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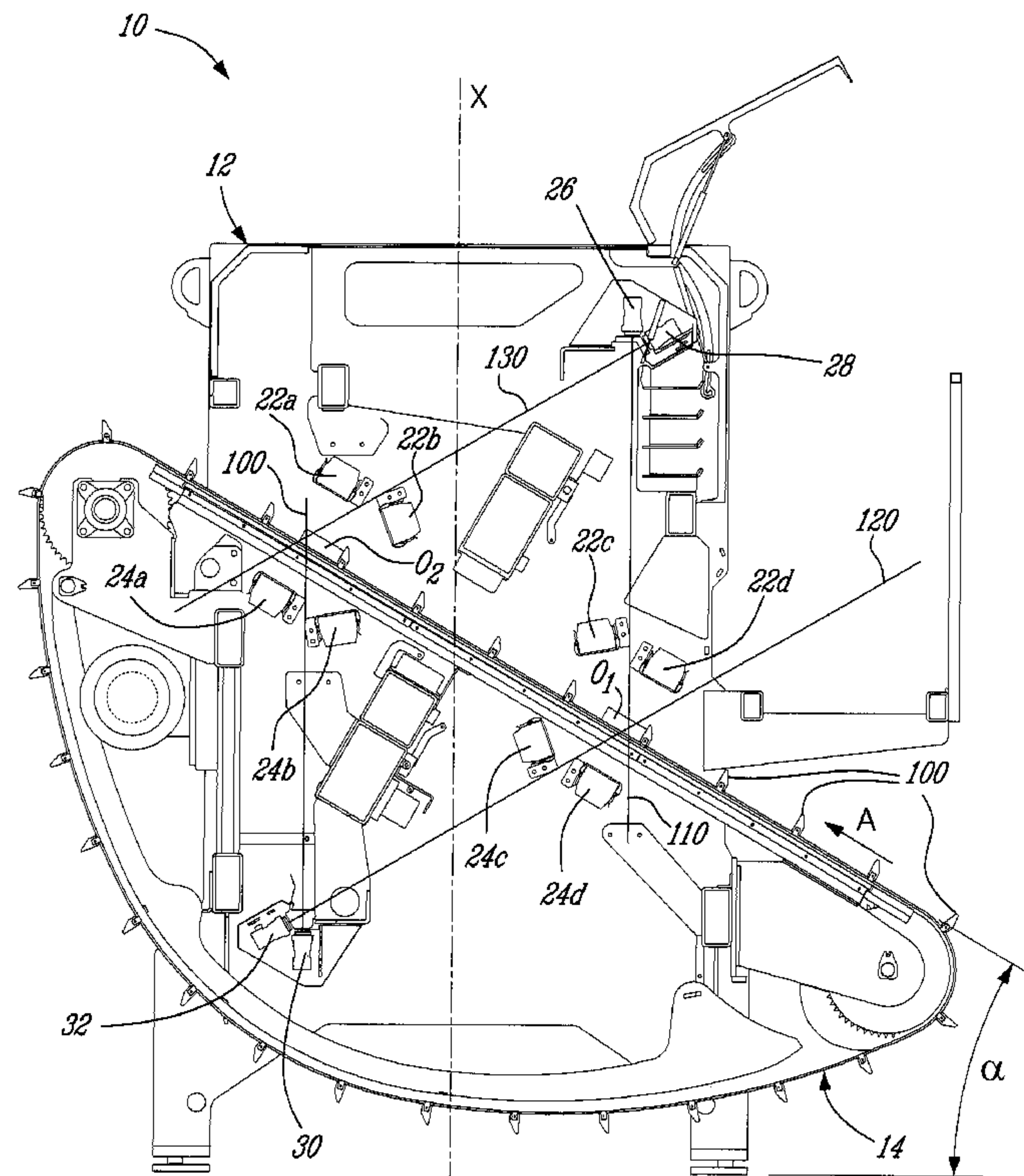
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(54) Titre : SYSTÈME DE VISION STEREOSCOPIQUE ET PROCÉDE CONNEXE

(54) Title: MULTIPLE VISION SYSTEM AND METHOD



(57) Abrégé/Abstract:

A conveyer method and system comprising at least one conveyer unit conveying an object; a lighting unit; a vision unit; wherein the lighting unit illuminates the object in the line of sight of the vision unit as the vision unit takes at least a first image at a first angle and a second image at a second angle of each surface of the object on the conveyer unit.

ABSTRACT

A conveyer method and system comprising at least one conveyer unit conveying an object; a lighting unit; a vision unit; wherein the lighting unit illuminates the object in the line of sight of the vision unit as the vision unit takes at least a first image at a first angle and a second image at a second angle of each surface of the object on the conveyer unit.

TITLE OF THE INVENTION

Multiple vision system and method

FIELD OF THE INVENTION

[0001] The present invention relates to a multiple vision system and method. More specifically, the present invention is concerned with a multiple vision system and method for identifying and classifying three-dimensional objects.

BACKGROUND OF THE INVENTION

[0002] In the wood processing industry for example, wood grading and wood classification are important steps to sort out a variety of wood grades in accordance with specific applications.

[0003] Traditionally, grading of planed lumbers is done by a qualified operator. The operator examines and segregates the wood pieces according to a numeric grade such as grade 1, grade 2, and grade 3 following predetermined standards. This evaluation must be done very rapidly, generally at a rate of sixty pieces per minute per operator, according to several criteria and in adherence to stringent rules. Grading allows selecting and dispatching wood pieces according to the specific applications and to a client's needs, thereby allowing rationalizing the use of wood in a cost-effective way.

[0004] Typically, classification is done according to norms generated by national commissions with the purpose of obtaining uniform characteristics and quality throughout plants manufacturing a given type of wood. Obviously, the operators work under tremendous pressure. Moreover, evaluation standards used by the operators are so strict that they result in "over-quality", meaning that approximately 15% of the wood pieces are over-classified, i.e. graded in an inferior grade, which in turn results in reduced profits. A number of technologies have been developed to

automate the classification work. However, few have been successful in increasing the rate of classification and allowing reducing human intervention while maintaining the desired quality.

[0005] Indeed, a number of attempts have been made to simplify and accelerate wood classification. Since evaluation of an object requires that a peripheral surface thereof is evaluated, it has been contemplated positioning cameras above and under a conveyor carrying the wood pieces for example, but a recurrent problem is the accumulation of debris on lower cameras. In US patent number 5,412,220 issued to Moore in 1995, this problem is addressed by adding to the conveyor a mechanism to rotate each wood piece in such a way that all four longitudinal faces thereof can be exposed to a camera.

[0006] There is still a need in the art for a multiple vision system and method for identifying and classifying three-dimensional objects.

SUMMARY OF THE INVENTION

[0007] More specifically, in accordance with the present invention, there is provided a conveyer system comprising at least one conveyer unit conveying an object; a lighting unit; a vision unit; wherein the lighting unit illuminates the object in the line of sight of the vision unit as the vision unit takes at least a first image at a first angle and a second image at a second angle of each surface of the object on the conveyer unit.

[0008] There is further provided a method of imaging a 3D object conveyed on a conveyer unit, comprising illuminating the object in the line of sight of a vision unit and taking, by the vision unit, at least a first image at a first angle and a second image at a second angle of each surface of the object on the conveyer unit.

[0009] Other objects, advantages and features of the present invention will become more apparent upon reading of the following non-restrictive description of specific embodiments thereof, given by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the appended drawings:

[0011] Figure 1 is a general side view of a system according to an embodiment of an aspect of the present invention;

[0012] Figure 2 is a general perspective view of the system of Figure 1;

[0013] Figure 3 illustrates the angle-of-view of each camera according to an embodiment of an aspect of the present invention;

[0014] Figures 4 illustrate corner detection according to an embodiment of an aspect of the present invention;

[0015] Figures 5 illustrate a double vision system in a linear conveyer assembly according to an embodiment of an aspect of the present invention;

[0016] Figure 6 shows a detail of a conveyer unit according to an embodiment of an aspect of the present invention;

[0017] Figure 7 shows a detail of a conveyer unit according to an embodiment of an aspect of the present invention;

[0018] Figure 8 shows a detail of a conveyer unit according to an embodiment of an aspect of the present invention;

[0019] Figure 9 shows a lug on a conveyer belt or chain according to an embodiment of an aspect of the present invention;

[0020] Figure 10 is a side view of a conveyer belt or chain according to an embodiment of an aspect of the present invention;

[0021] Figure 11 shows a detail of a conveyer unit according to an embodiment of an aspect of the present invention; and

[0022] Figure 12 illustrates a double vision system according to an embodiment of an aspect of the present invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0023] In a nutshell, there is provided a conveyer system and method comprising at least one conveyer unit conveying an object; a lighting unit; a vision unit; with the lighting unit illuminating the object in the line of sight of the vision unit as the vision unit takes at least a first image at a first angle and a second image at a second angle of each surface of the object on the conveyer unit.

[0024] As illustrated in Figures 1 and 2 the appended drawings, a system 10 generally comprises a frame 12, a conveyor unit 14 (which movement is indicated by arrow A), a lighting unit, a vision unit and a processing unit. Such system is described in patent US 7,227,165.

[0025] The frame 12 is a robust structural body, generally metallic. It is shown here as supporting the conveyor unit 14 conveying objects, but the conveyer unit 14 may be self supported. The frame 12 may be provided with articulated arms 20, shown in Figure 2 for example, extending and adjusting according to different angles.

[0026] The conveyor unit 14 is shown in Figures 1 and 2 as a transversal conveyer unit 14 comprising conveying means, such as longitudinal belts or chains 14a, 14b, 14c and 14d for example transversally separated by a distance along the width of the conveyer unit 14, and

supporting objects (O) to be analyzed with a minimum of contact points on the conveying means. The objects (O) are transported by the conveyer unit 14 transversally. Object transportation on the conveyor unit 14 may be performed with a minimum of conveyor unit length by adjusting the inclination slope α of the conveyor unit 14 relative to the horizontal (see Figure 1), taking advantage of the fact that the inclination of the conveyor unit 14 is adjustable. For example, an inclination α of approximately $30^{\circ} \pm 15^{\circ}$ relative to the horizontal is used in the embodiment illustrated in Figure 1. It is to be noted that the conveyor unit 14 is also adjustable in length. As people in the art will appreciate, an horizontal conveyer unit 14 could be used, providing a rotation of the light and vision unit of the system (see for example Figure 12).

[0027] The objects are generally 3D objects, comprising a top face, a bottom face and surfaces joining the top and bottom faces, referred to as edges. It is to be noted that the term "edges" as used herein refers to the sides of the 3D object, as opposed to the top face and the bottom face. The edges can be straight edges of 3D objects as illustrated in the Figures for clarity purposes, or less defined sides or transitions between a generally upper face and a generally lower face. Surfaces of the objects refer to the top face, the bottom face and the edges of the object.

[0028] The lighting and the vision units may be separate and remotely located from the frame 12.

[0029] In the embodiment illustrated in Figure 1, the lighting unit comprises light sources 22c, 22d, 24c and 24d, is positioned upstream of the conveyor unit 14 and light sources 22a, 22b, 24a and 24b, is positioned downstream of the conveyor unit 14, with light sources positioned above the conveyer unit 14 (22c, 22d and 22a, 22b) and light sources positioned below the conveyer unit 14 (24c, 24d and 24a, 24b). The light sources may be light ramps supported by the articulated arms 20 or fixed to the frame 12.

[0030] It is to be noted that a different number of light sources may be used, in order to illuminate the surfaces of the objects, provided the different light sources generate contrast

allowing to see defects of the objects. For example, it may be contemplated providing illumination on 360°, i.e. all around the conveyer unit 14.

[0031] The vision unit comprises cameras. The cameras may be permanently anchored on the frame 12 for example. The cameras may be color high-speed high-resolution line-scan cameras for example.

[0032] In the embodiment illustrated in Figure 1, the cameras are assembled in two independent sub-units. A first sub-unit, comprising cameras 26 and 28, is positioned above the conveyer unit 14 and a second sub-unit, comprising cameras 30 and 32, is positioned below the conveyer unit 14. Each camera sub-unit is placed in a row transversally with regard to the frame 12, in such a way that a first camera of the sub-unit on a first side (above or below) of the conveyer unit 14 and a first camera of the sub-unit of the opposite side (below or above respectively) of the conveyer unit 14 read respectively the top face and a first edge of the object; and the bottom face and the first edge again of the object (see O_1 in Figure 1). Then as the object moves forward (see arrow A and object noted as O_2 in Figure 1), a second camera of the sub-unit on the first side of the conveyer unit 14 and a second camera of the sub-unit of the opposite side of the conveyer unit 14 read respectively the top face and a second edge of the object; and the bottom face and the second edge again of the object, in such a way that the resulting collected data as a whole correspond to the four surfaces (top and bottom faces, and leading and trailing edges) of the object, each of these four surfaces being read twice at different angles.

[0033] In the example of Figure 1, cameras 26 and 32 read the top and the bottom faces, respectively, of the object (O_1) as it passes by and also read the leading edge (two readings for the leading edge). As the object is further conveyed (see arrow A), cameras 28 and 30 read the top and the bottom faces, respectively, again, of the same object (O_2), and also read the trailing edge (two readings for the trailing edge).

[0034] In each camera sub-unit, above and below the conveyor, the vision axis of each camera is inclined relatively to the conveyor unit movement axis (see arrow A Figures 1 and 2)

to allow that each surface of the object is read at least twice, at different angles, as the object is being moved by the conveyer unit 14 from position O_1 to position O_2 .

[0035] Moreover, on a given side (above or below) of the conveyer unit 14, the cameras of a sub-unit are arranged so that the angle-of-view of each camera is of $60^\circ \pm 15^\circ / 120^\circ \pm 15^\circ$ in relation to the surface of the object facing this given side (above or below of the conveyer unit 14), as shown in Figure 3.

[0036] The light sources are positioned to illuminate the object within the line of vision of each camera. In Figure 1, in a given light sub-unit, three out of the four light sources are used in relation to each row of cameras. For example, in Figure 1, light source 22c, 22d and 24c illuminate the object for camera 26, and light sources 22a, 22b and 24b illuminate for camera 28. As a result, two light source out of four are common to two rows of cameras (one on each side of the conveyer). For example, cameras 26 and 32 share light sources 22c and 24c, while light source 24d only relates to camera 32 and light source 22d only relates to camera 26. The sight line of each camera passes between two light sources of lights (see lines 100, 110, 120 and 130 in Figure 1).

[0037] As people in the art will appreciate, a system according to the present invention thus comprises at least four cameras, two above the conveyer unit and two below the conveyer unit and light sources located above the conveyer unit and below the conveyer unit to illuminate the object placed on the conveyer within the line of sight of each of the cameras.

[0038] As described hereinabove, in the embodiment of Figure 1, the light sources above and below the conveyer unit are separated into two groups, upstream (light sources 22c, 22d and 24c, 24d) and downstream (light sources 22a, 22b and 24a, 24b), and the object is imaged by the cameras at two positions O_1 and O_2 .

[0039] In the embodiments described hereinabove, the vision unit and the lighting unit are distributed on both side of the conveyer unit 14. However, it could be contemplated using a

vision unit and a lighting unit on one side of the conveyer unit 14 and moving the object upside down on the conveyer unit between different images.

[0040] The cameras are connected to computers (not shown) of the processing unit 18. In the embodiment illustrated in Figure 2, the processing unit 18 is housed in a chamber 40 supported by the frame 12. Obviously, the processing unit 18 may alternatively be separately or remotely located from the frame 12. Typically, the processing unit 18 comprises a master computer, a plurality of independent high speed computers linked to the cameras, a module dedicated to shape and object identification, and an optimization computer (not shown). The processing unit 18 may monitor the location of the vision unit and/or of the vision sub-units as well as the inclination of the adjustable conveyer unit 14 as parameters; these data may be inputted either manually or automatically.

[0041] In a specific embodiment given by way of example, the lighting and the vision units are inclined at an angle relatively to the movement axis of the conveyer unit 14 and comprise 16 linear high speed color high resolution cameras divided into two vision sub-units located above and below the conveyer unit 14 as described hereinabove. The first vision sub-unit comprises a set of 8 cameras in pairs located in a row and distributed at intervals on the frame 12 along a transversal axis. This sub-unit comprises 4 pairs of cameras located at an angle of approximately $60^{\circ} \pm 15^{\circ} / 120^{\circ} \pm 15^{\circ}$ above the conveyer unit 14 to collect data from the top face and the edges of the object to be analyzed. The second sub-unit comprises a set of 8 cameras in 4 pairs located in a row and distributed at intervals on the frame 12 along a transversal axis. This sub-unit comprises 4 pairs of cameras located at an angle of approximately $60^{\circ} \pm 15^{\circ} / 120^{\circ} \pm 15^{\circ}$ below the conveyer unit 14 to collect data from the bottom face and the edges of the object to be analyzed.

[0042] Such a spatial configuration of the vision system allows to collect data on the four longitudinal sides (top and bottom faces and two edges) of the object to be analyzed, by allowing each vision sub-unit to collect data on three of the longitudinal surfaces.

[0043] Depending of the length of the objects for example, the number of pairs of cameras can be increased from 2 pairs (4 cameras), with the corresponding adjustment in the number of light sources, as described hereinabove. Other relative angles may be used.

[0044] The processing unit thus receives for processing, for each of the four surfaces (top and bottom faces and the edges) of each objet, two views at different angles, which allows an accurate detection of defects in each object, especially, in the case of wood pieces, of openings, such as shakes (i.e., typically, separations of wood fibers along the grain), seasoning checks (i.e., typically, lengthwise separations of the wood that usually extend across the rings of annual growth and commonly result from stresses set up in wood during seasoning), ring shakes (i.e., typically, shakes appearing in the heart of mature wood, directed along the annual rings and characterized by a large extension lengthwise along the pieces); splits (typically cracks originating at one given face and crossing the piece to any other face); and drying checks (typically crack occurring due to drying of the piece, which may occur anywhere of the piece and consist of a separation of the grains of the wood).

[0045] By doubling the number of cameras, or by increasing the number of points of view of each object, it is possible to analyze each object from a number of angles, as well as to have a better observation of all corners of each object.

[0046] The present system and method allow analyzing defects on a plurality of images taken with different shooting angles.

[0047] It has been found that the visual contrast of an opening in a 3D object such as a wood piece for example depends on the angle of view (by the cameras) in relation to the penetration angle of the opening in the piece and the angle of the lighting provided.

[0048] With the present vision system and method, the four corners A, B, C and D of an object are distinctly detected, since they are all in the line of sight of a camera (see arrows Figure 4b), instead of only two corners A and B of the wood piece in the example of Figure 4a in case of

conventional single vision system since only these two corners are within the line of sight of cameras (top and bottom cameras) (see arrows Figure 4a). As a result, detection of openings is increased, especially in the corners.

[0049] It is to be noted that the present system allows handling 3D objects of a variety of shape and geometry. In particular, the system may be adapted to a range of longitudinal wood pieces of different lengths and types (for example, rough, raw, planed or uncut) by obvious adjustment of the vision unit.

[0050] As people in the art will appreciate, although illustrated hereinabove in relation to a transversal conveyer system 10, the present vision system may be adapted to linear conveyer systems, in place of a conventional single vision system comprising one camera looking perpendicularly at each face of the wood piece, yielding one view per face (see Figure 5a).

[0051] In Figure 5b, the present vision system is used in a linear conveyer system, without modifying the lighting unit, so that each surface of the object (top and bottom faces and edges) is seen at different angles.

[0052] In Figure 5c and 5d, still in a linear conveyer system, two sets of four cameras are used along the path of the object for example, each camera looking perpendicularly at one corresponding surface of the object as standardly done in linear conveyer systems. At each location (L) and (R), the light unit provides different angles of illumination, so that each set of four cameras takes the same views once but with a different angles of illumination. Alternatively, a single set of cameras could be used, and two different illumination angles provided in sequence so that the same set of cameras takes the same views with a different angles of illumination.

[0053] The present invention thus provides obtaining, for each surface of the object, at least two images at different angles.

[0054] As the objects are conveyed on conveyer belts or chains 14a, 14b, 14c, 14d for example as described hereinabove, some parts of the object may be hidden from the cameras. In order to obtain images from these hidden parts, it may be contemplated longitudinally displacing each object, using a plate 220 for example, from O_1 to O_2 as shown in Figure 7 for example, between the upstream and downstream light sub-units of Figure 1 for example, so that the cameras can see in position O_2 parts that were hidden to them in position O_1 .

[0055] Alternatively, it may be contemplated interrupting the continuity of the conveyer unit 14 transversally, i.e. from 14a, 14b, 14c, 14d to 14a', 14b', 14c', 14d' as shown for example in Figure 8, in order to allow obtaining at least one image of the remaining hidden parts of the object, thereby obtaining, on the whole, images of the entirety of the object.

[0056] As shown in Figures 1 and 6, the objects are maintained, flat on a face, and perpendicularly, in position on the conveyer means of the conveyer unit 14 by lugs 200 running along the length of the conveyer means so as to form rows of lugs that abut one edge of an object (O) at intervals along the length of the object (see Figure 2 for a general view). Lugs are usually short members extending perpendicularly to the surface of the conveyer means 14, as shown in 200 in Figure 1 and 6 for example.

[0057] It has been found that lugs 210 having an angle relative to the surface of the conveyer means, as shown in Figures 6 and 10 for example, allow reducing or even preventing up and down movements of the conveyed objects, perpendicular to the surface of the conveyer means, even in cases when the bottom face of the objects shows curves and is not completely flat as shown in Figure 11. Being inclined toward the object and toward the surface of the conveyer means, such lug 210 has a gripping-type action on the object. Such gripping action may even be increased by providing a rugged or toothed surface 112 of the face of the lug 210 that is inclined toward the object and toward the surface of the conveyer means, for example. Other shapes and structures for the lugs could be used, such as lugs with an radius of curvature towards the piece of wood and the surface of the conveyer means in a claw-like fashion for example.

[0058] Figure 10 shows another method used to control up and down movements of the conveyed object perpendicular to the surface of the conveyer means, by using foam rolls 150 pressing on the top face of the conveyed object.

[0059] As people in the art will appreciate, reducing the vibration and movements of the conveyed objects as they are conveyed through the multiple vision unit allows precise detection.

[0060] According to another embodiment of the present invention, the system comprises cameras taking images of the object at one position (as opposed to two positions as described in relation to Figure 1 for example). As illustrated in Figure 13 for example, the vision unit comprises two cameras 400 and 402 above the conveyer unit 14, two cameras 404 and 406 below the conveyer unit 14,. The lighting unit comprises light sources 300, 302, 304 above the conveyer unit 14 and light sources 306, 308 and 310 below the conveyer unit 14, each light source illuminating for two cameras as follows: camera 400 uses light source 302, 304 and 306; camera 402 uses light sources 302, 300 and 310; camera 404 uses light sources; and camera 406 uses light sources 306, 308 and 304. The cameras are line-can cameras, and the sight line of each camera passes between the beam of two light sources. The angle-of-view of each camera is $60^{\circ} \pm 15^{\circ} / 120^{\circ} \pm 15^{\circ}$ relative to a surface above or under the object on the conveyer 14. As people in the art will appreciate, as compared to the embodiment of Figure 1 for example, such a compact configuration uses fewer light sources while also allowing obtaining, for each surface of the object, two images at different angles, on a travel length reduced by at least half as compared with the distance between the positions O_1 and O_2 of the object in Figure 1 for example.

[0061] Although the present invention has been described hereinabove by way of embodiments thereof, it can be modified, without departing from the nature and teachings of the subject invention as recited hereinbelow.

CLAIMS:

1. A system for detecting defects on a peripheral surface of a wood piece, comprising at least one conveyor unit conveying the wood piece; and a combination of independent multispectral light sources and cameras; wherein said multispectral light sources illuminate surfaces of said wood piece and generate contrast on the surfaces of the wood piece in the line of sight of said cameras as said cameras take, for each surface of the wood piece, at least two transversal two-dimensional surface images, each at a different angle.

2. The system of claim 1,
said cameras comprising:

at least a first and a second cameras positioned above the conveyor unit; and
at least a first and a second cameras positioned below the conveyor unit;

said multispectral light sources comprising:

at least one multispectral light source above the conveyor unit;
and

at least one multispectral light source below the conveyor unit;

wherein the surface of the wood piece in the line of sight of each camera is illuminated by at least one multispectral light source above the conveyor unit and by one multispectral light source below the conveyor unit said multispectral light source above the conveyor unit and by one multispectral light source below the conveyor unit generating contrast on the surfaces of the wood piece the wood piece;

wherein the first camera above the conveyor unit takes a first transversal surface image of a top face of the wood piece and a first transversal surface image of a first one of: i) a leading edge and ii) a trailing edge of the wood piece, the second camera above the conveyor unit takes a second transversal surface image of the top face and a first transversal surface image of a second one of i) said leading edge and ii) said trailing edge of the wood piece, the first camera below the conveyor unit takes a first transversal surface image of a bottom face of the wood piece and a second transversal surface

image of said first one of: i) the leading edge and ii) the trailing edge, and the second camera below the conveyor unit takes a second transversal surface image of the bottom face and a second transversal surface image of said second one of: i) said leading edge and ii) the trailing edge, as the wood piece passes by on said conveyor unit, each first and second transversal surface images being at a different angle.

3. The system of claim 1, wherein said system further comprises a unit moving the wood piece upside down on the conveyor unit between different transversal surface images;

said cameras and multispectral light sources being positioned on one side of the conveyor unit,

said multispectral light sources illuminating said wood piece with a first surface thereof resting on said conveyor unit, in the line of sight of said cameras as said cameras take first transversal surface images of the wood piece, and

said multispectral light sources illuminating said wood piece, with a second surface thereof opposite said first surface resting on said conveyor unit, in the line of sight of said vision unit as said cameras as said cameras take second transversal surface images of the wood piece;

said multispectral light sources generating contrast on exposed surfaces of the wood piece.

4. The system of claim 1, wherein said multispectral light sources are separated into a downstream group comprising multispectral light sources above and below the conveyor unit and an upstream group comprising multispectral light sources above and below the conveyor unit;

wherein, in an upstream position on the conveyor unit, the wood piece, in the line of sight of a camera positioned above the conveyor unit, is illuminated by the multispectral light sources of the upstream group, and the wood piece, in the line of sight of a camera positioned below the conveyor unit, is illuminated by the multispectral light sources of the upstream group; the camera above the conveyor unit taking a first transversal surface image of a

top face of the wood piece and a first transversal surface image of a first one of: i) a leading edge and ii) a trailing edge of the wood piece and the camera below the conveyor unit taking a first transversal surface image of a bottom face of the wood piece and a second transversal surface image of said first one of: i) the leading edge and ii) the trailing edge of the wood piece, as the wood piece passes by on said conveyor unit between the multispectral light sources of said upstream group;

wherein, in a downstream position on the conveyor unit, the wood piece, in the line of sight of a camera positioned above the conveyor unit, is illuminated by the multispectral light sources of the downstream group and the wood piece, in the line of sight of a camera positioned below the conveyor unit, is illuminated by the multispectral light sources of the downstream group; the camera above the conveyor unit taking a second transversal surface image of the top face and a first transversal surface image of a second one of: i) said leading and ii) the trailing edge of the wood piece and the camera below the conveyor unit taking a second transversal surface image of the bottom face and a second transversal surface image of the second one of: i) said leading and ii) the trailing edge of the object, as the wood piece passes by on said conveyor unit between said multispectral light sources of said downstream group, said first and said second transversal surface images being at a different angle.

5. The system of claim 1, comprising cameras on each side of the conveyor unit placed in a row transversally with regard to said conveyor unit.

6 The system of claim 5, wherein, above and below the conveyor unit respectively, a vision axis of each camera is inclined relatively to said conveyor unit movement axis.

7. The system of claim 2, wherein each camera reads two surfaces of the wood piece as the wood piece is being moved by the conveyor unit.

8. The system of claim 2, wherein, on a given side of the conveyor unit, the cameras are arranged so that an angle-of-view of each camera is of

$60^{\circ}\pm 15^{\circ}/120^{\circ}\pm 15^{\circ}$ in relation to a surface of the wood piece facing this given side.

9. The system of claim 1, wherein the inclination of said conveyor unit is adjustable.

10. The system of claim 1, wherein said multispectral light sources and cameras are inclined at an angle relatively to a movement axis of the conveyor unit.

11. The system of claim 1, wherein said cameras comprise 16 linear high speed color high resolution cameras divided into two vision sub-units located above and below the conveyor unit respectively, a first vision sub-unit comprising a set of 8 cameras in pairs located in a row and distributed at intervals along a transversal axis; a second sub-unit comprising a set of 8 cameras in 4 pairs located in a row and distributed at intervals along the transversal axis.

12. The system of claim 11, wherein said first vision sub-unit comprises 4 pairs of cameras located at angle of about $60^{\circ}\pm 15^{\circ}/120^{\circ}\pm 15^{\circ}$ on each side of the conveyor unit; and said second sub-unit comprises 4 pairs of cameras located at angle of about $60^{\circ}\pm 15^{\circ}/120^{\circ}\pm 15^{\circ}$ on each side of the conveyor unit.

13. The system of claim 1, comprising a processing unit, wherein said processing unit receives, for each surface of the wood piece, the at least two transversal two-dimensional surface images, each at a different angle.

14. The system of claim 1, wherein all corners of the wood piece are in the line of sight of at least one camera.

15. The system of claim 1, wherein said conveyor unit is a transversal conveyor unit.

16. The system of claim 15, wherein said transversal conveyor unit comprises longitudinal conveying means transversally separated by an adjustable distance along a width of the conveyor unit.

17. The system of claim 1, wherein said conveyor unit is a linear conveyor unit.

18. A method for detecting defects on a peripheral surface of a wood piece, the wood piece being conveyed on a conveyor unit, comprising using a combination of independent multispectral light sources and cameras, illuminating surfaces of the wood piece and generating contrast on the surfaces of the wood piece by the multispectral light sources, in the line of sight of the cameras, and taking, by the cameras, for each one of the top, bottom, first edge and second edge surfaces of the wood piece, at least two two-dimensional surface images, transversally each at a different angle.

19. The method of claim 18, comprising:

positioning a multispectral light source on one side of the conveyor unit;

illuminating, by the multispectral light source, the wood piece, with a first surface thereof resting on the conveyor unit, in the line of sight of the camera;

taking, by the camera, first transversal two-dimensional surface images of the wood piece;

moving the wood piece upside down on the conveyor unit;

illuminating, by the multispectral light source, the wood piece, with a second surface thereof opposite the first surface resting on the conveyor unit, in the line of sight of the camera;

taking, by the camera, second transversal two-dimensional surface images of the wood piece.

20. The method of claim 18, comprising:

providing at least a first and a second cameras positioned above the conveyor unit;

providing at least a first and a second cameras positioned below the conveyor unit;

illuminating the wood piece in the line of sight of each camera by at least one multispectral light source above the conveyor unit and by one multispectral light source below the conveyor unit;

taking a transversal two-dimensional surface image of the top face of the wood piece at a first angle and a transversal two-dimensional surface image of a first edge of the wood piece at a first angle by the first camera above the conveyor unit, a transversal two-dimensional surface image of the top face at a second angle and a transversal two-dimensional surface image of a second edge at a first angle by the second camera above the conveyor unit, a transversal two-dimensional surface image of the bottom face at a first angle and a transversal two-dimensional surface image of the first edge at a second angle by the first camera below the conveyor unit, and a transversal two-dimensional surface image of the bottom face at a second angle and a transversal two-dimensional surface image of the second edge at a second angle by the second camera below the conveyor unit, as the wood piece passes by on the conveyor unit.

21. The method of claim 20, wherein said taking transversal two-dimensional surface images of the wood piece comprises:

taking transversal two-dimensional surface images of the wood piece by a first set of cameras positioned above the conveyor unit and a second set of cameras positioned below the conveyor unit; each multispectral light source illuminating for the cameras of the first set and for the cameras of the second set; and the cameras of the first set and the cameras of the second set reading the top face, the bottom face and a first edge of the wood piece, as the wood piece passes on the conveyor unit;

moving the wood piece;

taking transversal two-dimensional surface images of the wood

piece by a third set of cameras positioned above the conveyor unit and a fourth set of cameras positioned below the conveyor unit; each multispectral light source illuminating for the cameras of the third set and for the cameras of the fourth set; and the cameras on the third and fourth sets reading the top face, the bottom face and the second edge of the wood piece as the wood piece passes on the conveyor unit.

22. The method of claim 20, said taking transversal two-dimensional surface images of the wood piece comprises:

taking transversal two-dimensional surface images of the wood piece, in a first position of the conveyor unit, by a first set of cameras positioned above the conveyor unit and a second set of cameras positioned below the conveyor unit; the multispectral light sources illuminating for the cameras; and the cameras of the first set and the cameras of the second set reading the top face, the bottom face and an edge, as the wood piece passes on the conveyor unit;

modifying a transverse position of the conveyor unit from the first position to a second position;

taking transversal two-dimensional surface images of the wood piece, in the second position of the conveying unit, by the first set of cameras and by the second set of cameras; each multispectral light source illuminating for the cameras; and the cameras of the first set and the cameras of the second set reading the top face, the bottom face and an edge of the wood piece, as the wood piece passes on the conveyor unit.

23. The method of claim 20, wherein said illuminating the wood piece comprises using first multispectral light sources positioned upstream of the conveyor unit and second multispectral light sources positioned downstream of the conveyor unit, each multispectral light source comprising multispectral lights above the conveyor unit and multispectral lights below the conveyor unit; and said taking transversal two-dimensional surface images of the wood piece comprises using cameras positioned above the conveyor unit and cameras positioned below the conveyor unit.

24. The method of claim 20, wherein said taking transversal two-dimensional surface images of the wood piece comprises cameras of a camera sub-unit on a first side of the conveyor unit and cameras of a camera sub-unit of the opposite side of the conveyor unit reading respectively the top face and the edges of the wood piece; and the bottom face and the edges of the wood piece.

25. The method of claim 20, wherein said taking transversal two-dimensional surface images of the wood piece comprises a first camera of a first camera sub-unit and a first camera of a second camera sub-unit reading the top face and the bottom face respectively, and also each one reading the first edge of the wood piece as it passes by; and a second camera of the first camera sub-unit and a second camera of the second camera sub-unit reading the top and the bottom faces respectively, and also each one reading the second edge of the wood piece as it passes by.

26. The method of claim 20, wherein said taking transversal two-dimensional surface images comprises:

using a first camera sub-unit comprising a set of cameras located in a row and distributed at intervals along a transversal axis, with pairs of cameras being located at an angle of $60^{\circ} \pm 15^{\circ} / 120^{\circ} \pm 15^{\circ}$ on each side of the conveyor unit; and

using a second camera sub-unit comprising a set of cameras located in a row and distributed at intervals along a transversal axis, with pairs of cameras located at an angle of $60^{\circ} \pm 15^{\circ} / 120^{\circ} \pm 15^{\circ}$ on each side of the conveyor unit.

27. The system of claim 1, wherein said defects are one of shakes, seasoning checks, ring shakes, splits, and drying checks.

28. The method of claim 18, for detecting at least one of shakes, seasoning checks, ring shakes, splits, and drying checks.

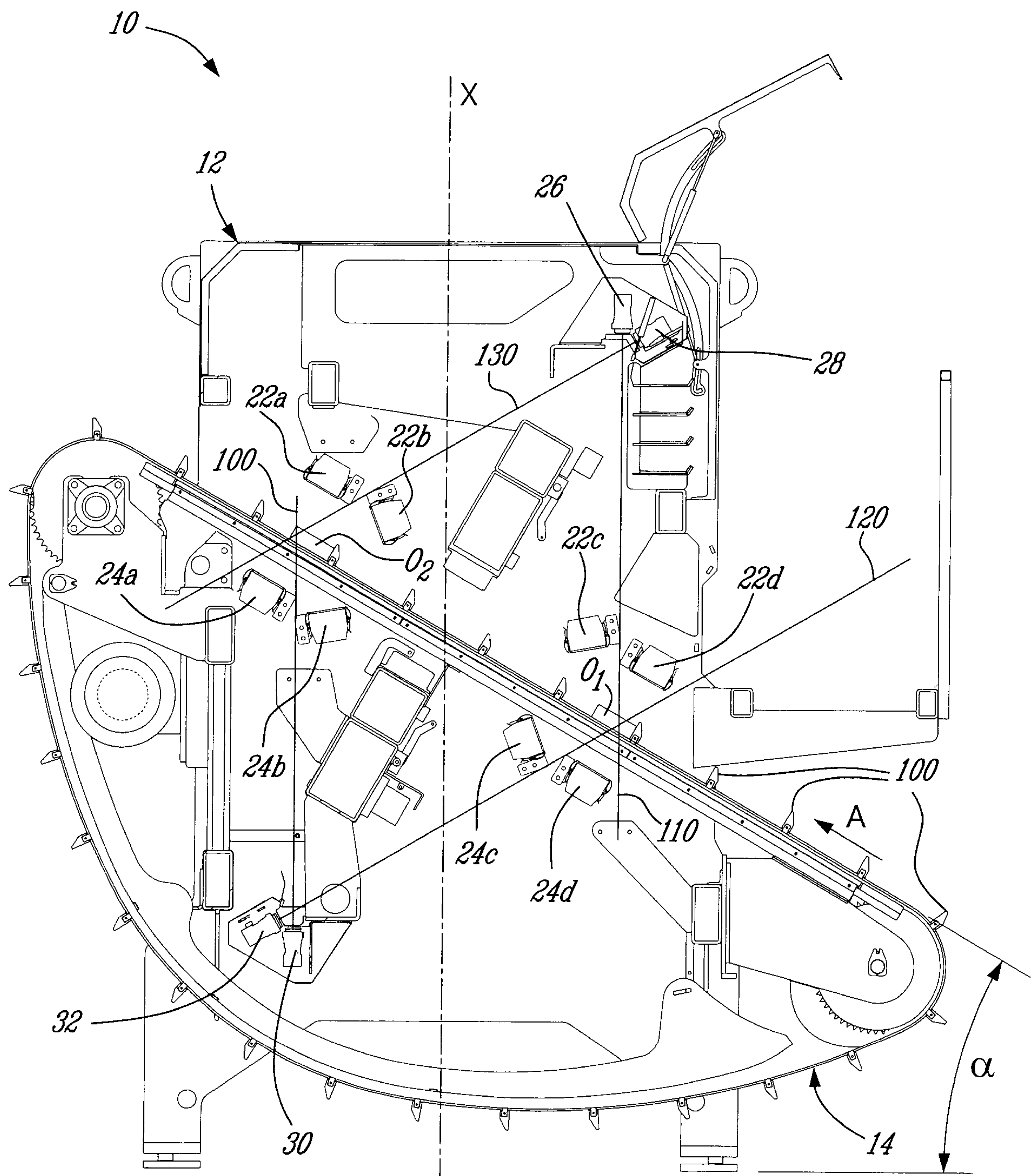
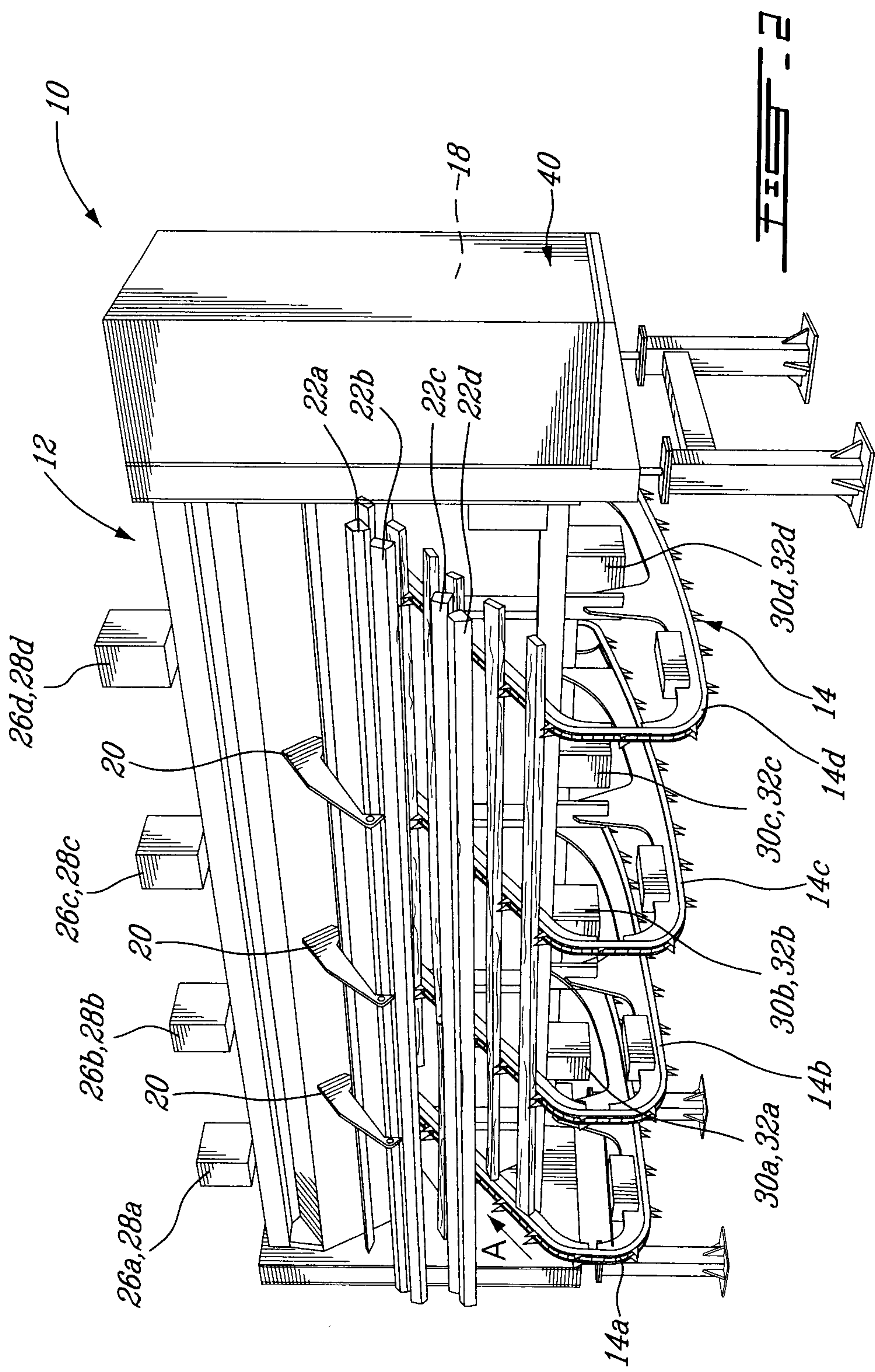
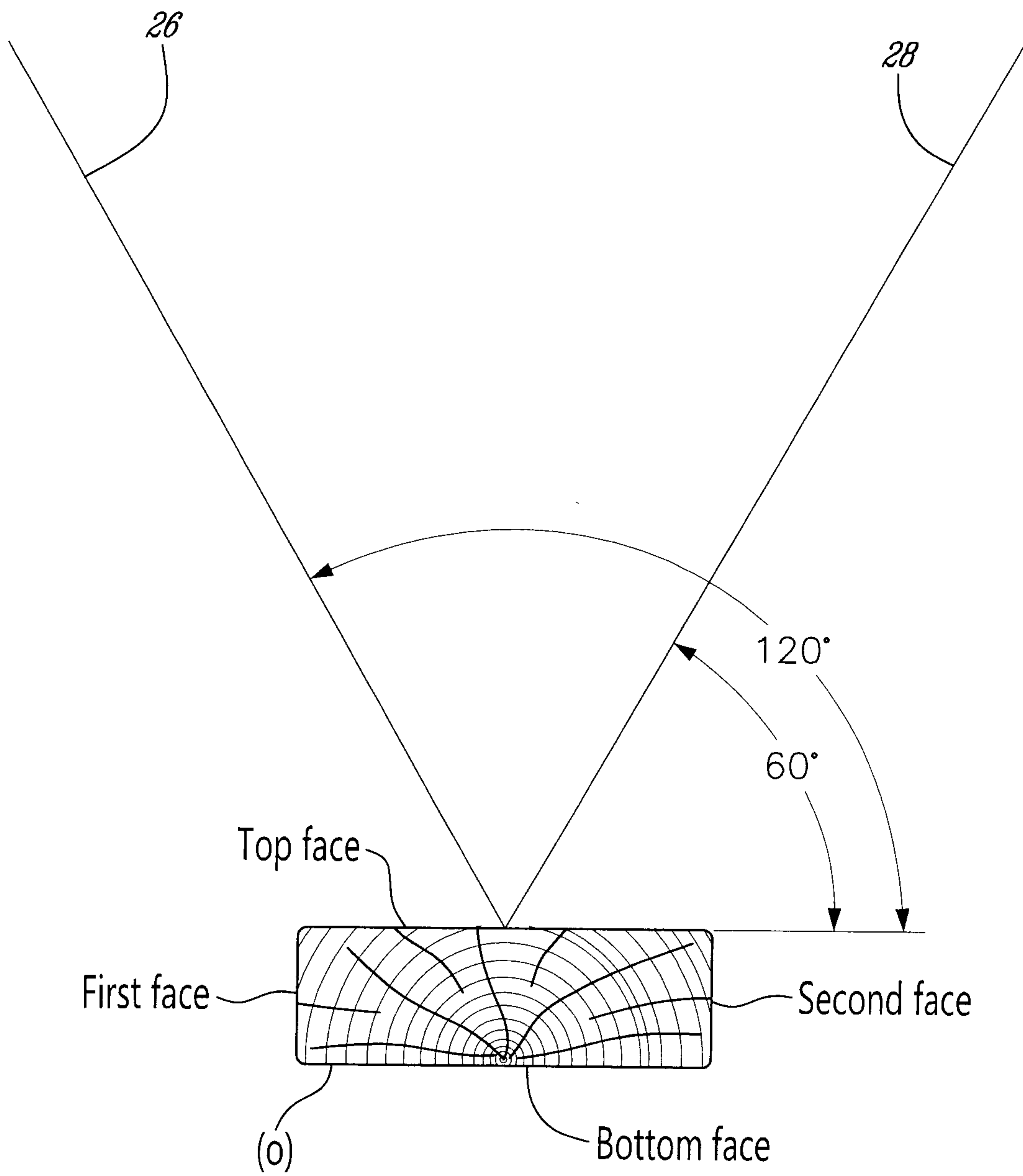
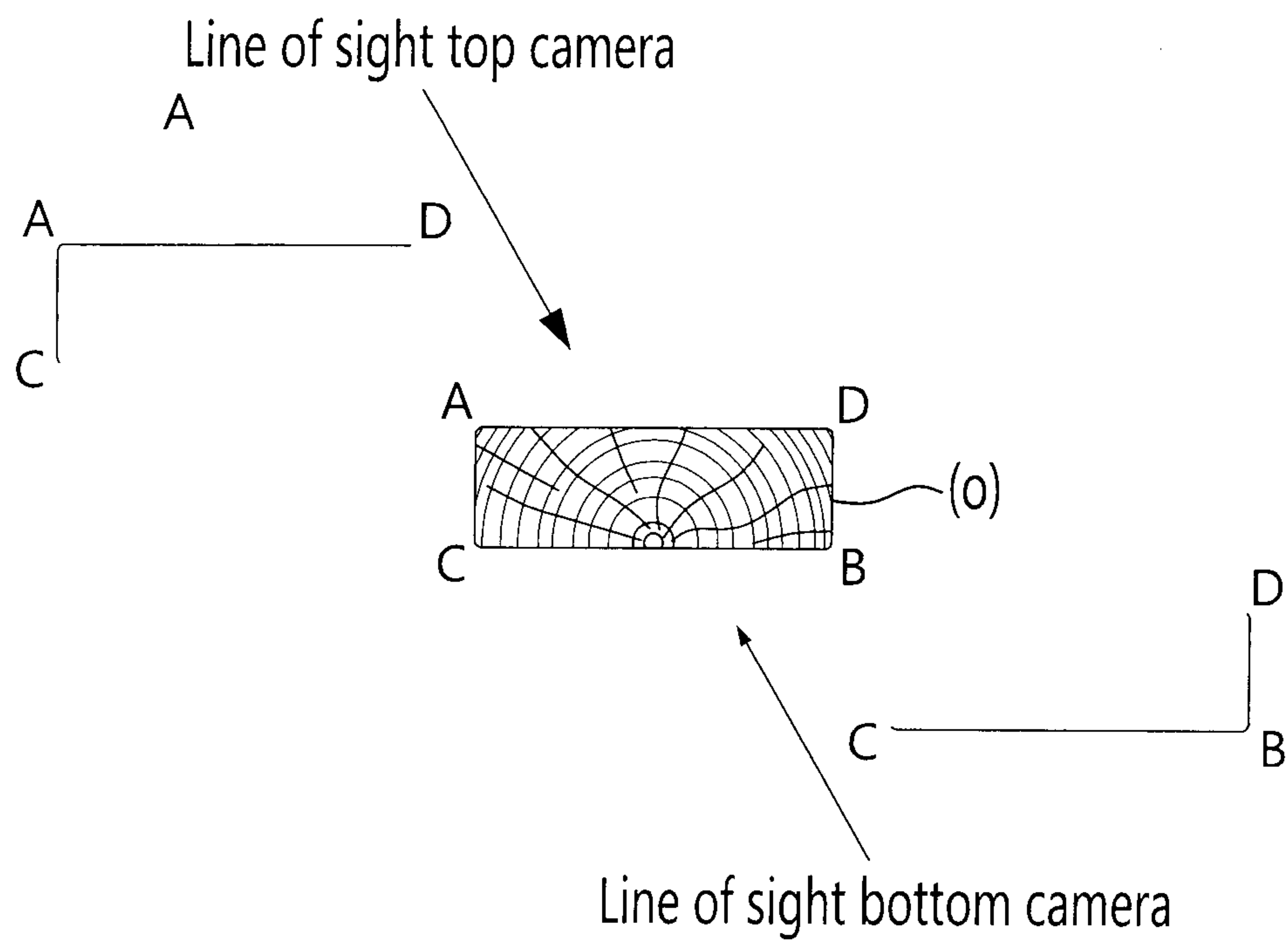
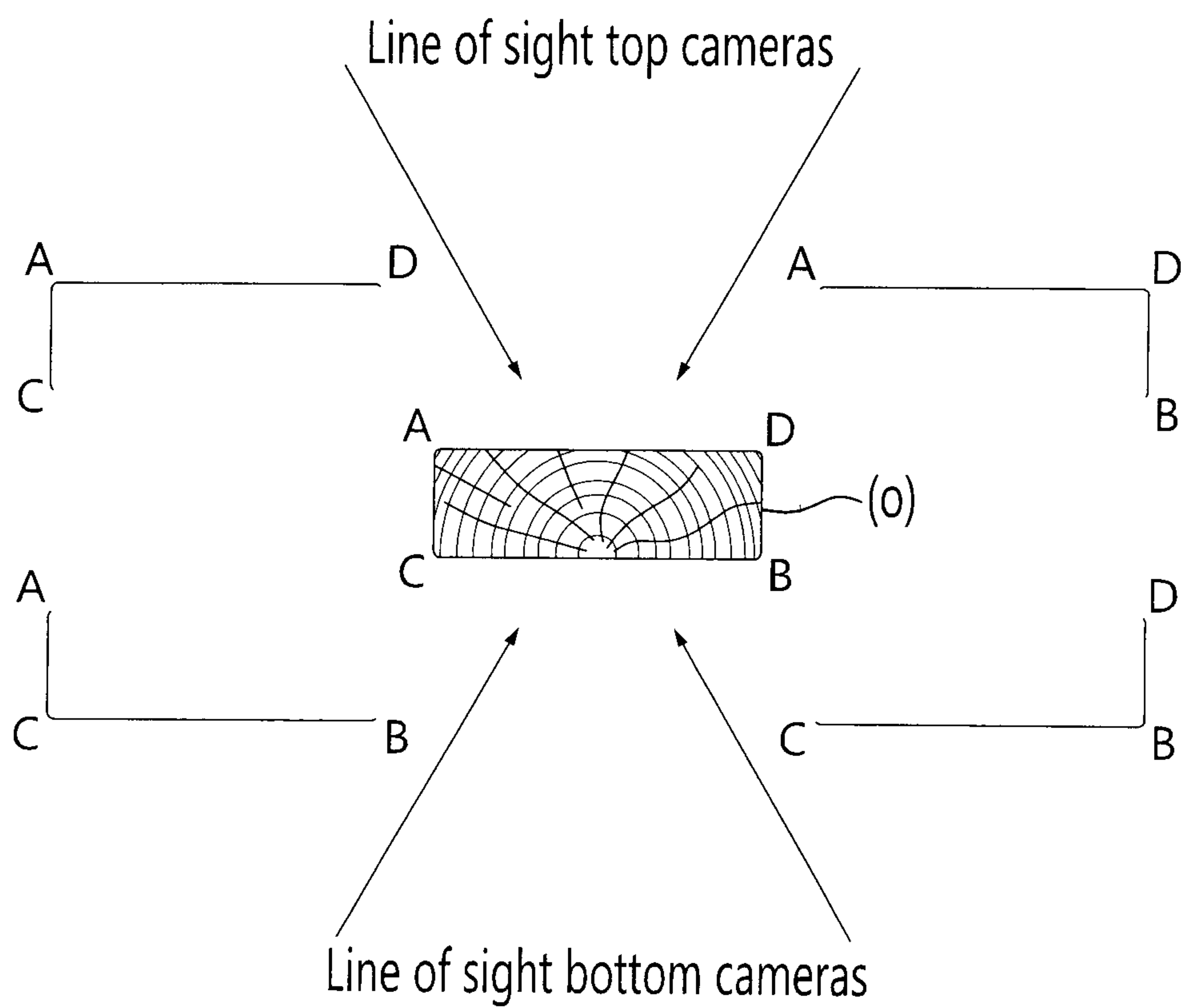


Fig. 1



**FIG. 3**

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FIG. 4a (PRIOR ART)FIG. 4b

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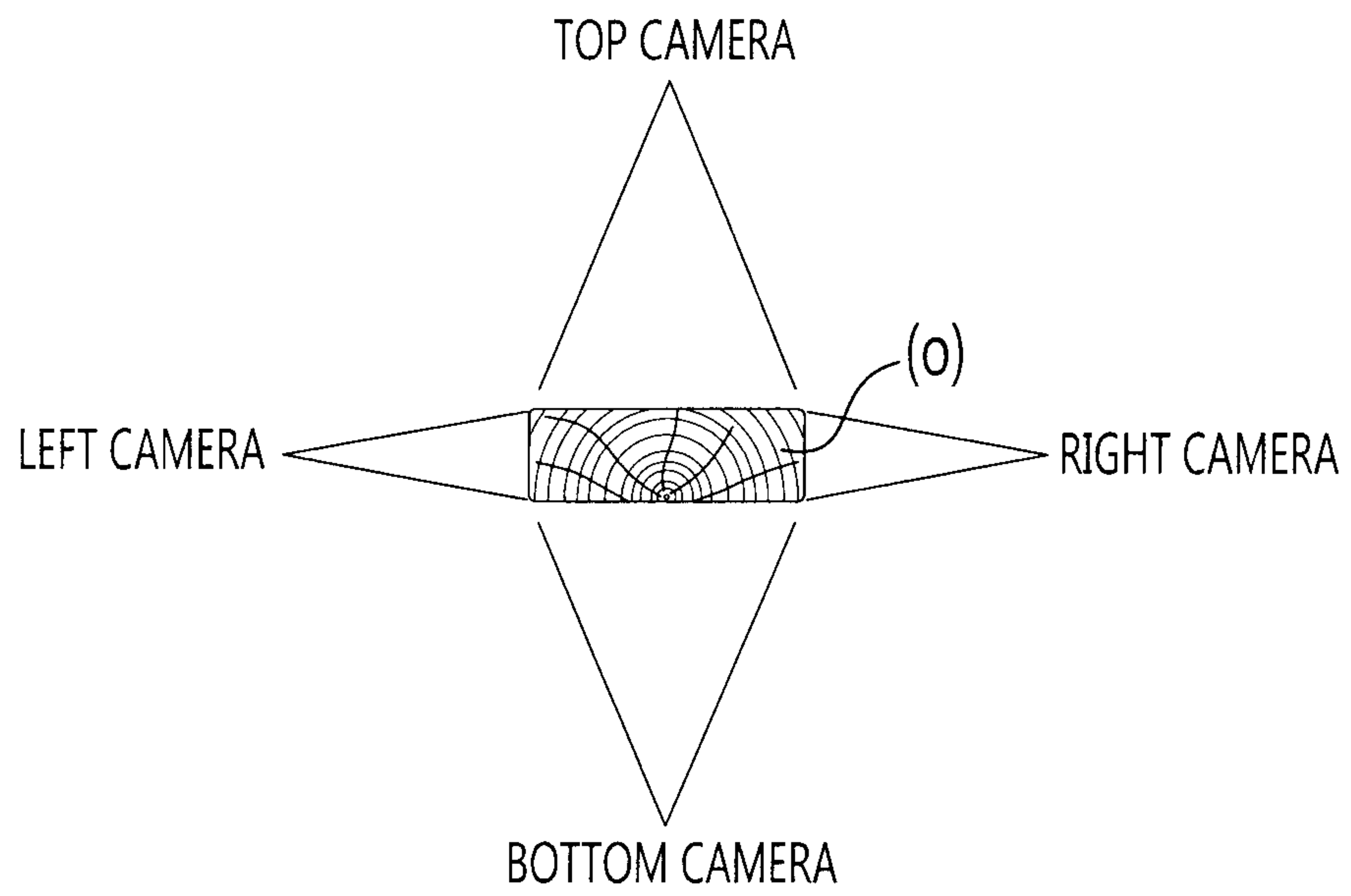


FIG. 5a (PRIOR ART)

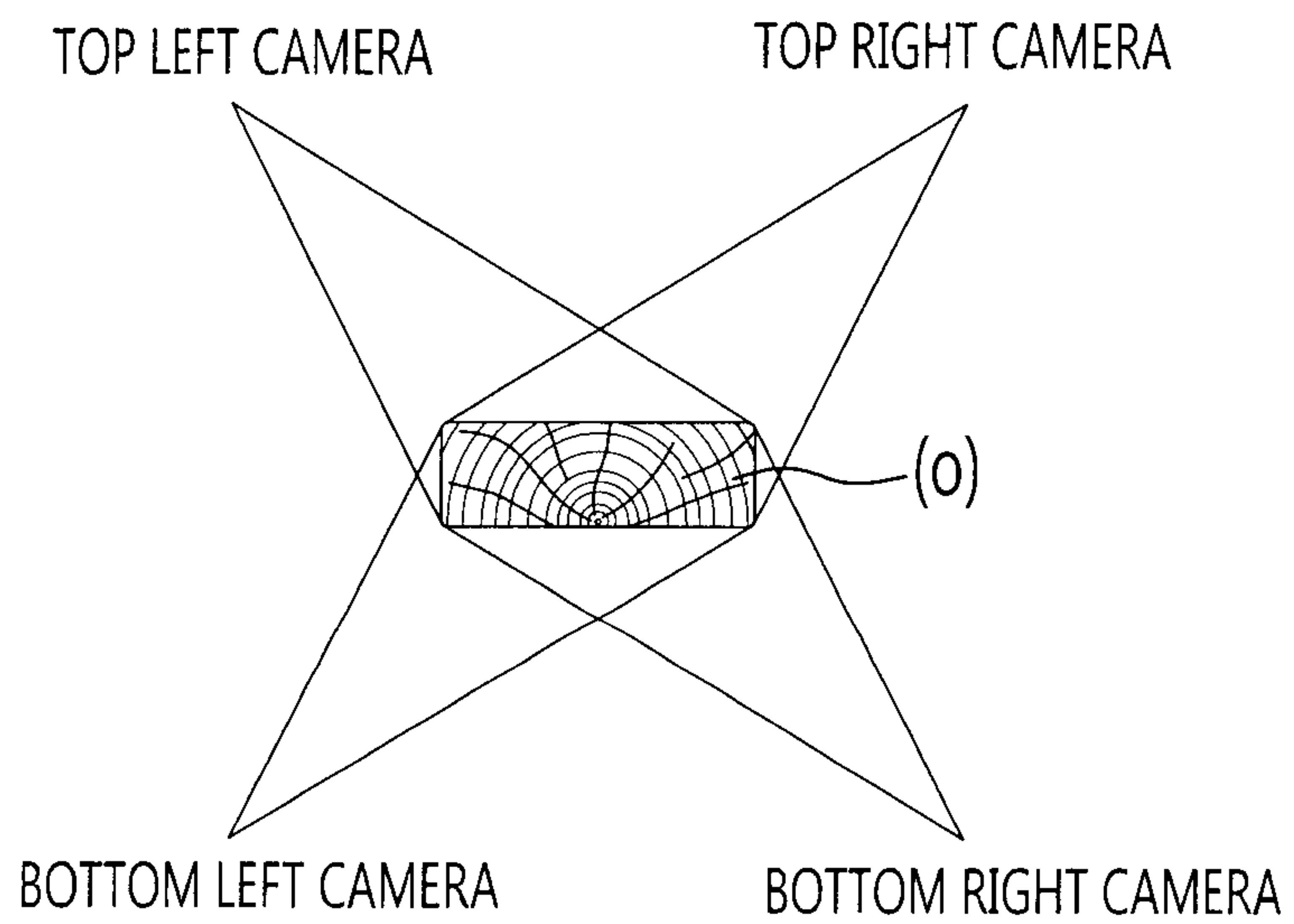


FIG. 5b

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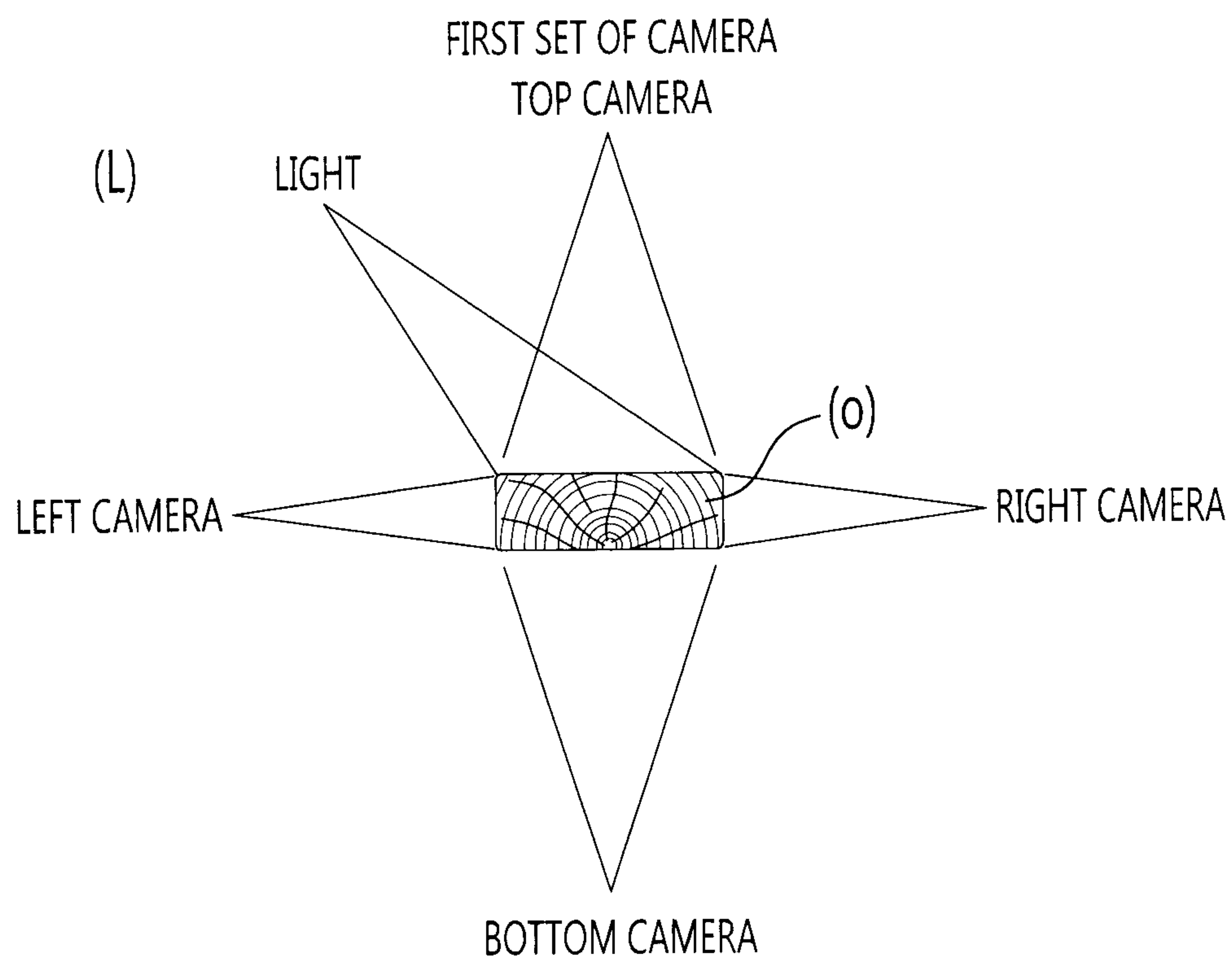


FIG. 5c

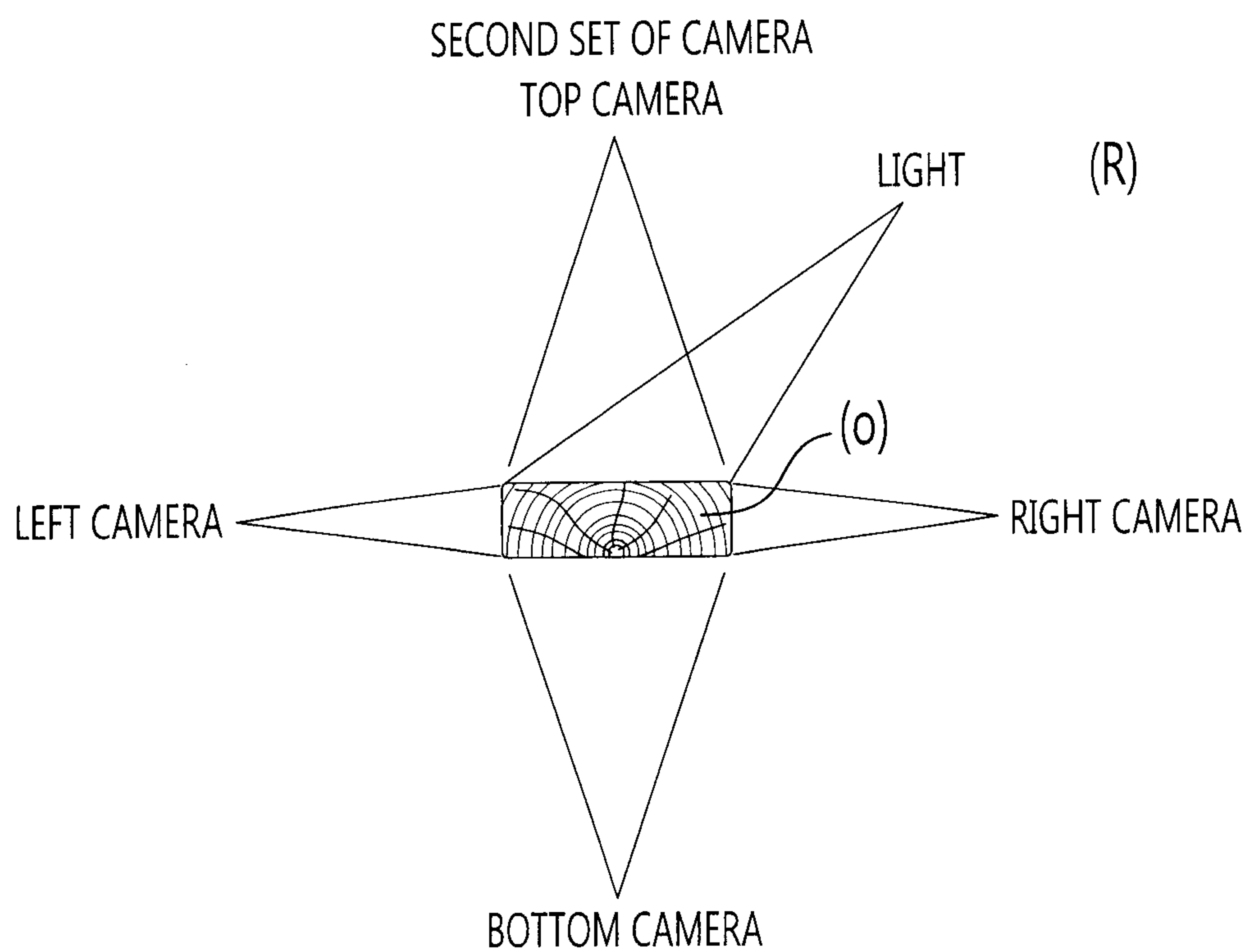
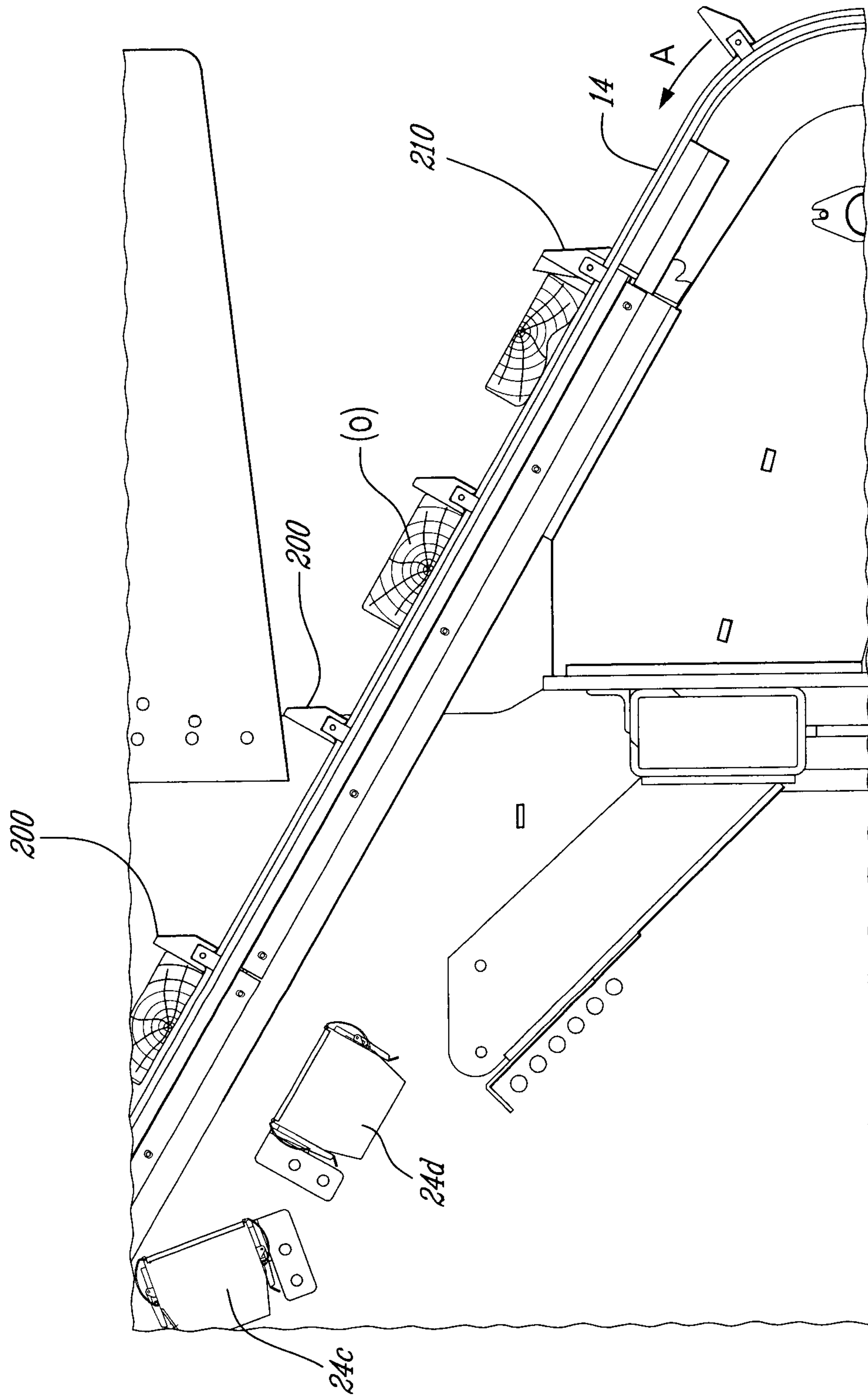
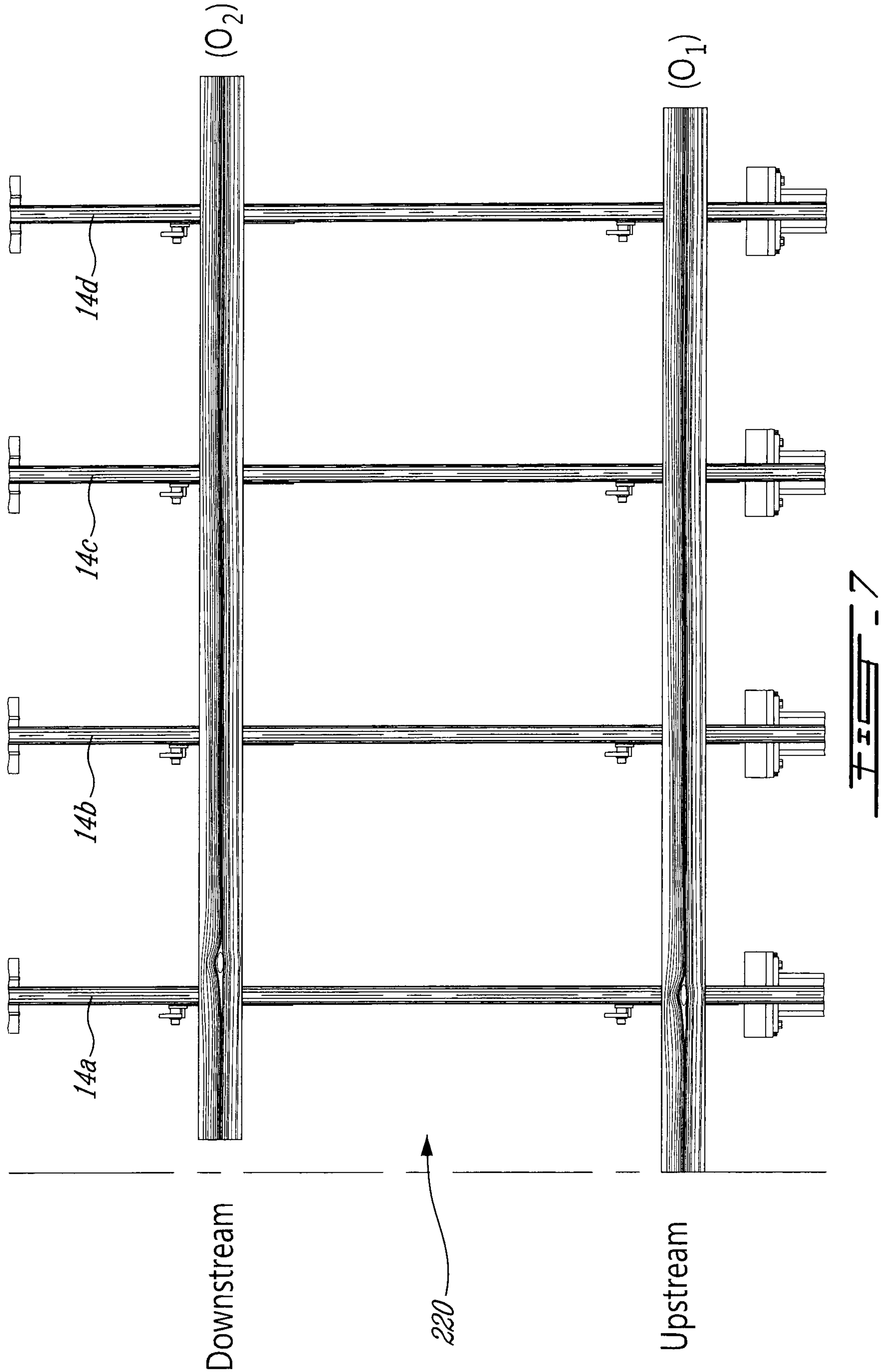
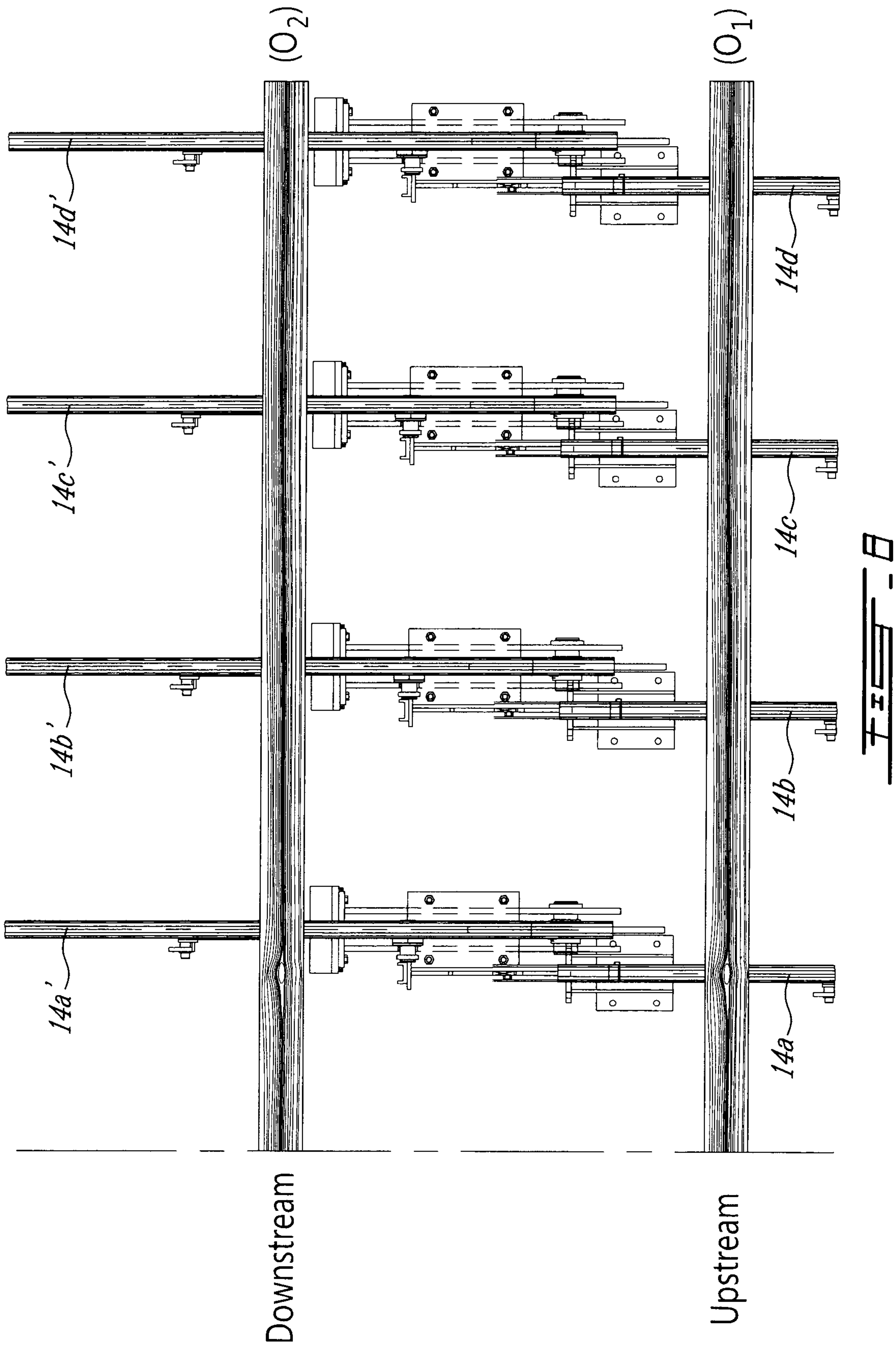


FIG. 5d









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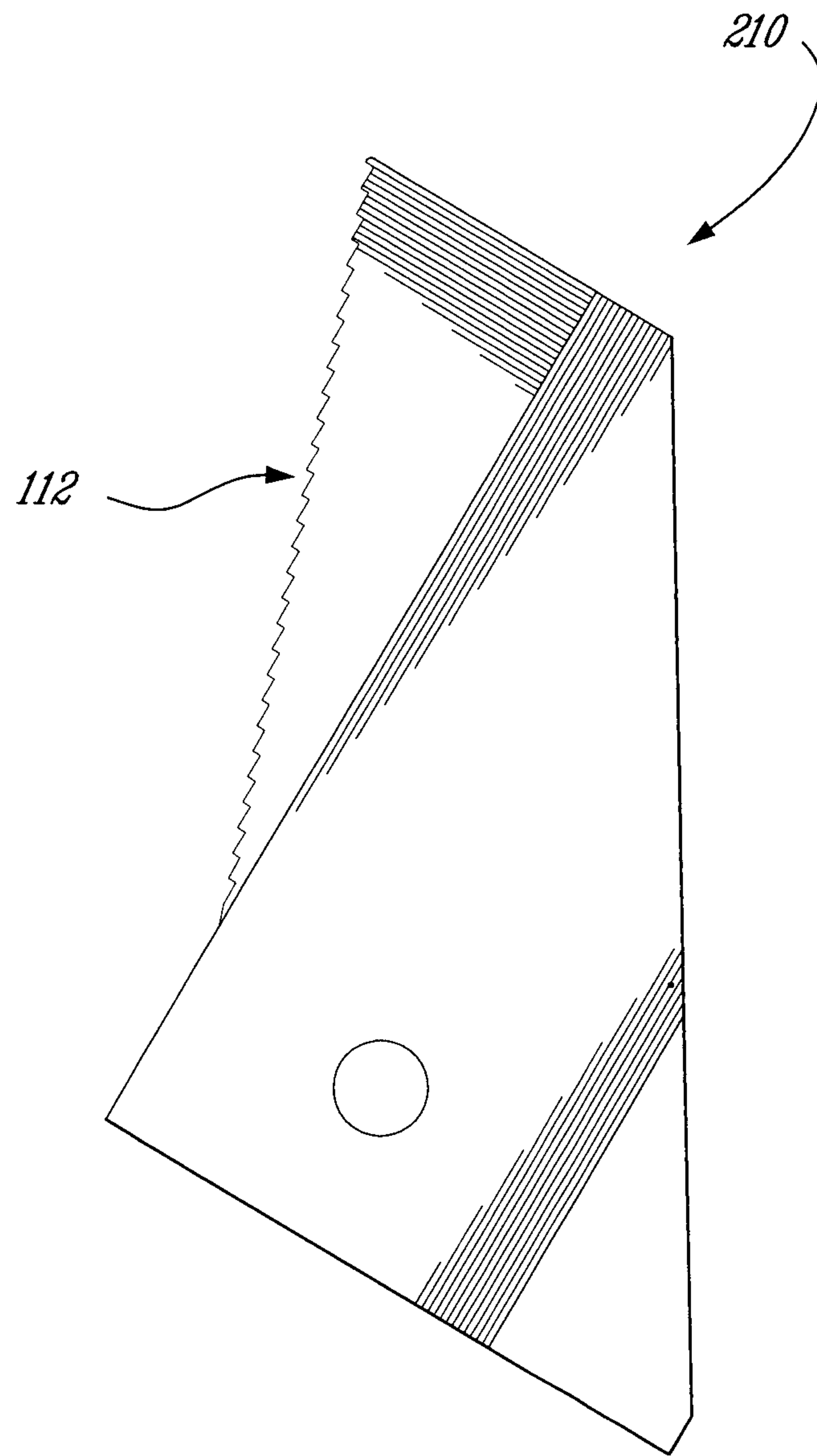
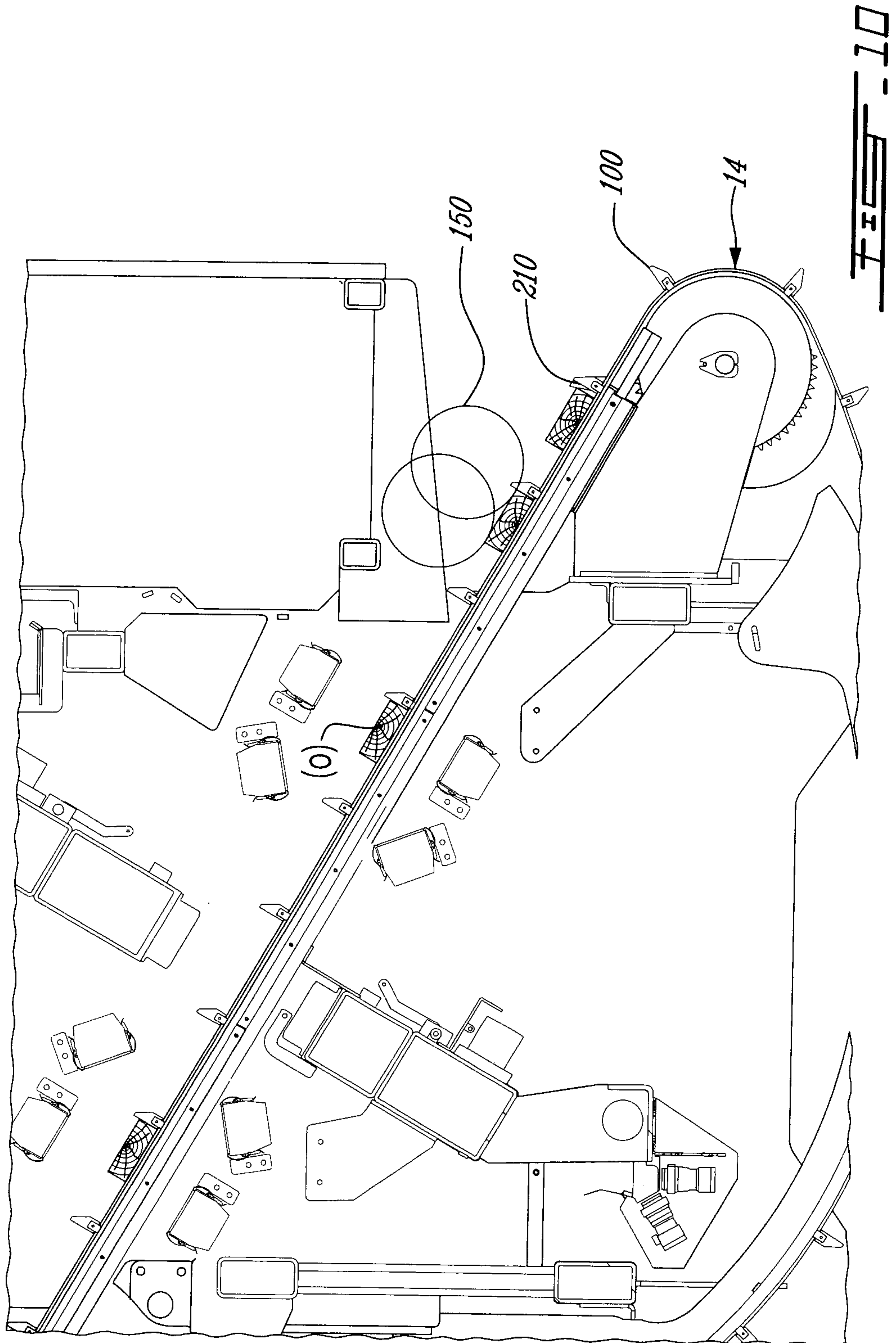
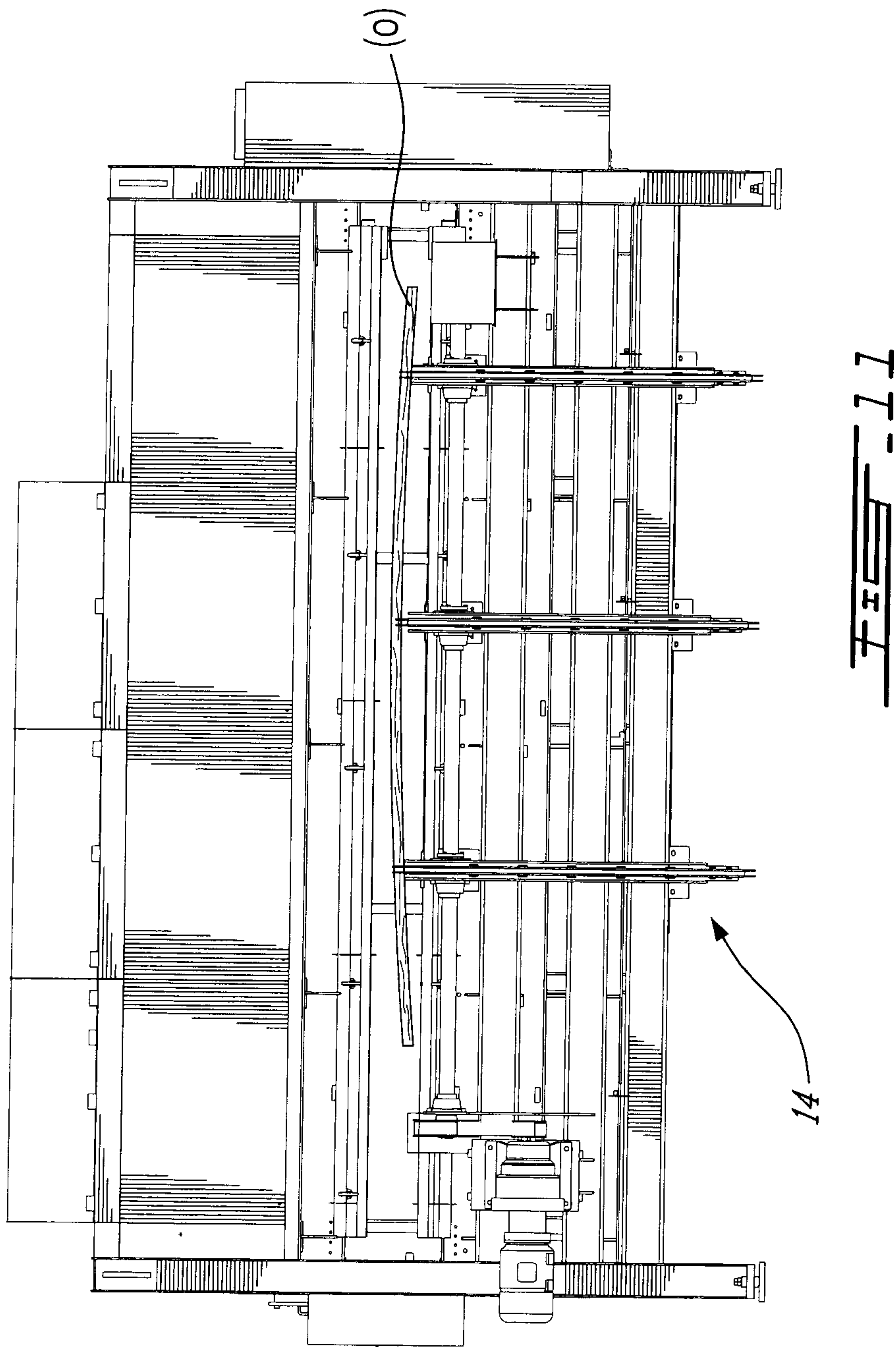


FIG. 9



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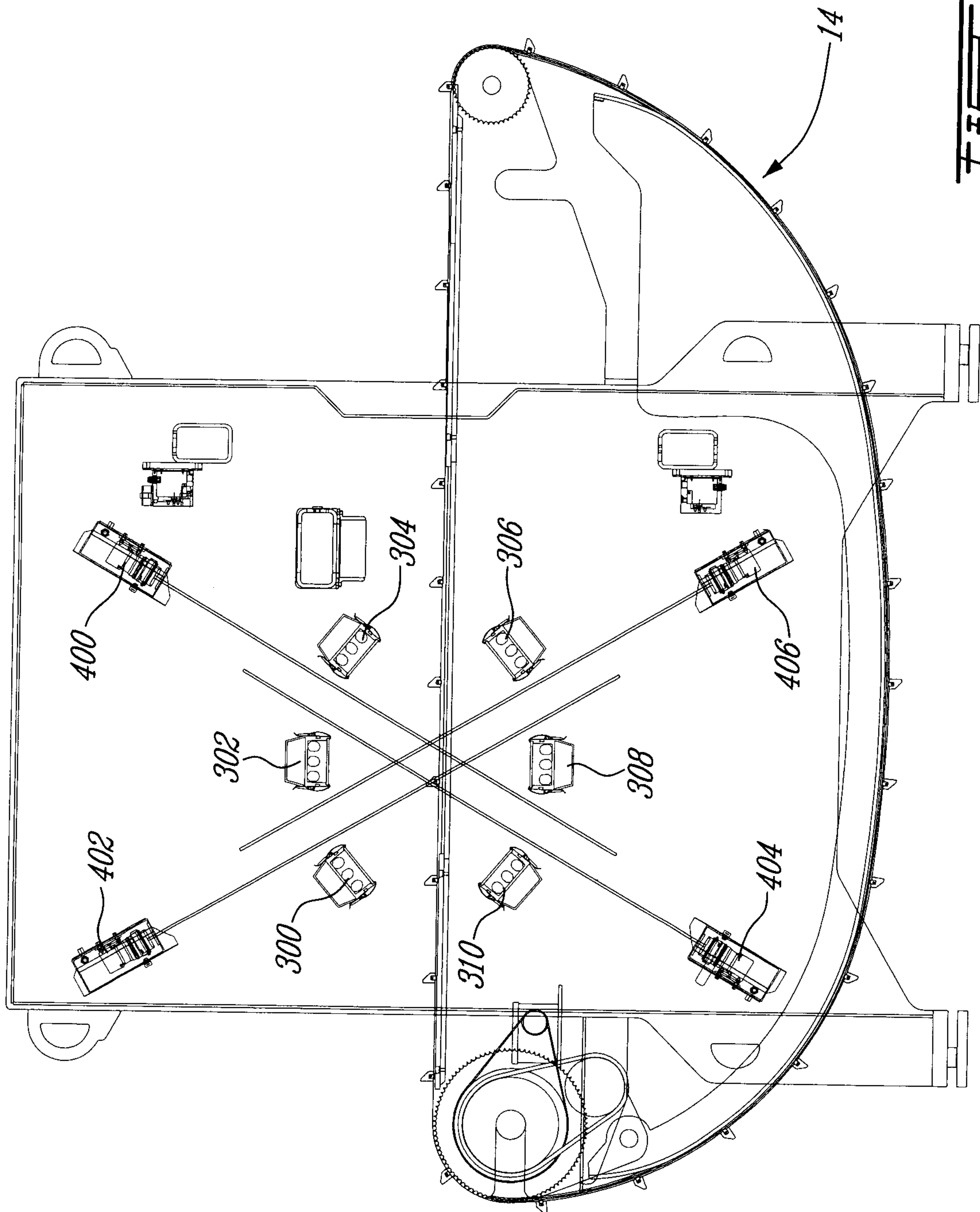


Fig. 12

