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(54) Title: METHOD FOR COMPARING A FIRST DRAWING WITH A SECOND DRAWING BY COMPARING THEIR DRAWING ELEMENTS

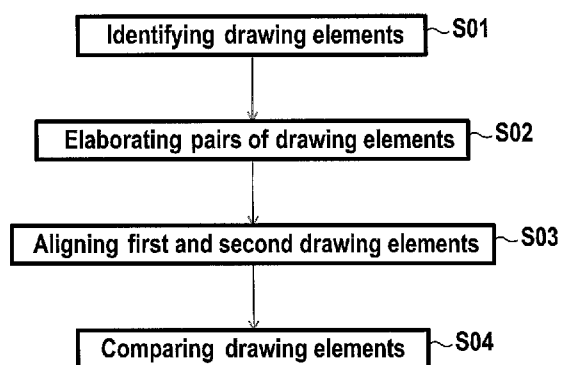


FIG.1

(57) Abstract: A method for comparing a first drawing with a second drawing, the first drawing comprising first drawing elements and the second drawing comprising second drawing elements, characterized in that it comprises: - identifying (S01), for each drawing, each drawing element present on the drawing, - elaborating (S02) a plurality of pairs of drawing elements each comprising a first drawing element and second drawing element corresponding to the first drawing element, - for each pair of drawing elements, aligning (S03) the first drawing element and the second drawing element, - for each pair of drawing elements, comparing (S04) the first drawing element and the second drawing element.

Method for comparing a first drawing with a second drawing by comparing their drawing elements

Field of the disclosure

- 5 The present disclosure is related to the comparison of drawings, and more precisely to a method for comparing drawings such as engineering drawings.

Background of the Disclosure

- 10 Drawings such as engineering drawings comprise a plurality of drawing elements such as:

- Views (graphical projections of an object, engineering drawings generally comprise a plurality of views of a same object);
- Notes;
- 15 - Title block (for example present in the bottom right portion of a drawing);
- A frame (for example a frame placed at the periphery of the drawing and touching the title block),
- Etc.

- 20 Usually, drawings are changed during the design of a new part or of a new object, for the modification of an existing part or object or a change in assembly instructions. Before the validation of this part or object design or assembly instructions, the drawings have to be verified. The verification can consist in a comparison between an original drawing and the new drawing so
25 that each instruction on the drawing is confirmed, both to confirm change request were implemented and that no other changes were performed.

- This verification is typically aimed at ensuring that all changes instructed have been made. This verification is very time consuming because the drawings are big and each dimension, shape, text, lines have to be
30 confirmed, regardless of whether a change has been instructed or not. Should the verification prove to be unsatisfactory, the drawings are rejected, modified and the process of verification can start again.

- For some applications, the drawings are verified several times. They may be verified by the engineer in charge of drawing them, by a client of the
35 engineer, or by its hierarchical superior.

Thus, there is a need for a more automatic comparison method in order to simplify and to accelerate the verification of changed drawings.

A known method has been disclosed in document JPA-2016021102. This solution is unsatisfactory because it requires manual identification of the differences before performing the comparison.

Performing an at least partially automatic comparison is very intricate because the drawings are usually printed in A0 format or even in multiple A0 format. If the drawings are subsequently scanned, the files obtained may have a resolution of approximately 50000x20000 pixels (at 400 dot per inch) which requires a great amount of computation power to automatically process the drawings.

In addition to this, comparing the differences between pages can be challenging because the various drawing elements may have moved relative to each other and to the page.

Furthermore, it should be noted that comparing the differences pixel by pixel usually leads to unsatisfactory results because scanning a document usually leads to obtaining a file in which the drawing appears with an offset or with noise. Thus, even if few differences are expected between two drawings, the entire drawing may appear to contain differences as the scanning process has caused the drawings to be impossible to align at a pixel level.

It is a primary object of the disclosure to provide methods and systems that overcome the deficiencies of the currently available systems and methods.

Summary of the disclosure

The present disclosure overcomes one or more deficiencies of the prior art by proposing a method for comparing a first drawing and a second drawing.

According to embodiments of the present disclosure, the first drawing comprises first drawing elements and the second drawing comprises second drawing elements, and the method comprises:

- identifying, for each drawing, each drawing element present on the drawing,
- elaborating a plurality of pairs of drawing elements each comprising a first drawing element and a second drawing element corresponding to the first drawing element,

- for each pair of drawing elements, aligning the first drawing element and the second drawing element,
- for each pair of drawing elements, comparing the first drawing element and the second drawing element.

5 As explained above, a drawing element may be an element of a drawing such as a view of an object or of a part, a text, a title block, etc.

 If the second drawing is a changed version of the first drawing, then the second drawing usually comprises drawing elements in common with the first drawing. For example, they may both contain a title block (including a
10 frame) and substantially the same number of views (if the two drawings have different number of views, a view present on only one of the drawings may be considered as an orphan view). In these drawing elements, the text in the title block may be changed in the second drawing and at least a part of a view may be changed in the second drawing.

15 It should be noted that corresponding drawing elements may be drawing elements of a same type which share properties such as views elaborated from the same point of view. By way of example, a top view of an object or of a part represented on a first drawing may correspond to a top view of the same object or of the same part represented on a second drawing
20 (although some changes may have been performed on the second drawing with respect to the first drawing). Also by way of example, the title block of the first drawing corresponds to the title block of the second drawing (even if the text in the title block of the second drawing has been changed).

 Because the drawing elements are aligned before being compared, only
25 the real changes may appear in the result of this comparison. This advantage is also obtained because drawing elements are compared with drawing elements, instead of drawings being compared with drawings.

 The above method therefore provides a solution to show differences between two drawings and their drawing elements with minimal parasitic
30 differences. The method is also able to compare drawings printed on several pages (because it is the drawing elements which are compared). The method is adapted for drawings which are printed and scanned. The method can also handle drawings in which the views have been displaced or even rotated.

Identifying each drawing element present on a drawing may comprise defining a plurality of regions of a drawing, each region being elaborated in order to envelop a single drawing element.

Thus, each drawing is divided into a plurality of regions defined so that
5 only one drawing element is present in each region. Elaborating pairs of drawing elements may therefore be performed on the basis of the portions of drawings contained in each region.

Defining the plurality of regions of a drawing may comprise:

- obtaining a bitmap from the drawing,
- 10 - forming groups of pixels of the bitmap so that in each group of pixels, every pixel is adjacent to at least another pixel of the group or spaced from at least another pixel of the group of pixels by a distance which is less than a predefined distance threshold, each group of pixel corresponding to a drawing element.

15 In the present description, a bitmap corresponds to a rectangular matrix of pixels.

Usually, a drawing element such as a view is separated from other drawing elements. Because of this separation, it is possible to group the pixels which belong to the same drawing element because they will all be spaced from
20 at least another pixel of the group of pixel by a distance which is less than a predefined distance threshold.

This predefined distance threshold may be chosen to be less than the smallest distance which separates drawing elements such as views or the smallest distance which separates a view from the title block.

25 The first drawing and the second drawing may comprise drawn areas and blank areas, and obtaining a bitmap from a drawing comprises expanding the drawn areas of the drawing.

For example, this expansion can be done by expanding the drawn areas by a predefined number of pixels. Thus, every pixel which is drawn can be
30 surrounded in a disk of drawn pixels having a radius equal to the predefined number of pixels. For example, for an image in which the drawn areas are black and the blank areas are white (black on white image), this expansion will be often be designated by the person skilled in the art as an erosion (the white blank areas are eroded so that the drawn areas are thickened). Alternatively
35 and by way of example, for an image in which the drawn areas are white and

the blank areas are black (white on black image), the expansion will often be designated by the person skilled in the art as a dilatation which grows the white areas.

Also, blank areas may be areas which have the color of the background of an image which the skilled person will easily recognize with respect to the color of the drawn areas.

This predefined number of pixels may be chosen so that in the resulting bitmap, close drawing elements may touch each other. Therefore, the predefined distance threshold can be set at one pixel and every touching another pixel belongs to the same group of pixels as this other pixel. For example, the predefined number of pixels may be chosen so that characters of a text come into contact with each other.

Obtaining a bitmap from a drawing further may comprise resizing the drawing in which the drawn areas have been expanded.

While the bitmap may be obtained directly from a scan of the drawings, it is also possible to resize the scanned image into a bitmap having a smaller resolution. An image having a smaller resolution may require less computing power to manipulate and it may still be usable to define the regions and to identify the groups of pixels. Because the regions only comprise pixels of one group of pixels, the regions fully separate the drawings into drawing elements that carry meaning to the skilled person which can be compared to each other.

Defining the plurality of regions may comprise:

- a - defining a center of each group of pixels placed on each group of pixels,
- b - tessellating the bitmap to obtain a first plurality of tiles each comprising only one center of group of pixels,
- c - if a tile of the plurality of tiles comprises at least a pixel from a group other than the group having its center in the tile, then:
 - defining a supplementary center for the sub-group of pixels,
 - tessellating the bitmap to obtain a new plurality of tiles each comprising only one center of group of pixels or only one supplementary center of sub-group of pixels,
- d - repeating step c until an exit condition is met,
- e - merging together tiles comprising pixels of a single group of pixels to obtain a new plurality of tiles,

f – obtaining the regions enveloping drawing elements using the plurality of tiles, each tile corresponding to a region.

The center of each group, also called a centroid, is a pixel of a group of pixels which may be the center of gravity of each group of pixels. If the center
5 of gravity of a group of pixels is placed on a pixel which does not belong to the group of pixels, the center will be the point of the group of pixels which is the closest to this point.

Tessellating the bitmap may comprise forming a Voronoi diagram.

Voronoi diagrams are known to the skilled person.

10 The exit condition may be met if each tile of the plurality of tiles does not comprise pixels from two different groups of pixels.

Alternatively, the exit condition may be reached after a predefined number of repetitions of step c. It is then possible that an operator may finish the process by separating the drawing elements manually if tiles still comprise
15 pixels from different groups of pixels.

Comparing, for each pair of drawing elements, the first drawing element and the second drawing element may comprise:

- obtaining the differences between the first drawing element and the second drawing element,
- 20 - for each pair of drawing element, elaborating a mask having areas enveloping the differences between the first drawing element and the second drawing element,
- for each pair of drawing element, superimposing the mask on either the first drawing element or the second drawing element.

25 This mask may be partially transparent and its color may be chosen to highlight the areas in which changes have been made.

The method may comprise blurring the drawn areas of the first drawing element and of the second drawing element before obtaining the differences between the first drawing element and the second drawing element.

30 The method may comprise thresholding the difference between the first drawing element and the second drawing element after obtaining the differences between the first drawing element and the second drawing element.

This allows only taking into account large differences between the drawings and it hides small differences.

According to another embodiment of the present disclosure, a system for comparing a first drawing with a second drawing is provided.

In this embodiment, the first drawing comprises first drawing elements and the second drawing comprises second drawing elements, and the system
5 comprises:

- a module for identifying, for each drawing, each drawing element present on the drawing,
- a module for elaborating a plurality of pairs of drawing elements each comprising a first drawing element and a second drawing element
10 corresponding to the first drawing element,
- a module for aligning, for each pair of drawing elements, the first drawing element and the second drawing element,
- a module for comparing, for each pair of drawing elements, the first drawing element and the second drawing element.

15 It should be noted that the system may be configured to perform the various steps of the above-defined method.

According to another aspect of the embodiments of the present disclosure, there is provided a computer program including instructions for executing the steps of a method as defined above when said program is
20 executed by a computer.

This program can use any programming language and take the form of source code, object code or a code intermediate between source code and object code, such as a partially compiled form, or any other desirable form.

According to another aspect of the embodiments of the present
25 disclosure, there is provided a recording medium readable by a computer and having recorded thereon a computer program including instructions for executing the steps of a method as defined above

The recording medium can be any entity or device capable of storing the program. For example, the medium can include storage means such as a ROM,
30 for example a CD ROM or a microelectronic circuit ROM, or magnetic storage means, for example a diskette (floppy disk) or a hard disk.

Alternatively, the recording medium can be an integrated circuit in which the program is incorporated, the circuit being adapted to execute the method in question or to be used in its execution.

Brief description of the drawings

How the present invention may be put into effect will now be described by way of example with reference to the appended drawings, in which:

- figure 1 is a block diagram of an exemplary method for comparing
5 two drawings,
- figures 2A and 2B are respectively examples of first and second drawings,
- figures 3A and 3B are the first and the second drawing after having been expanded,
- 10 - figures 4 to 8, 9A and 9B, and 10 illustrate the steps carried out for obtaining the regions,
- figure 11 illustrates the plurality of pairs of drawing elements,
- figure 12 illustrates aligning the drawing elements,
- figures 13A and 13B illustrate a view of an object with a mask on the
15 changed parts, and
- figure 14 is a block diagram of the steps of an example of comparison of two views.

Description of the embodiments

20 Reference will now be made in detail to exemplary embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 1 is a block diagram of an exemplary method for comparing two
25 drawings.

It should be noted that the steps of the method illustrated on FIG. 1 may be implemented by a processor of a computer.

The steps of the method illustrated on claim 1 may also be performed by a system comprising modules to perform the distinct steps of the method for
30 comparing two drawings of figure 1, for example a computing system.

Also, for the sake of conciseness, in the present description, "drawing" may refer to the drawn areas of a drawing, and the drawing may exist on computer files. For example, in a black on white drawing, the "drawing" can designate the black areas.

The method of FIG. 1 is implemented to compare drawings comprising drawing elements. If the drawings are engineering drawings, then the drawing elements may be views, title blocks, or even notes. The drawings may have been printed and subsequently scanned.

5 In a first step S01, the drawing elements are identified on each drawing. For example, each view may be identified as being a drawing element of a drawing, the title block may also be identified as a drawing element of the drawing, and a block of notes may be identified as a drawing element of the drawing.

10 In a second step S02, pairs of corresponding drawing elements are elaborated. This step is carried out by finding drawing elements which are similar between the first drawing and the second drawing.

 In a third step S03, in each pair, the first drawing element and the second drawing element are aligned.

15 Then, in a fourth step S04, the drawing elements are compared.

 It should be noted that in the above method, the two drawings are compared because every drawing element which they comprise is compared with a corresponding drawing element. If a drawing element cannot be in a pair (for example if a view has been added during the elaboration of the second
20 drawing), then this drawing element is automatically considered as a new drawing element and as a difference. Such a drawing element may also be designated as an orphan drawing element.

 FIG. 2A is an example of a first drawing. This drawing comprises a plurality of drawing elements. The drawing element referenced by 20 is a view
25 of a cylindrical object. The drawing element referenced by 21 is a side view of a part of another object present on the drawing. The drawing element referenced by 22 is a side view of an object. The drawing element referenced by 23 is a side view of the object of drawing element 22 along cutline A-A'. The drawing element referenced by 24 is a block of notes. The drawing element referenced
30 by 25 is the title block including the frame of the drawing.

 It should be noted that in the present description, a drawing element may comprise both a drawing and other elements such as arrows, dimensions, references (the references of the drawing are noted "XXXX" so that they are not confused with the references used in the present description).

FIG. 2B is an example of second drawing. This second drawing has been elaborated by performing changes on the first drawing.

This second drawing comprises drawing elements which all correspond to the drawing elements of the first drawing of FIG. 2A. The second drawing
5 comprises drawing elements referenced by 20', 21', 23', 24', and 25'. It can be seen that drawing elements 20 and 20' correspond to each other and that no change has been performed between the first and the second drawing. It can also be seen that drawing elements 21 and 21' correspond to each other and that a corner has been changed between the first and the second drawing. It
10 can also be seen that drawing elements 22 and 22' correspond to each other and that the same corner has been changed between the first and the second drawing. It can also be seen that drawing elements 23 and 23' correspond to each other and that the circular part of the first drawing has been changed into a square part. It can also be seen that drawing elements 24 and 24' correspond
15 to each other and that the notes of the second drawing have been changed. It can also be seen that drawing elements 25 and 25' correspond to each other, as they are both title blocks and that the text in the title block of the second drawing has been changed.

The following figures illustrate an example of the identification of
20 drawing elements in which the drawn areas of the first drawing and of the second drawing are expanded.

On FIG. 3A, the drawn areas of the first drawing have been expanded.

It should be noted that in a step carried out before this expansion, the first drawing and the second drawing may have been resized to obtain images
25 of pixels which are associated with the first and the second drawing.

The expansion is carried out by expanding the drawn areas of the first drawing. Each line has been thickened on this drawing. This has been done by adding drawn pixels in every direction around every drawn pixel of the first drawing.

30 This expansion is performed so that characters from a text all come in contact with each other. Also, the texts of the references of the drawing have been expanded so that they come in contact with the lines that link them to the drawing. The dimensions and arrows are also expanded so that they come in contact with the drawing. The skilled person will understand by how much the
35 drawing will have to be expanded.

As a result, each drawn pixel belonging to a drawing element 20 to 25 is in contact with another drawn pixel belonging to the same drawing element. Thus, groups of pixels which are contiguous are formed.

On FIG. 3B, the drawn areas of the second drawing have been expanded in a similar manner.

FIG. 4 to 8 illustrate the definition of a plurality of regions each comprising a drawing element on the first drawing.

On FIG. 4, centers 40 of each drawing element have been placed. In this example, each center is the center of gravity of each group of pixels, or the closest pixel of the group to the actual center of gravity (thus, all centers are placed on a group of pixels).

On FIG. 5, a first Voronoi diagram 50 has been formed by tessellating the first drawing and by forming a tile for each center 40 (each center is a centroid in the sense of a Voronoi diagram).

As can be seen on FIG. 5, every tile comprises pixels from at least two groups of pixels.

In each tile, there are pixels belonging to the group of pixels of the center 40. There are also sub-groups of pixels which belong to a group of pixel other than the one of the center 40.

On FIG. 6, supplementary centers 60 are defined for each sub-group of pixels. These supplementary centers 60 are the centers of gravity of each sub-group of pixels, or the closest pixel of the sub-group to the actual center of gravity.

On FIG. 7, a new Voronoi diagram 70 is formed to obtain new tiles each comprising only one center of group of pixels or only one supplementary center of sub-group of pixels. Here, all the centers and supplementary centers will be centers (or centroids) in the sense of a Voronoi Diagram.

As can be seen on the figure, some tiles still comprise pixels from at least two groups of pixels.

In each tile, there are pixels that either belong to the group of the center of the tile (which may be a center 40 or a supplementary center 60), or pixels which belong to a group other than the one of the center of the tile and these pixels can form new sub-groups of pixels. Thus, the previous steps have to be repeated again.

For each new-sub group of pixels, new supplementary centers 80 are determined, as illustrated on FIG. 8. These supplementary centers 80 are the centers of gravity of each new sub-group of pixels, or the closest pixel of the new sub-group to the actual center of gravity.

5 On FIG. 8, a new Voronoi diagram is formed to obtain new tiles each comprising only one center 40 of group of pixels or only one supplementary center 60 of sub-group of pixels or only one new supplementary center 80 of sub-group of pixels.

10 As can be seen on the FIG. 8, there are still tiles comprising pixels from different groups.

For the sake of conciseness, the repetition of the previous steps is not shown on more figures and the end results are illustrated on FIG. 9A and FIG 9B.

15 On FIG. 9A, a Voronoi diagram 90 is shown on the first drawing in which each tile comprises only pixels from a single group of pixels, this diagram has been obtained by repeating the previous steps.

20 On FIG. 9B, a Voronoi diagram 90' is shown on the second drawing in which each tile comprises only pixels from a single group of pixels. The method for obtaining this diagram is the same as the one described in reference to the first drawing on FIG. 4 to FIG. 8.

It is possible to define a region comprising only pixels from a single group of pixels, and thus only pixels from a single drawing element of a drawing, by combining the tiles which comprise pixels of the same group of pixels.

25 An illustration of the combination of tiles into a region 100 has been illustrated on FIG. 10. This combination may be done automatically or also manually by an operator. An operator may also correct manually the diagram to ensure that every tile comprises pixels of a single group of pixels. This manual correction can be carried out if the expansion has left isolated a part of drawing
30 which should have been included in a group of pixel or also if the previous steps are only repeated a predefined number of times.

After combining the tiles that include pixels of the same group, regions are obtained which can be reported or applied on the initial first and second drawings to delimit the drawing elements of the drawings.

It is then possible to elaborate a plurality of pairs of drawing elements each comprising a first drawing element and a second drawing element corresponding to the first drawing element of the pair. For example, elaborating the pairs may use the SURF (Speeded Up Robust Features) algorithm, or the
5 SIFT (Scale-Invariant Feature Transform) algorithm, or the Harris corner detector algorithm.

For example, an implementation of the elaboration of a plurality of pairs of drawing elements may comprise:

- For each drawing, obtaining all the features present on the drawing
10 using the SIFT or SURF feature detector or a Harris corner detector;

- Regrouping the features per drawing element previously identified.
Thus, each drawing element is attributed a certain number of features;

- Calculating a matching score for each possible pairs of drawing
15 element. For example, it is possible to use SURF features which have properties that allow identifying which features are matching between two drawing element. Based on the amount of matching and the distribution of line length linking similar features, it is possible to have a score representing how similar the drawing elements are.

- Associating each drawing element with another by sorting the
20 matching scores and selecting the drawing element having the highest matching score.

It should be noted that using matching scores allows determining potential matches or drawing elements which do not match (for example if there are similar matching scores or if any matching score is too low).

25 On FIG. 11, the pairs of drawing elements P1, P2, P3, P4, P5, and P6 obtained from the first drawing and on the second drawing have been represented. The pair P1 comprises drawing elements 20 and 20', the pair P2 comprises drawing elements 21 and 21', the pair P3 comprises drawing elements 22 and 22', the pair P4 comprises drawing elements 23 and 23', the
30 pair P5 comprises drawing elements 24 and 24', the pair P6 comprises drawing elements 25 and 25'.

The drawing elements have all been obtained by using the regions corresponding to the first drawing on the first drawing and the regions corresponding to the second drawing on the second drawing which may have

been scanned. It is possible that because of the scanning, these drawings are misaligned.

Therefore, the drawings of each drawing element are aligned with each other, as illustrated on FIG. 12. For example, aligning two drawing elements
5 can comprise using the features of the drawing elements obtained using SURF, SIFT, or Harris. These features may be corners, and for example, three matching corners in each drawing element may be used to perform the aligning (matching corners may be determined using SURF properties of the features).

Also, the aligning may be performed through an affine transformation
10 by placing the axis system of two drawing elements to be aligned (for example a corner) on the same specific feature with the same alignment.

It should be noted that other types of transformations may be used. For example, a triangular tessellation may be carried out to divide each drawing element into a plurality of cells, before aligning each cell using an affine
15 transformation. This transformation provides better results if one of the drawing element has been subjected to non-linear deformation (for example because of the use of a scanner which produces waviness).

After aligning the drawing elements, it is possible to compare the drawing elements, for example by subtracting one drawing element with the
20 other drawing element of the pair. Preferably and as described in reference to FIG. 14, image filters should be applied prior to the subtraction and after the subtraction in order to only obtain the most significant changes between the two drawing elements. Because the drawings have been scanned, minimal, and non-perceivable differences remain even after the drawings have been aligned,
25 as will be described later, the use of filter allows disregarding the least significant changes between the drawing elements.

Because the drawing elements have been aligned, and preferably filtered, the result of this subtraction will be the changes between the two drawings.

30 For each pair of drawing element, a mask can be elaborated having areas (for example highlighting areas, for example semi-transparent areas of a given color) enveloping the differences between the first drawing element and the second drawing element of the pair.

This mask can be superimposed on the drawing elements of the pair.

On FIG. 13A and on FIG. 13B, the elaborated mask for drawing elements 21 and 21' is superimposed on drawing element 21 and on drawing element 21'.

5 In this example, the area of the mask enveloping the difference is a semi-transparent gray area MSK. Alternatively, a mask may be the opposite and it may be semi-transparent everywhere except around the differences where it will have transparent areas that envelop the differences.

FIG. 14 is a block diagram of the steps of an example of comparison of two views.

10 In this example, a first drawing element 141 is compared with a second drawing element 142 and the effect of the steps may be illustrated along line L-L' of the drawing elements.

In a first step S101, the drawing of the first drawing element is blurred, for example using a Gaussian blur. The drawing of the second drawing element
15 is blurred in a corresponding step S101'.

The blurred drawings are subtracted in step S102.

A thresholding is carried out on the result of the subtraction in step S103. As can be seen on the figure, this thresholding can filter small differences which may be considered as not relevant. For example, the thresholding can
20 filter out noise that appears during the printing and scanning steps.

In order to obtain the mask which envelops the differences, the result of the thresholding is expanded using another blurring (step S104), then another thresholding is performed (step S105) and another blurring is carried out to soften the edges of the mask which is then obtained.

25 Additionally, an operator may decide how the mask should be superimposed on the drawings, for example its level of transparency or its color.

Thus the above described embodiments all show differences between two drawings and their drawing elements with minimal parasitic differences.
30 The above methods are also able to compare drawings printed on several pages (because it is the drawing elements which are compared). The methods are adapted for drawings which are printed and scanned. The methods can also handle drawings in which the views have been displaced.

Claims

1. A method for comparing a first drawing with a second drawing, the first drawing comprising first drawing elements and the second drawing comprising second drawing elements, characterized in that it comprises:
- 5 - identifying (S01), for each drawing, each drawing element present on the drawing,
- elaborating (S02) a plurality of pairs of drawing elements each comprising a first drawing element and a second drawing element
- 10 corresponding to the first drawing element,
- for each pair of drawing elements, aligning (S03) the first drawing element and the second drawing element,
- for each pair of drawing elements, comparing (S04) the first drawing element and the second drawing element.
- 15 2. The method according to claim 1, wherein identifying (S01) each drawing element present on a drawing comprises defining a plurality of regions (100) of a drawing, each region being elaborated in order to envelop a single drawing element.
3. The method according to claim 2, wherein defining the plurality of
- 20 regions of a drawing comprises:
- obtaining a bitmap from the drawing,
- forming groups of pixels of the bitmap so that in each group of pixels, every pixel is adjacent to at least another pixel of the group or spaced from at least another pixel of the group of pixels by a distance which is less than a
- 25 predefined distance threshold, each group of pixel corresponding to a drawing element.
4. The method according to claim 3, wherein the first drawing and the second drawing comprise drawn areas and blank areas, and obtaining a bitmap from a drawing comprises expanding the drawn areas of the drawing.
- 30 5. The method according to claim 4, wherein obtaining a bitmap from a drawing further comprises resizing the drawing in which the drawn areas have been expanded.
6. The method according to any one of claims 3 to 5, in which defining the plurality of regions comprises:

a - defining a center (40) of each group of pixels placed on each group of pixels,

b - tessellating the bitmap to obtain a first plurality of tiles each comprising only one center of group of pixels,

5 c - if a tile of the plurality of tiles comprises at least a pixel from a group other than the group having its center in the tile, then:

- defining a supplementary center (60, 80) for the sub-group of pixels,

10 - tessellating the bitmap to obtain a new plurality of tiles each comprising only one center of group of pixels or only one supplementary center of sub-group of pixels,

d - repeating step c until an exit condition is met,

e - merging together tiles comprising pixels of a single group of pixels to obtain a new plurality of tiles,

15 f - obtaining the regions enveloping drawing elements using the plurality of tiles, each tile corresponding to a region.

7. The method according to claim 6, in which tessellating the bitmap comprises forming a Voronoi diagram (50, 70, 90, 90').

20 8. The method according to claim 6 or 7, wherein the exit condition is met if each tile of the plurality of tiles does not comprise pixels from two different groups of pixels.

9. The method according to any one of claims 1 to 8, wherein comparing, for each pair of drawing elements, the first drawing element and the second drawing element comprises:

25 - obtaining (S102) the differences between the first drawing element and the second drawing element,

- for each pair of drawing element, elaborating (S103, ..., S106) a mask having areas enveloping the differences between the first drawing element and the second drawing element,

30 - for each pair of drawing element, superimposing the mask on either the first drawing element or the second drawing element.

10. The method according to claim 9, comprising blurring (S101, S101') the drawn areas of the first drawing element and of the second drawing element before obtaining the differences between the first drawing element and
35 the second drawing element.

11. The method according to claim 10, comprising thresholding (S103) the difference between the first drawing element and the second drawing element after obtaining the differences between the first drawing element and the second drawing element.

5 12. A System for comparing a first drawing with a second drawing, the first drawing comprising first drawing elements and the second drawing comprising second drawing elements, characterized in that it comprises:

- a module for identifying, for each drawing, each drawing element present on the drawing,

10 - a module for elaborating a plurality of pairs of drawing elements each comprising a first drawing element and a second drawing element corresponding to the first drawing element,

- a module for aligning, for each pair of drawing elements, the first drawing element and the second drawing element,

15 - a module for comparing, for each pair of drawing elements, the first drawing element and the second drawing element.

13. A computer program including instructions for executing the steps of a method according to any one of claims 1 to 11 when said program is executed by a computer.

20 14. A recording medium readable by a computer and having recorded thereon a computer program including instructions for executing the steps of a method according to any one of claims 1 to 11.

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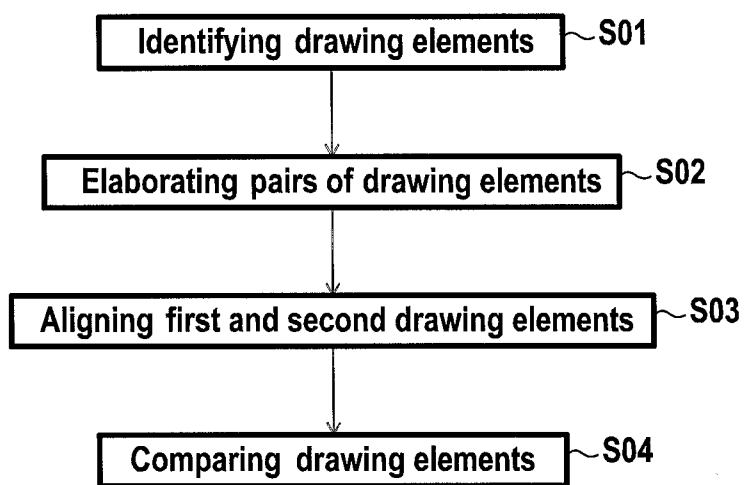
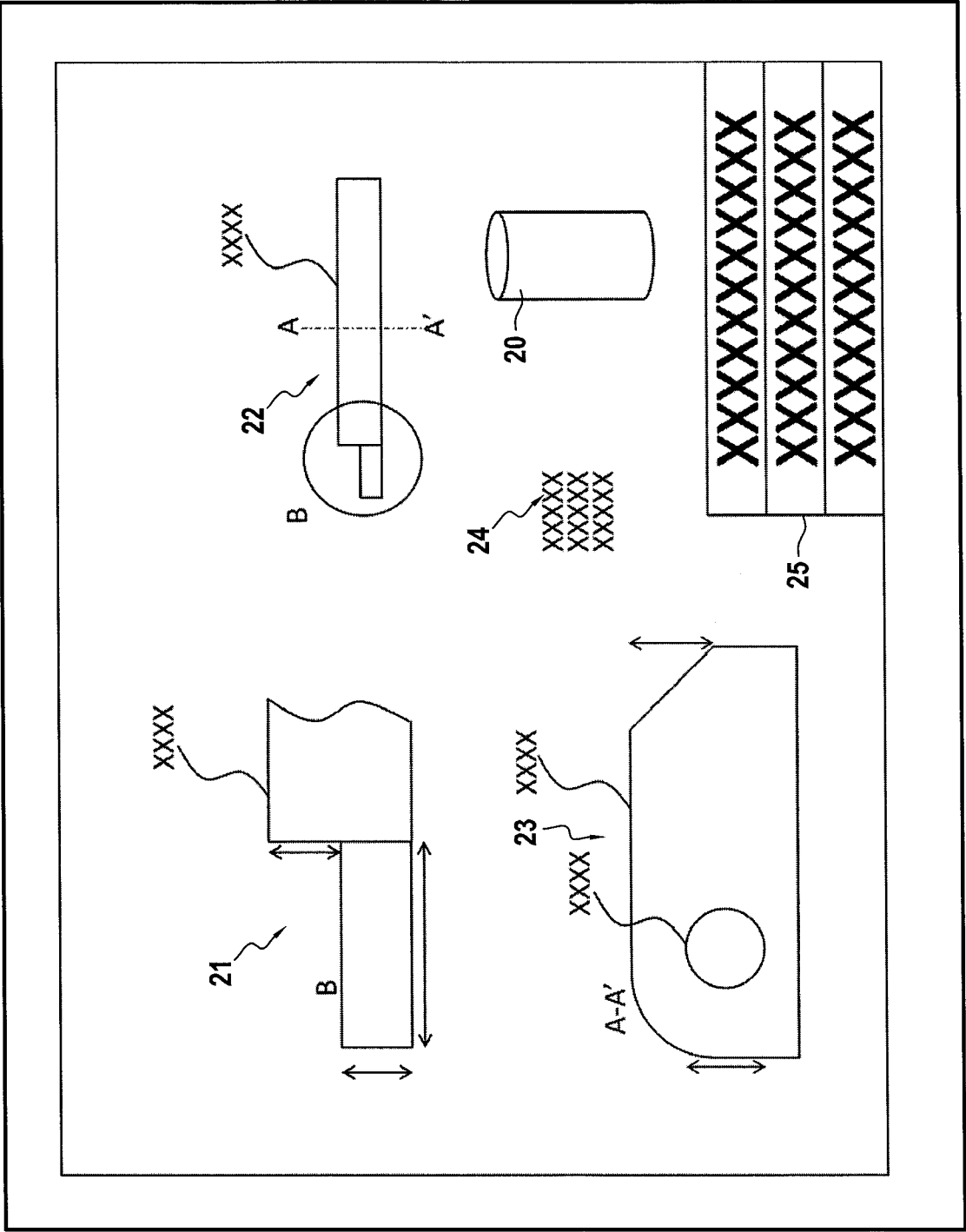


FIG.1



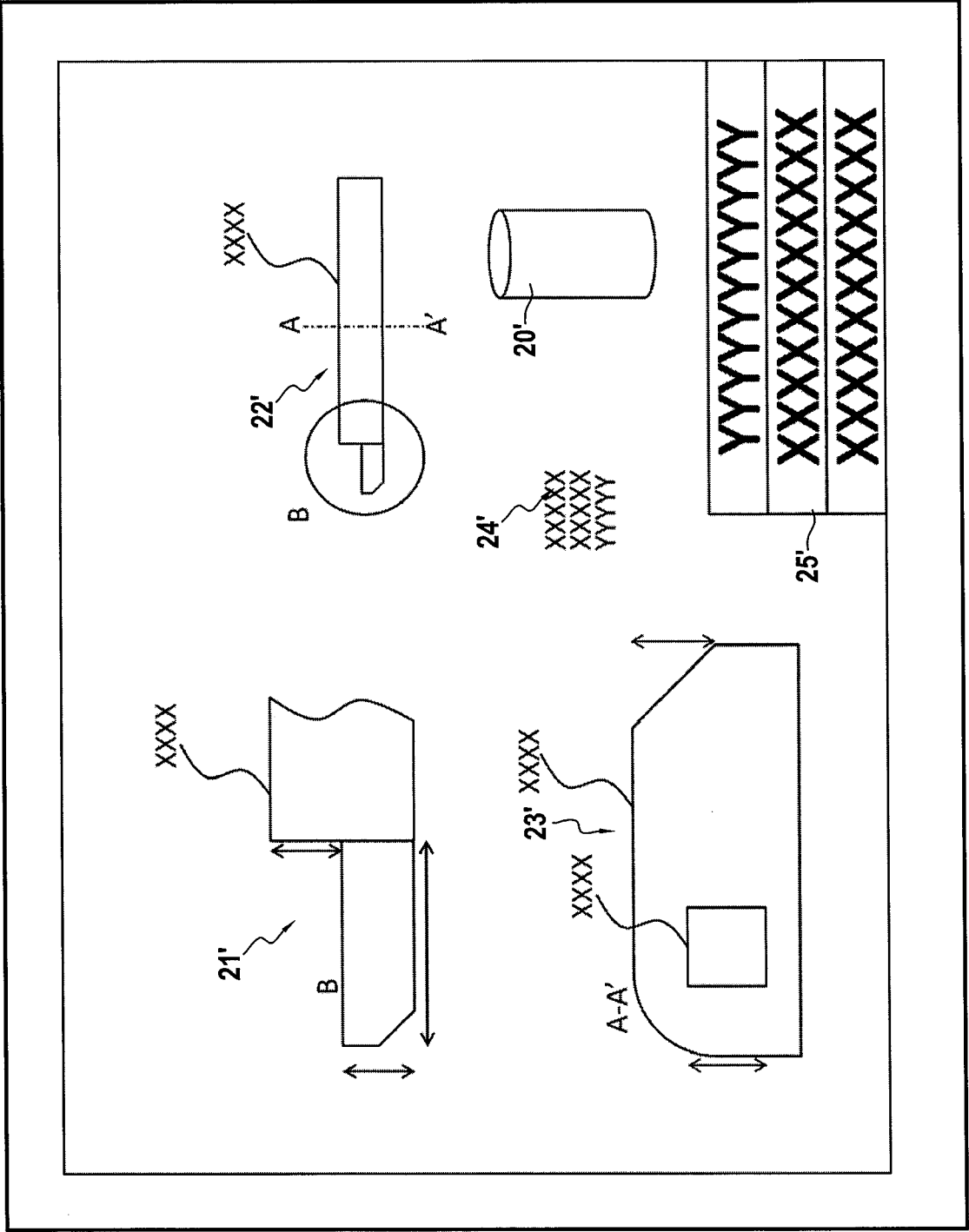


FIG. 2B

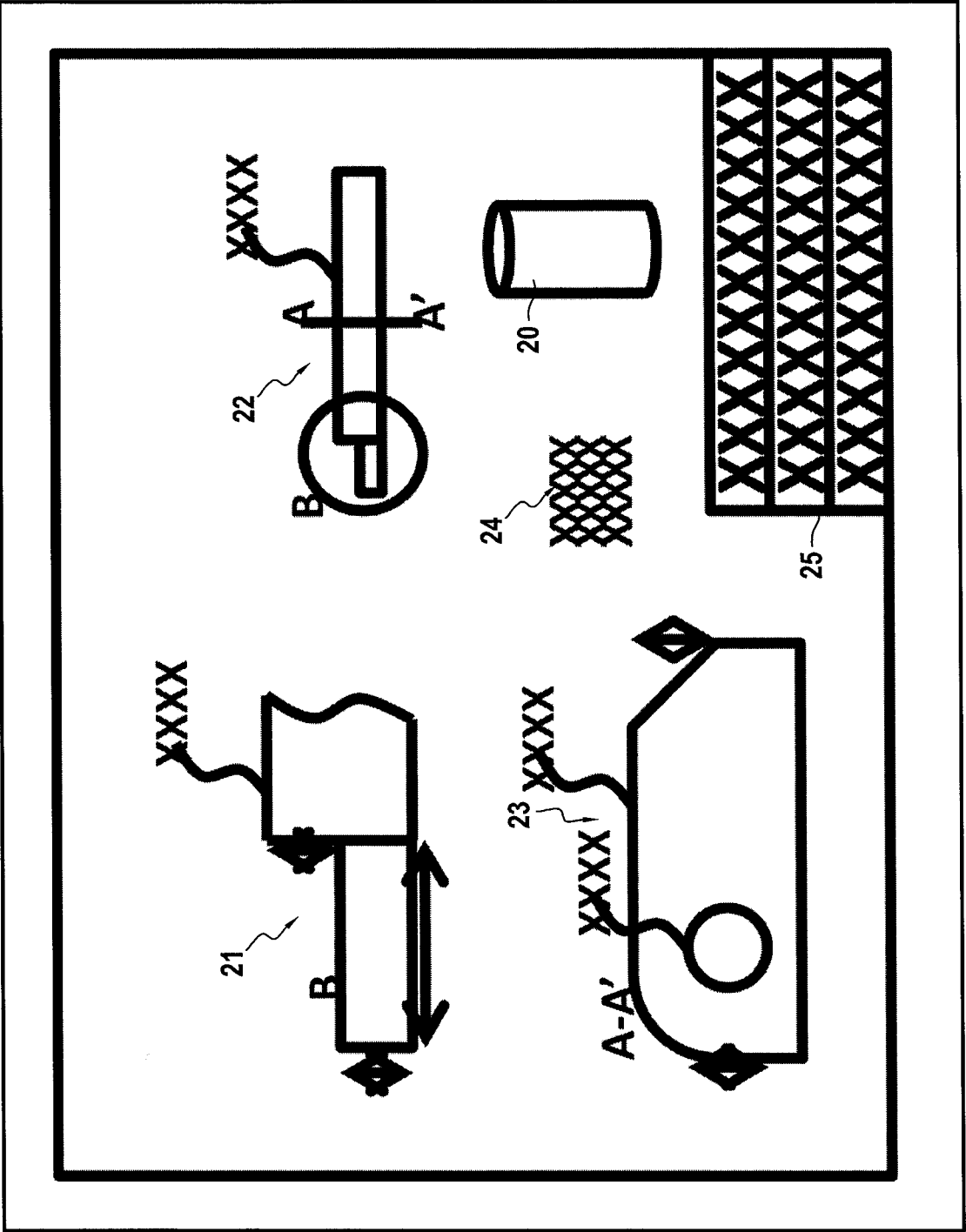


FIG.3A

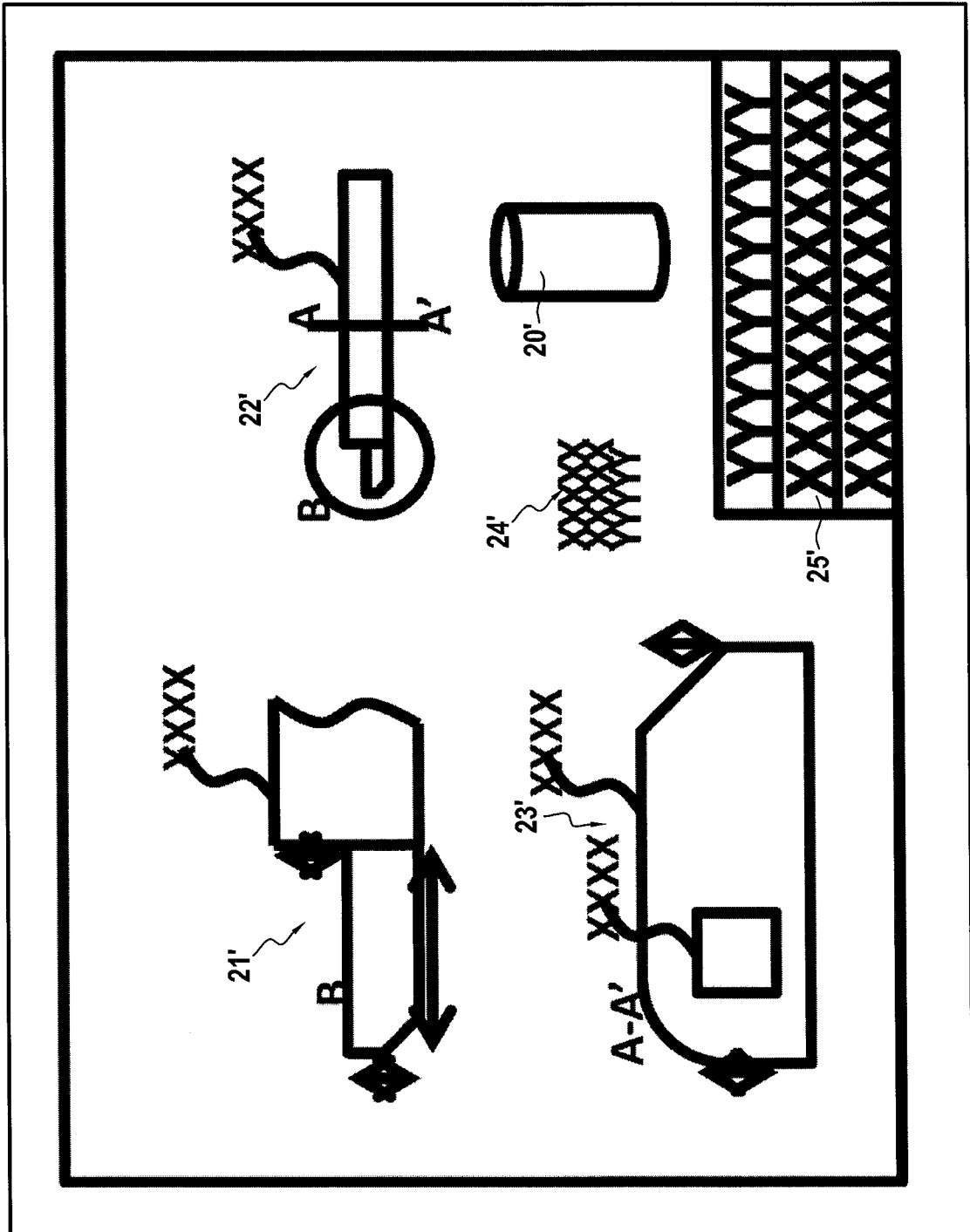


FIG. 3B

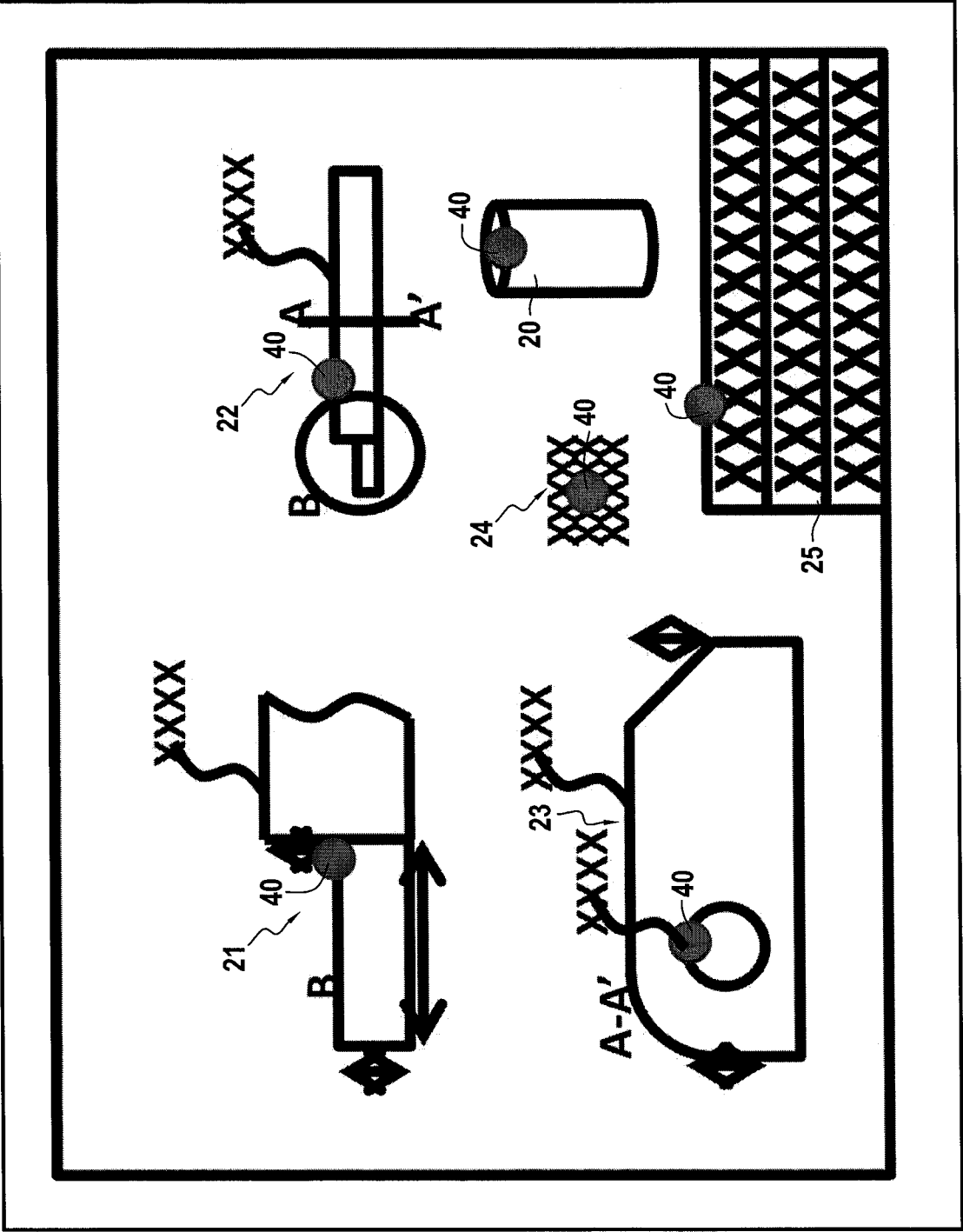


FIG.4

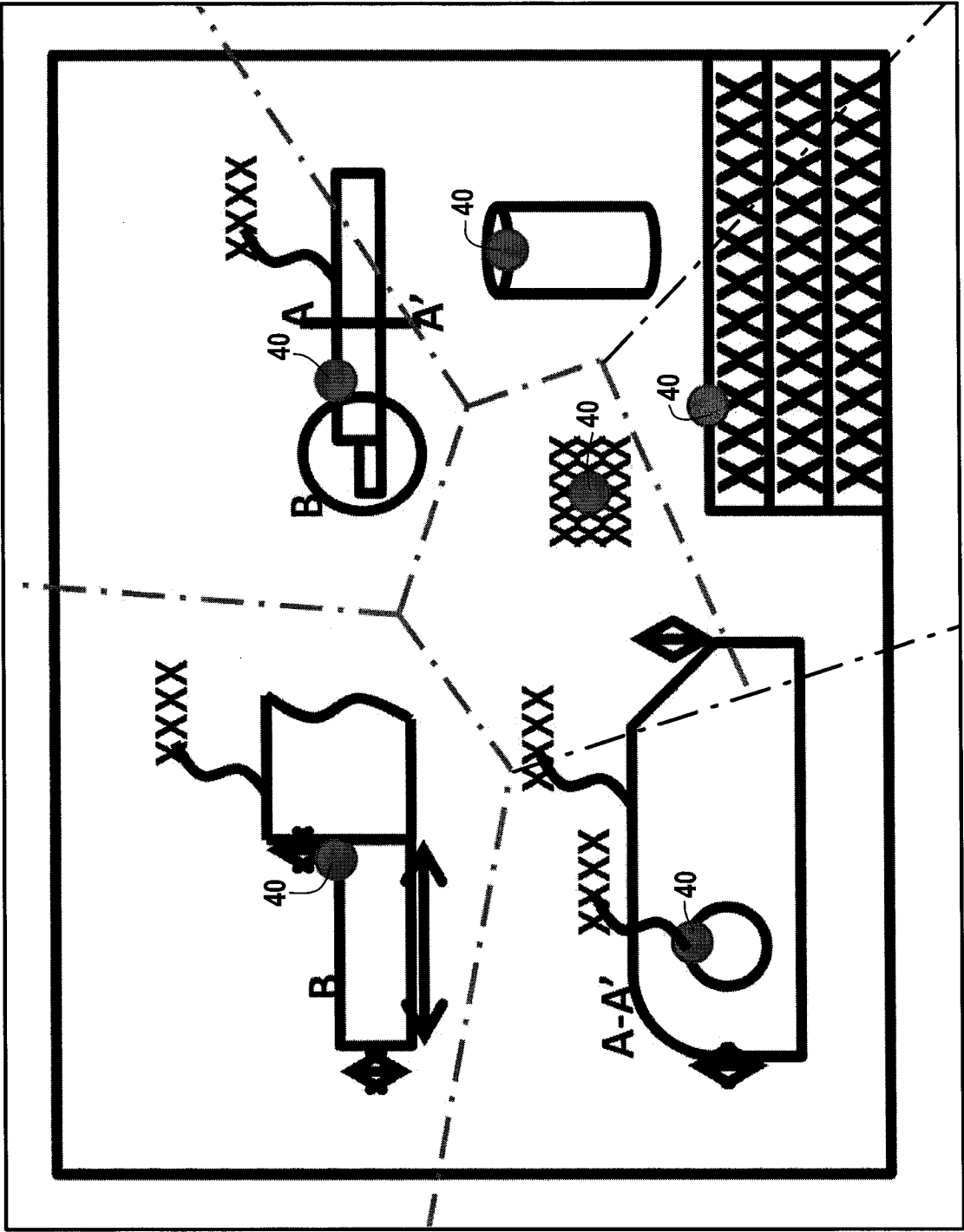


FIG. 5

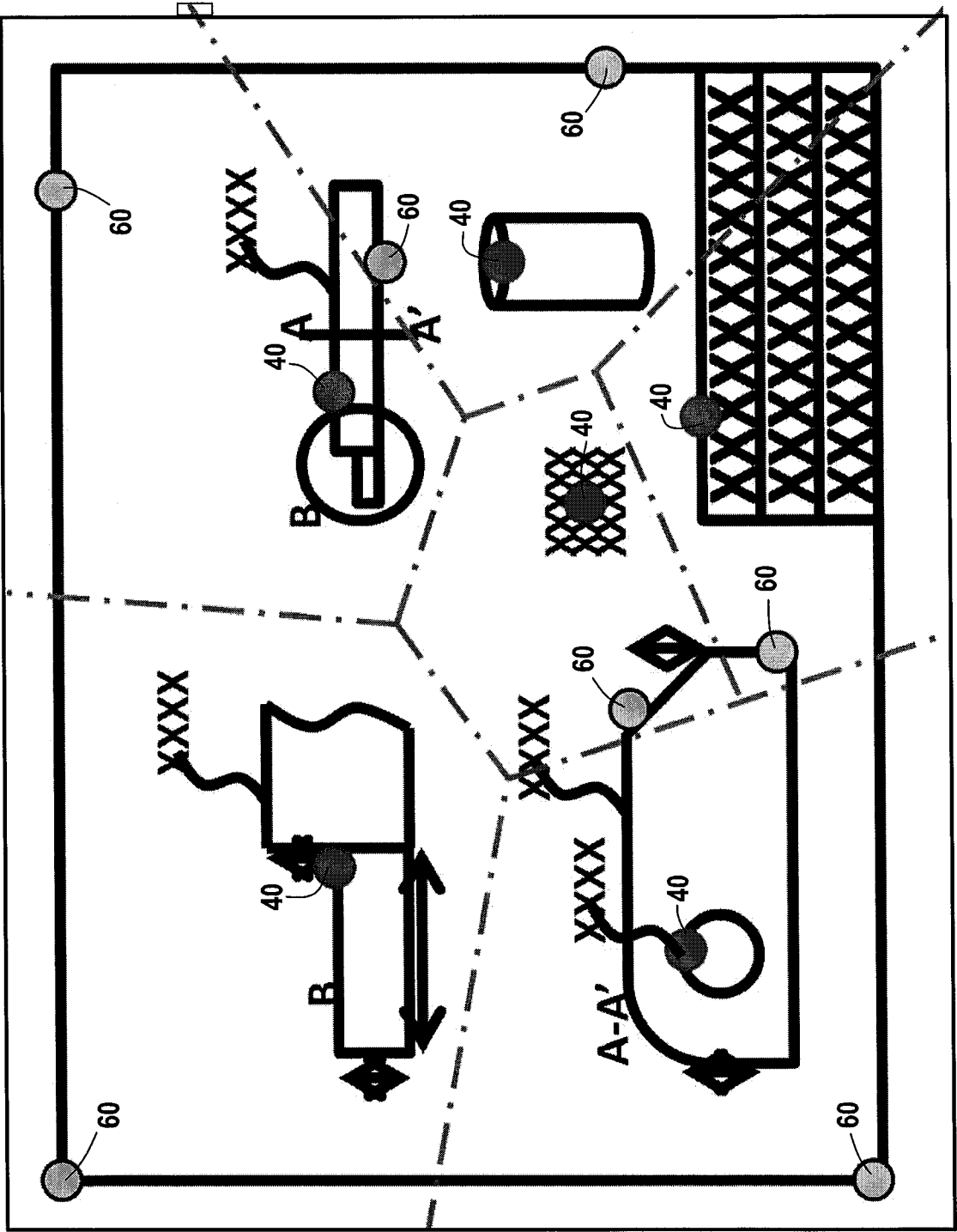


FIG.6

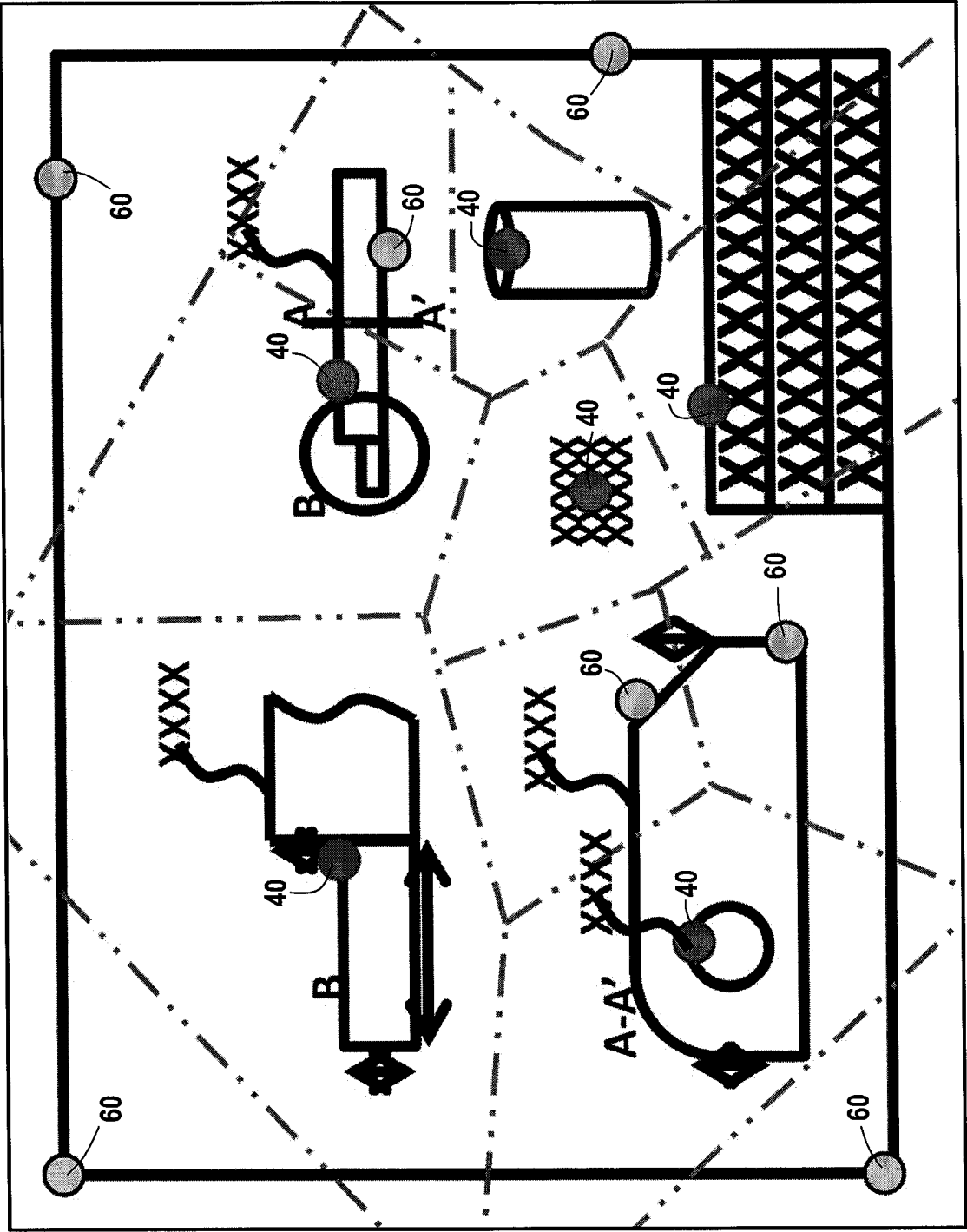


FIG.7

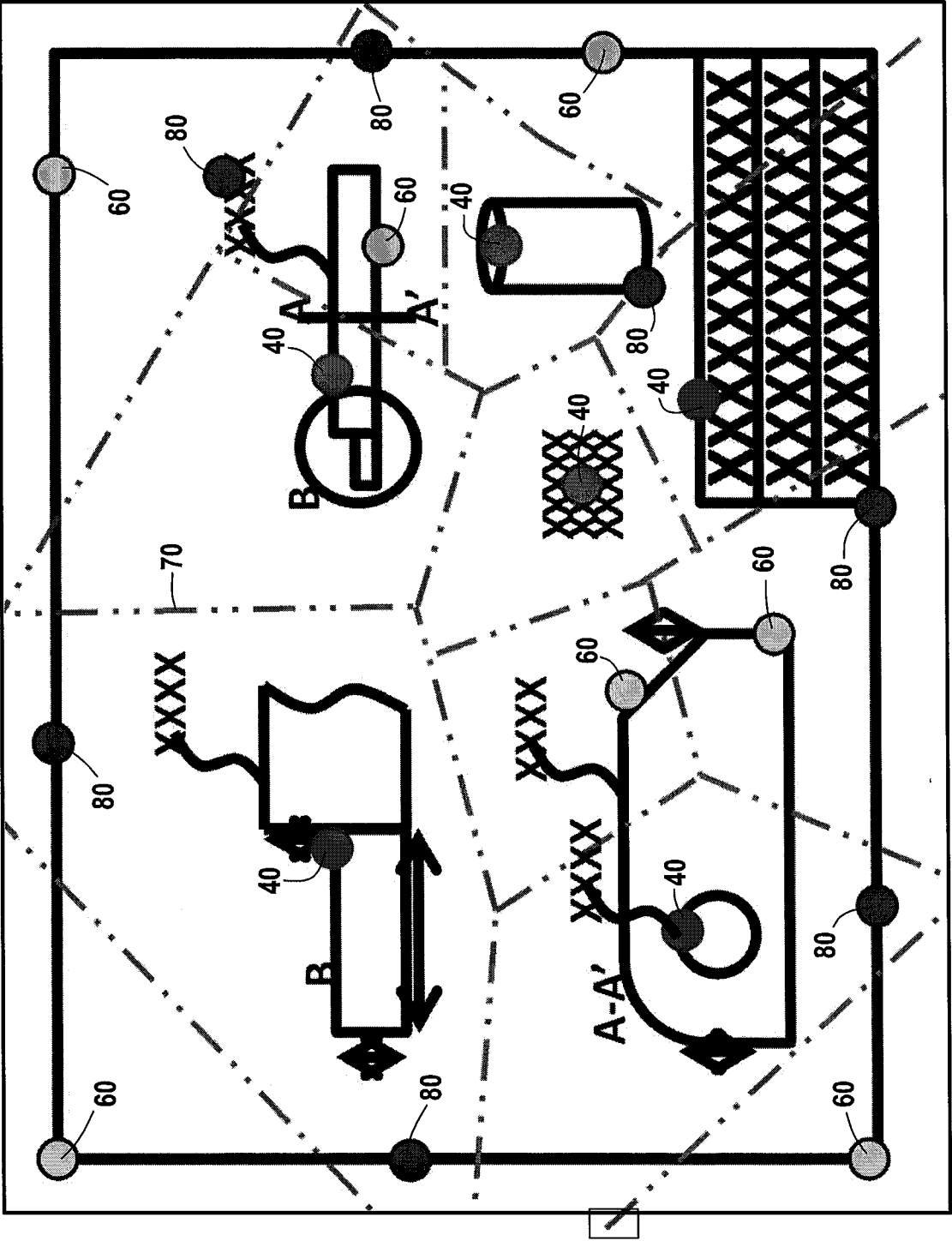


FIG.8

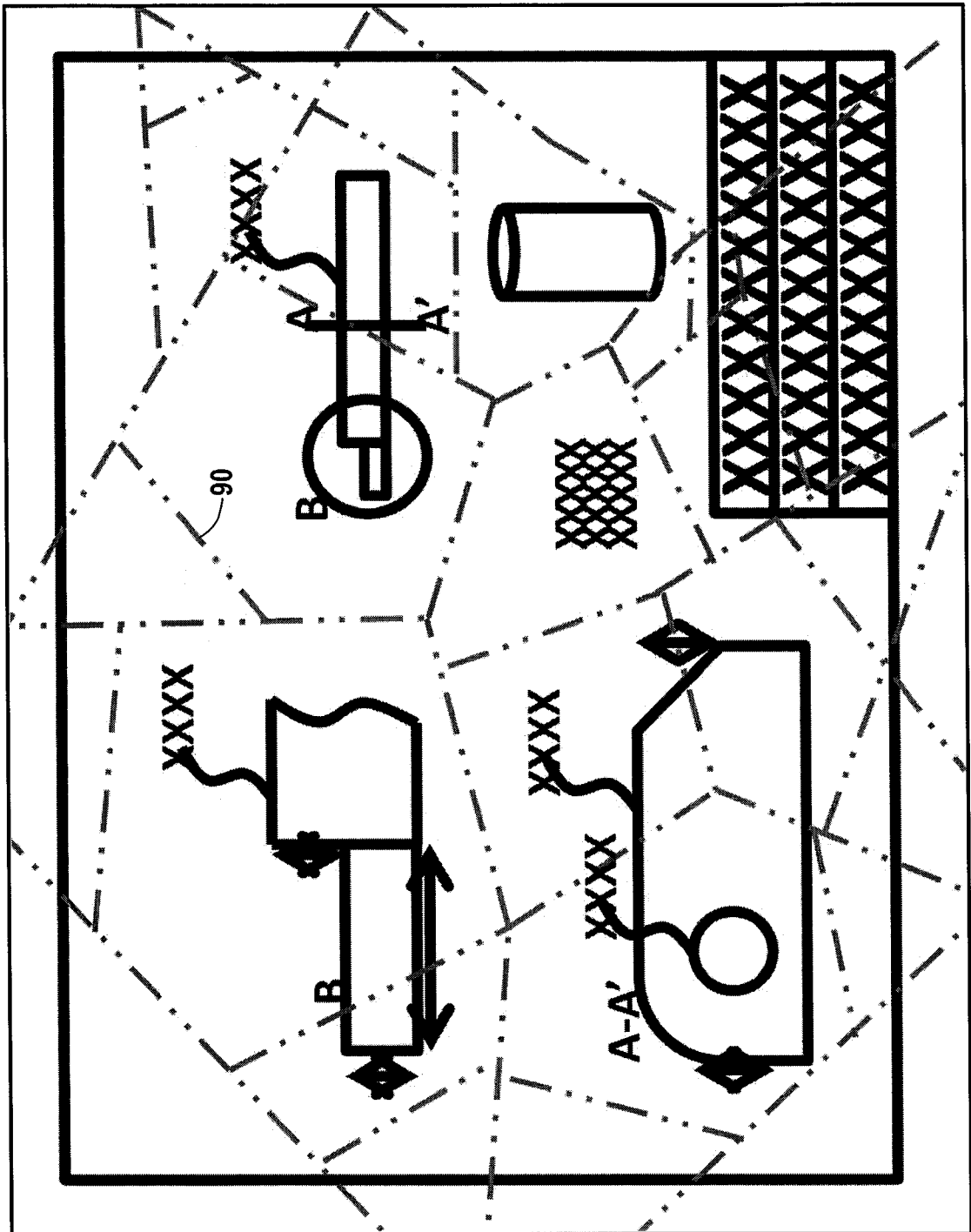


FIG. 9A

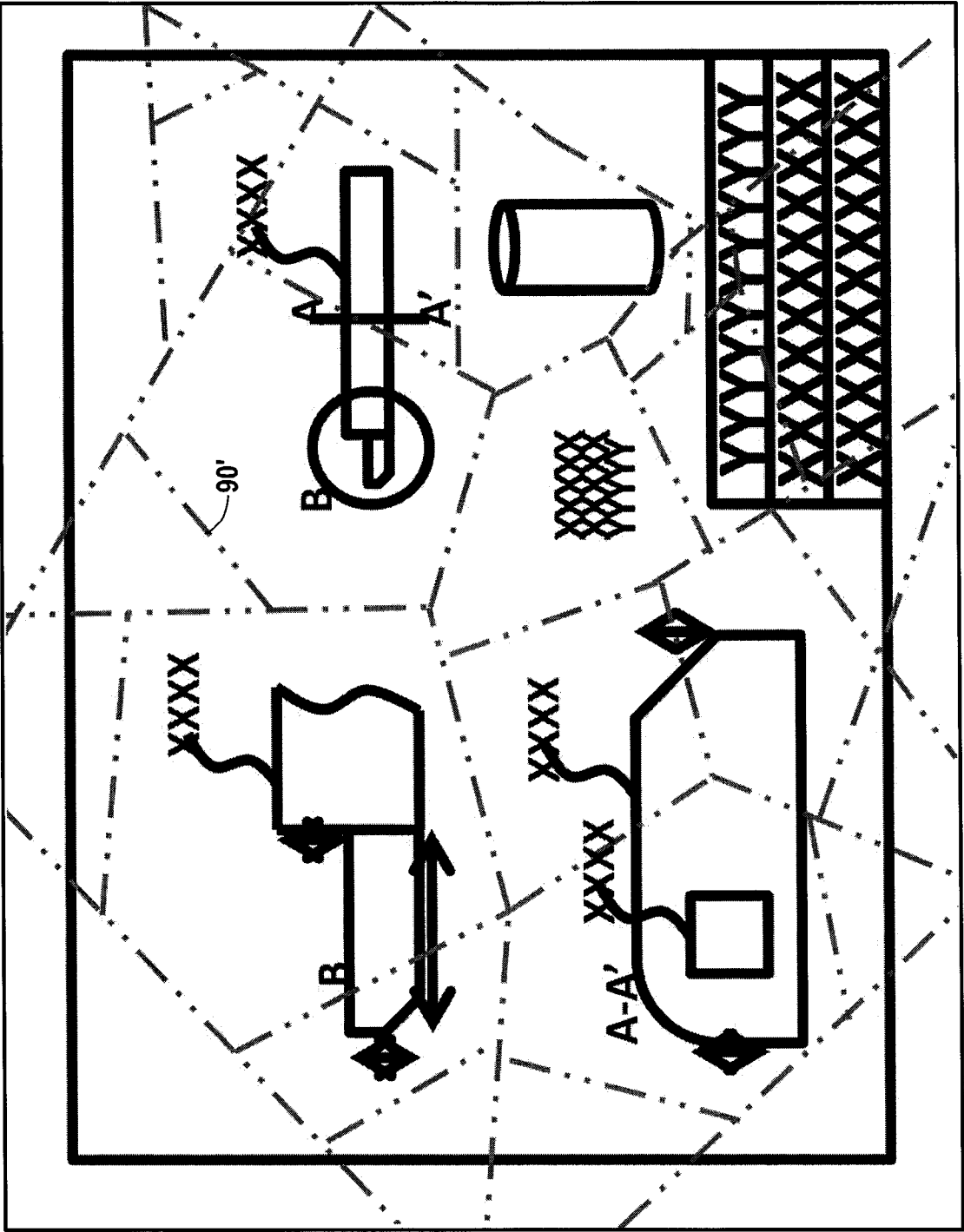


FIG. 9B

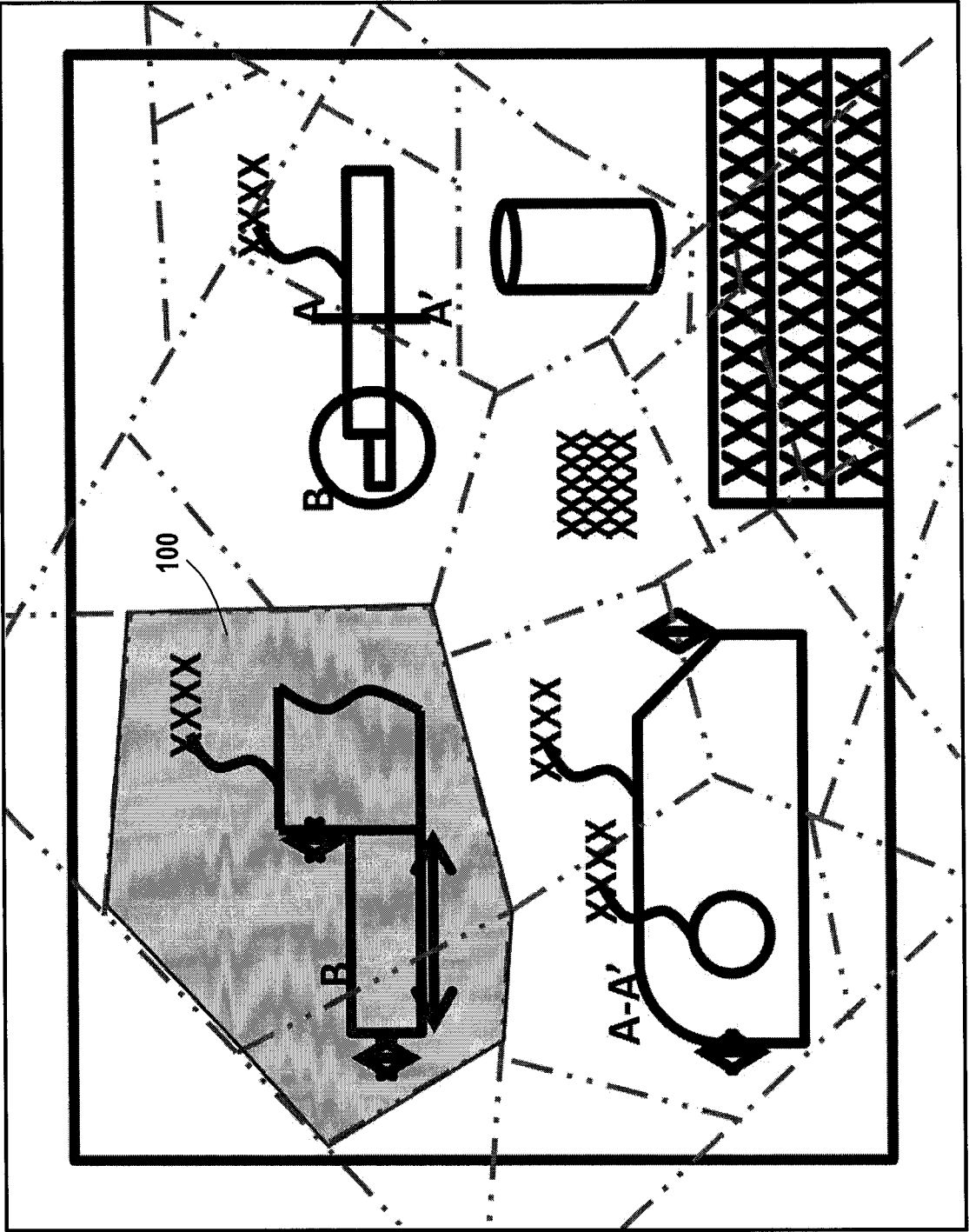


FIG.10

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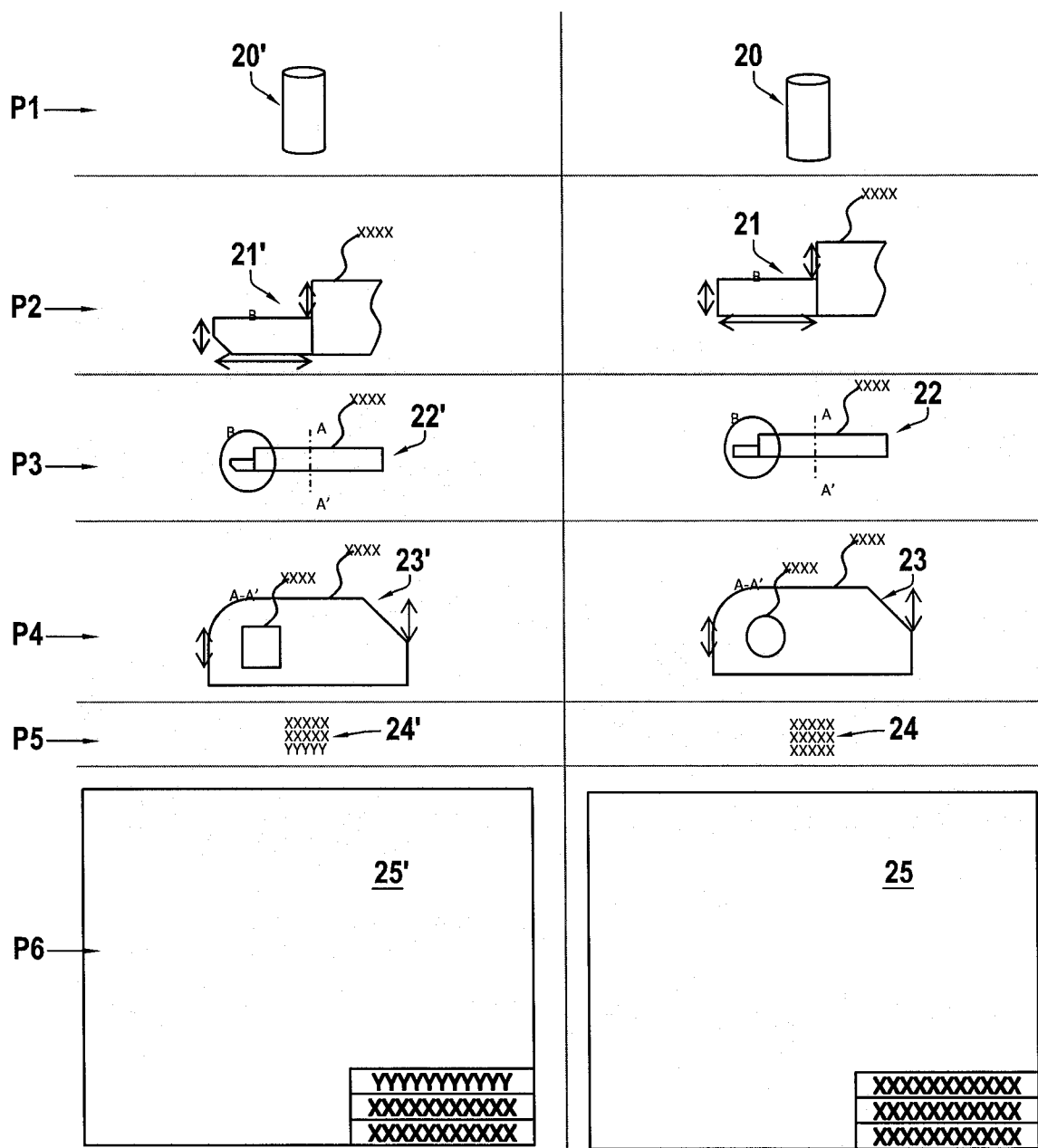


FIG.11

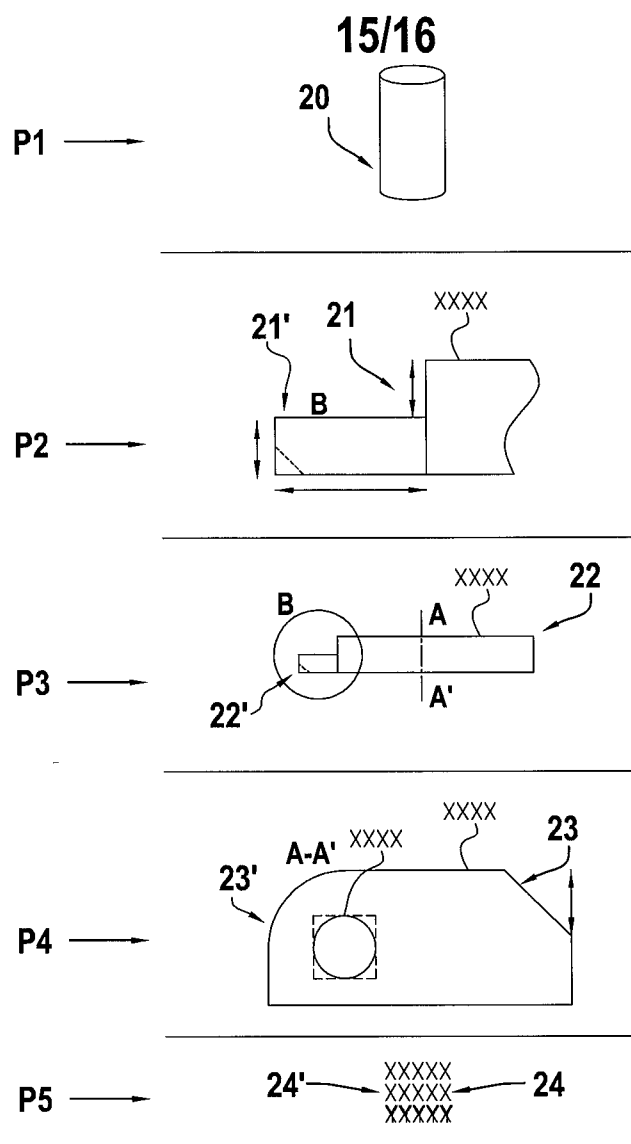


FIG.12

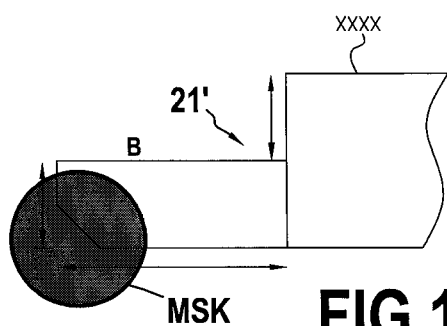


FIG.13B

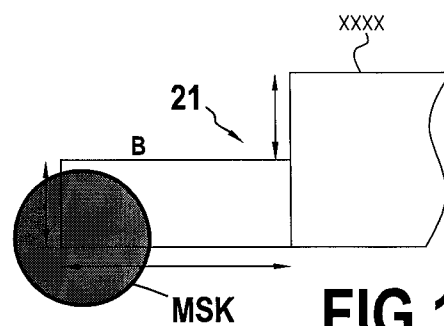


FIG.13A

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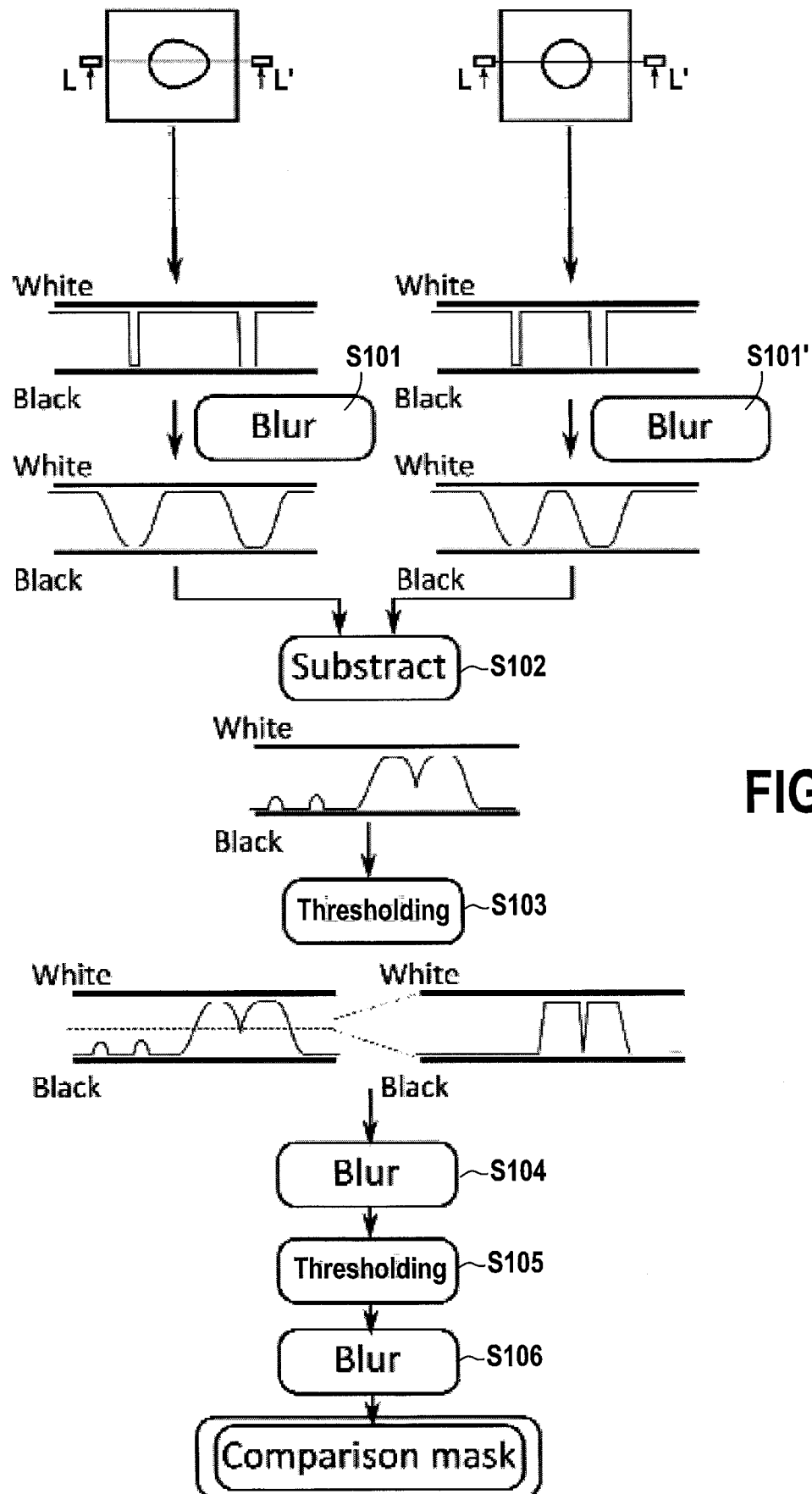


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/078086A. CLASSIFICATION OF SUBJECT MATTER
INV. G06K9/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Ha ET AL: "Image Processing Methods for Document Image Analysis" In: "Handbook of Character Recognition and Document Image Analysis", 1 January 1997 (1997-01-01), World Scientific, XP055261240, pages 1-47, DOI: 10.1142/9789812830968_0001,	1-5,9-14
Y	section 3 - section 5 ----- -/--	6-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 June 2017

Date of mailing of the international search report

06/07/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Angelopoulou, Maria

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/078086

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Yue Lu ET AL: "Word Grouping in Document Images Based on Voronoi Tessellation" In: "LECTURE NOTES IN COMPUTER SCIENCE", 1 January 2004 (2004-01-01), Springer Berlin Heidelberg, Berlin, Heidelberg, XP055180681, ISSN: 0302-9743 ISBN: 978-3-54-045234-8 vol. 3163, pages 147-157, DOI: 10.1007/978-3-540-28640-0_14, section 1 - section 2 figures 1, 6 -----	6-8