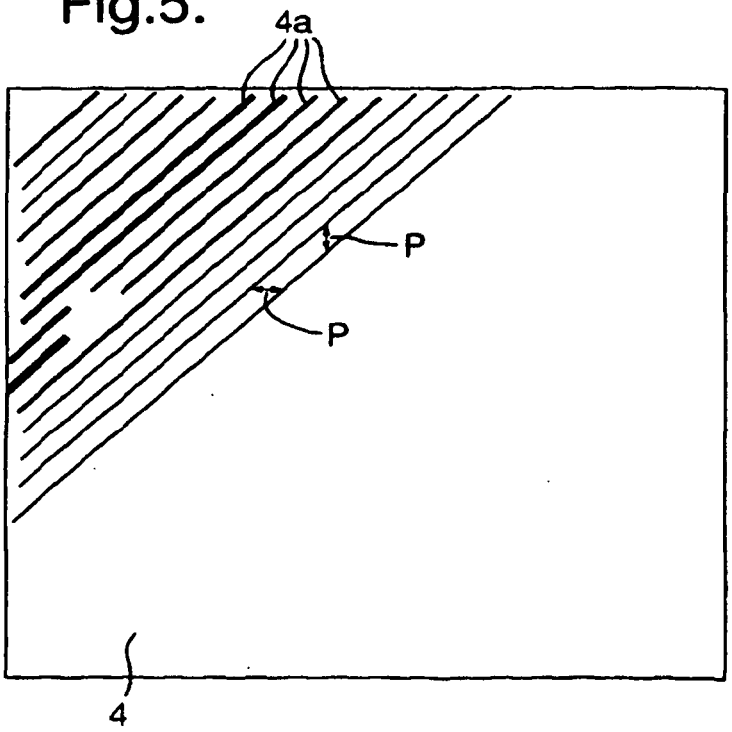


Fig.6.

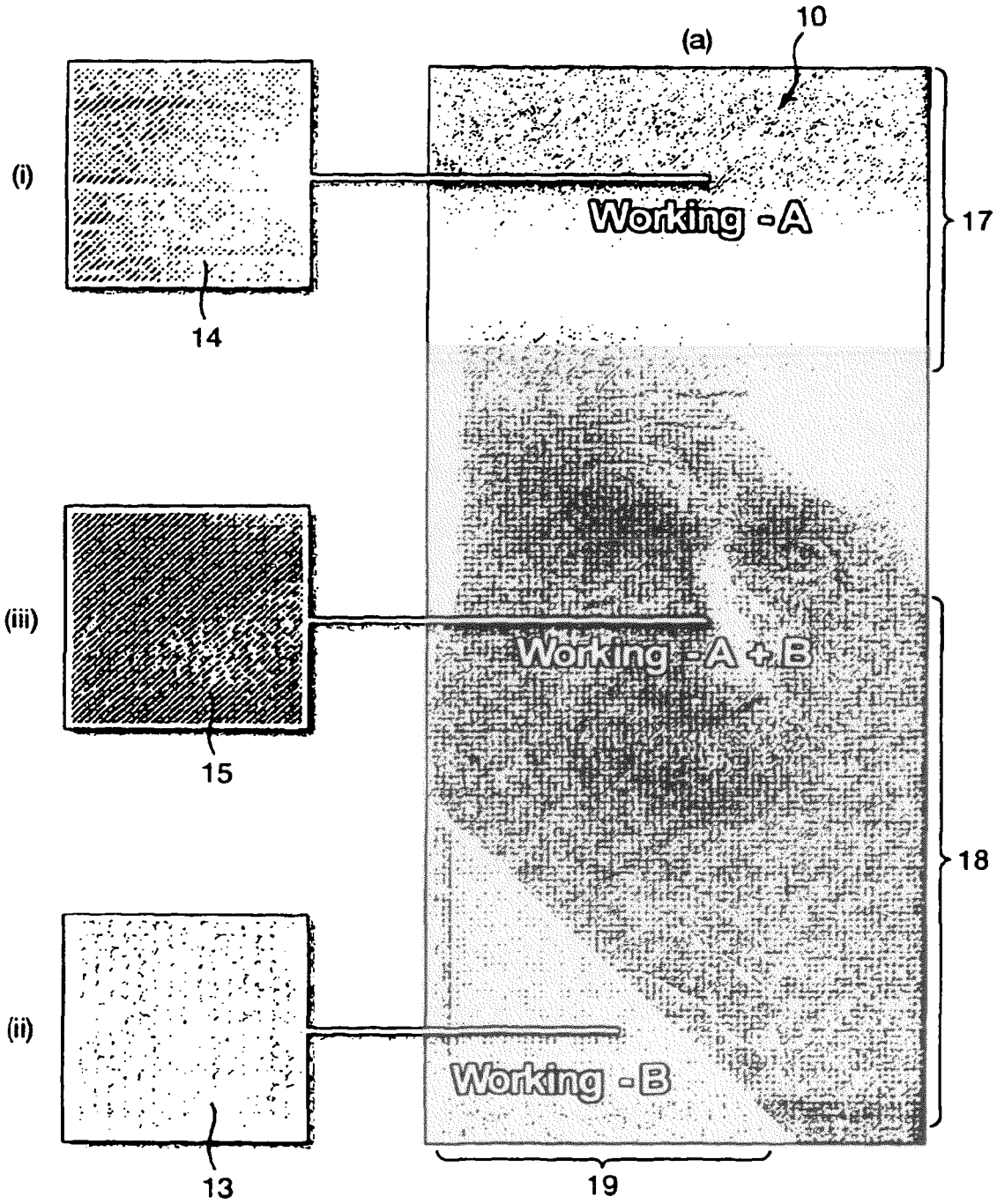


Fig.7.

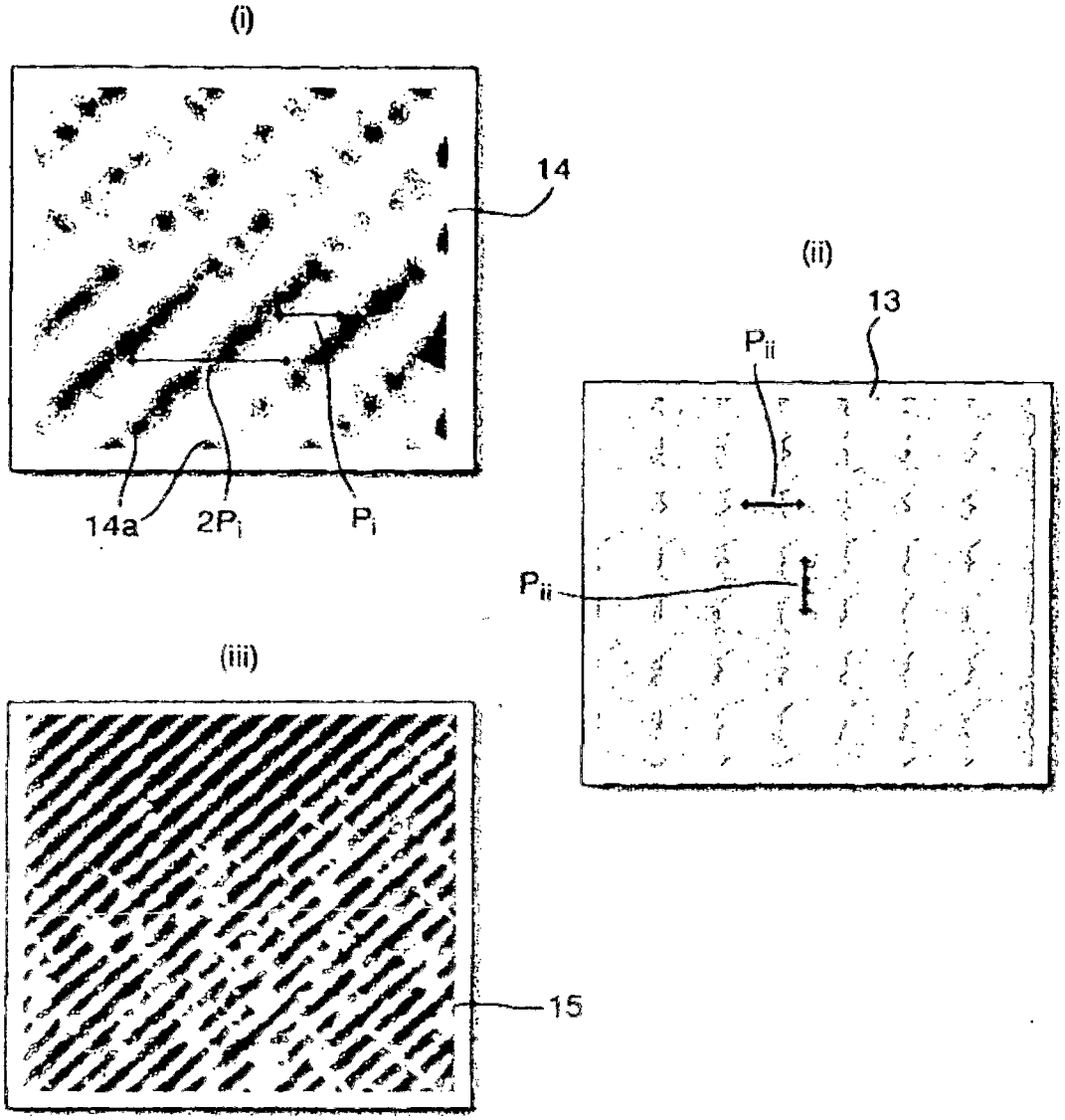


Fig.8.

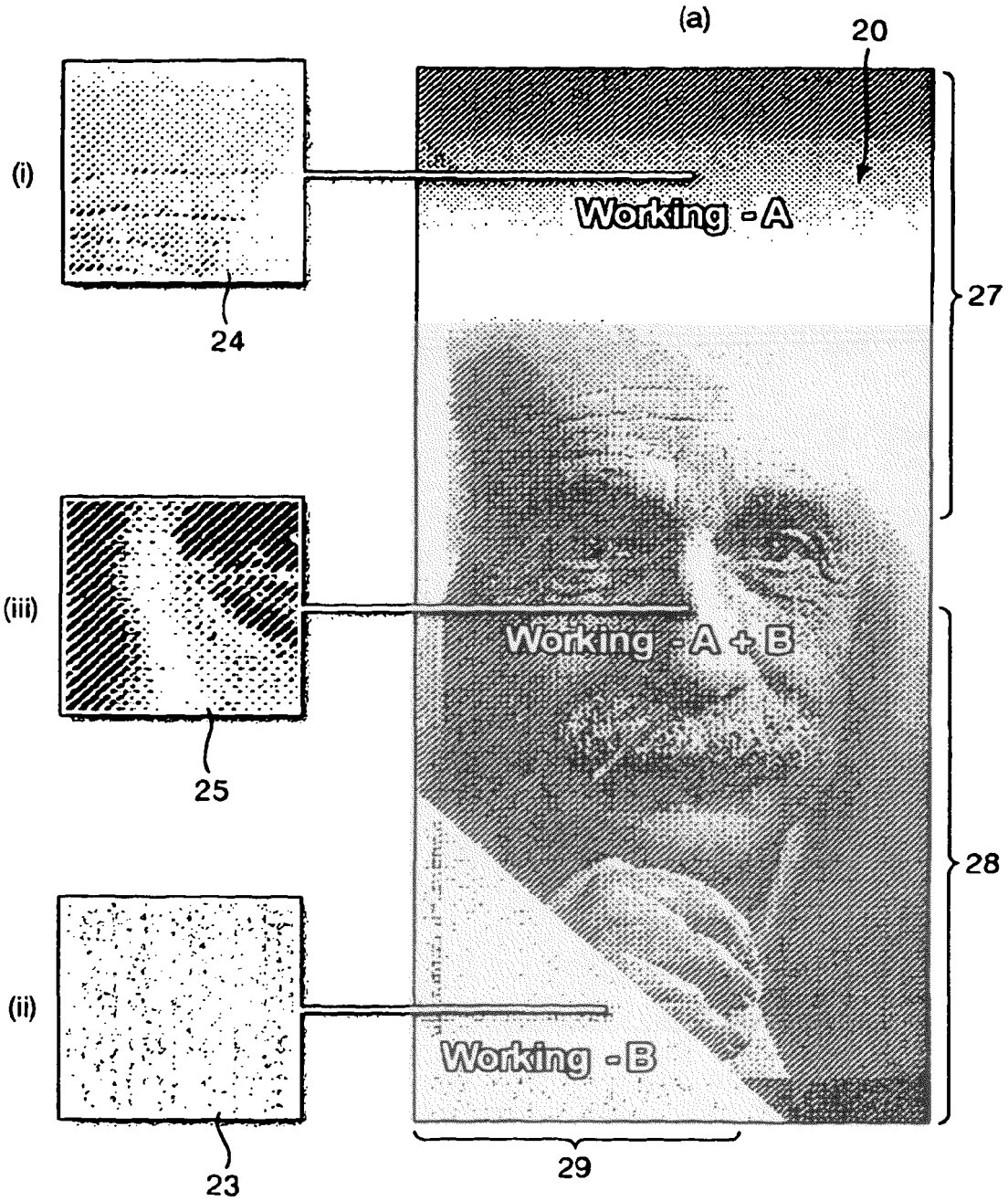


Fig.9.

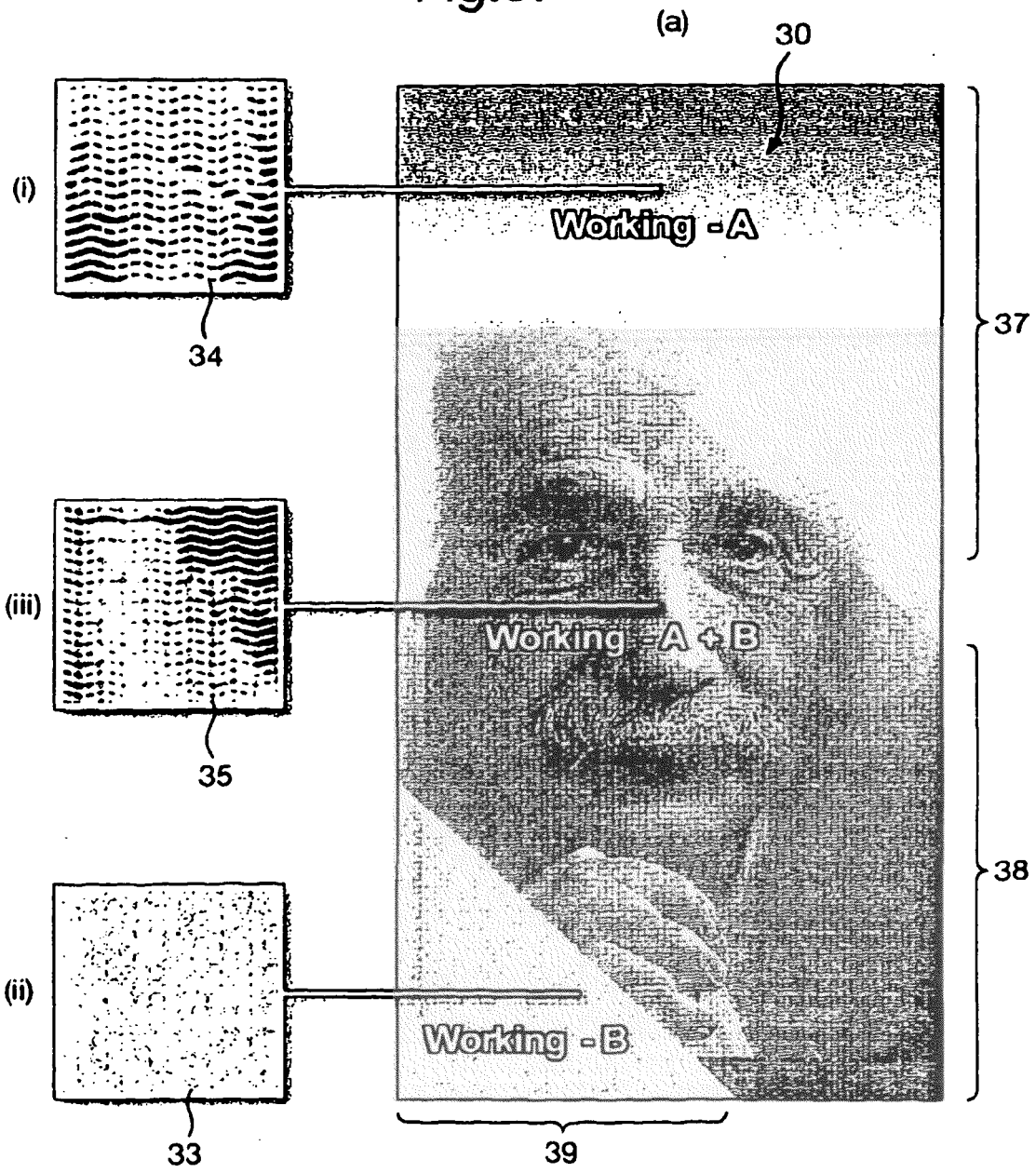


Fig.10.

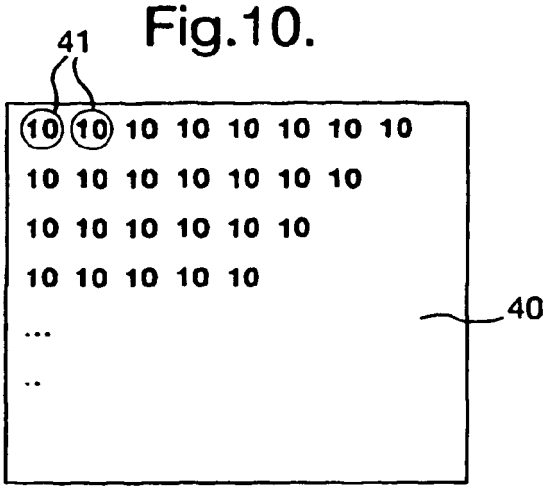


Fig.11.

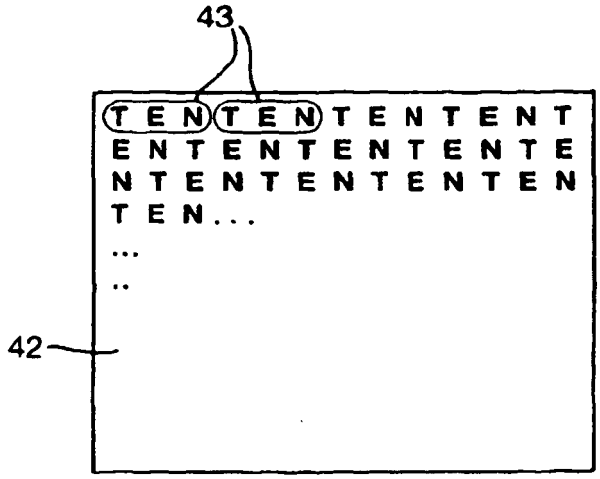
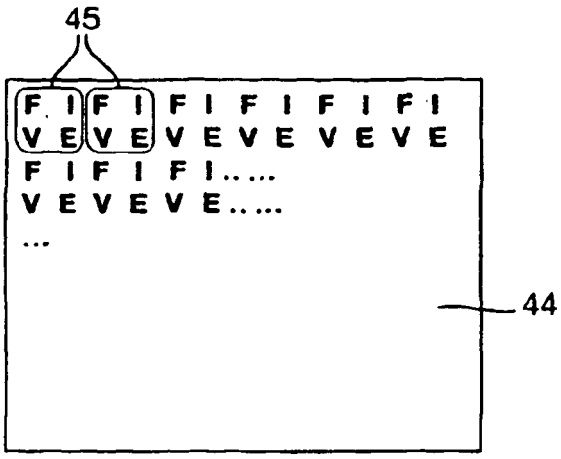


Fig.12.



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