

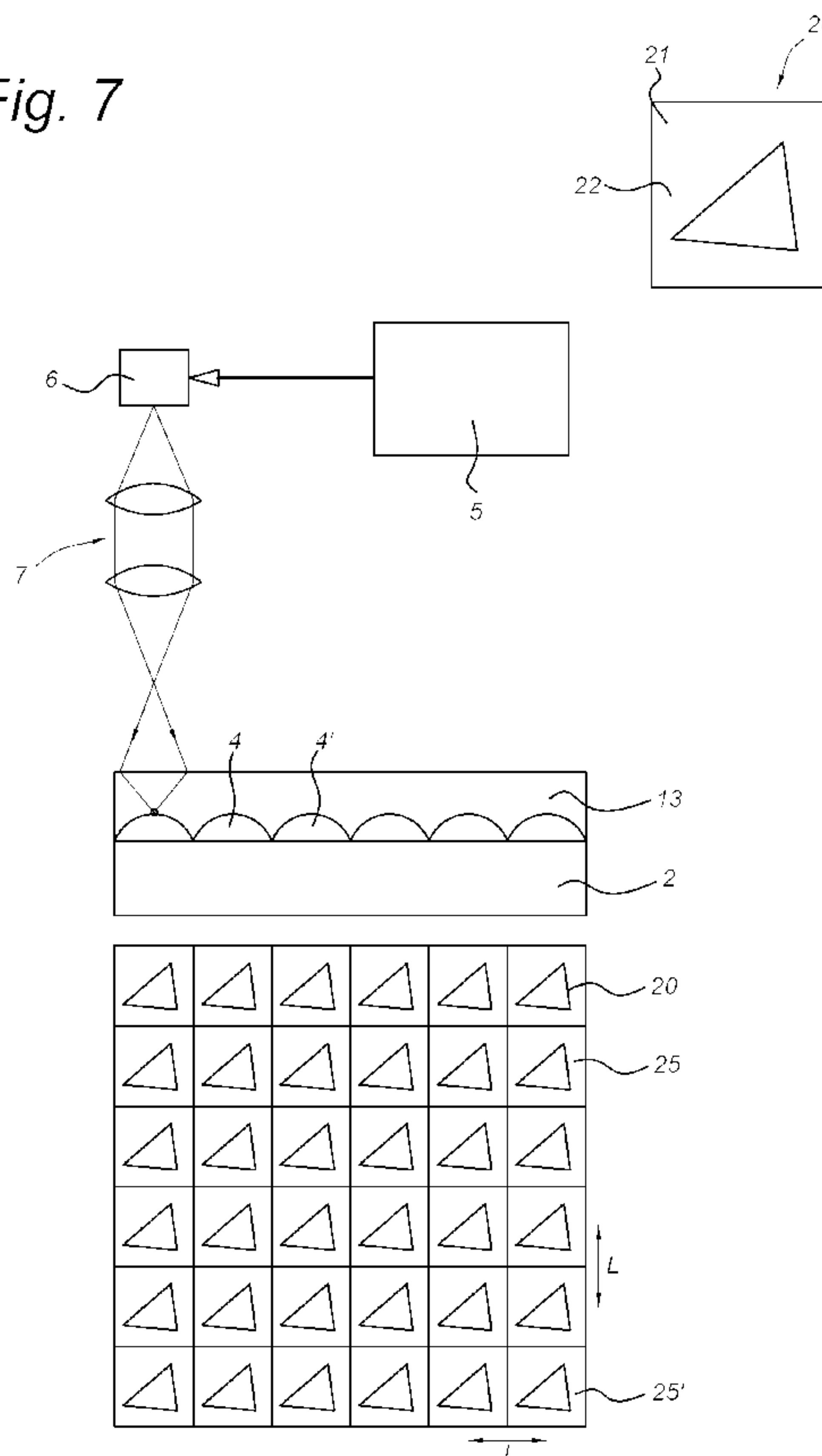


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(71) **Demandeur/Applicant:**
MORPHO B.V., NL
(72) **Inventeurs/Inventors:**
VAN DEN BERG, JAN, NL;
WESSELINK, WILHELMUS JOHANNES, NL
(74) **Agent:** GOWLING WLG (CANADA) LLP

(54) **Titre : PROCÉDE PERMETTANT DE FOURNIR UNE IMAGE AU MOYEN D'UN RESEAU COMPOSE DE MULTIPLES LENTILLES**
(54) **Title: METHOD OF PROVIDING AN IMAGE THROUGH A MULTIPLE LENS ARRAY**

Fig. 7



(57) **Abrégé/Abstract:**

The invention relates to a method of providing an image on a carrier, comprising the steps of: providing the carrier comprising an array of lenses having a predetermined focal length, a distance between adjacent lenses being P micron, providing a removable



(57) Abrégé(suite)/Abstract(continued):

optically active layer over the lenses whereby the focal length of the combined lenses and layer is increased, providing an image of an object in an image processing unit, providing the image through the array of lenses and through the optically active layer, and removing the active layer from the lenses, defining an array of target areas on the carrier and providing the image onto each target area via a projection lens system, a distance between adjacent target areas being L micron, and wherein the image is composed of pixels, the pixels of a first image being imaged via a laser onto a predetermined target area.

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(71) Applicant: MORPHO B.V. [NL/NL]; Oudeweg 32, NL-2031 CC Haarlem (NL).

(72) Inventors: VAN DEN BERG, Jan; Bloklandpolderstraat 15, NL-2807 LH Gouda (NL). WESSELINK, Wilhelmus Johannes; Reyer Anslostraat 11, NL-2025 TA Haarlem (NL).

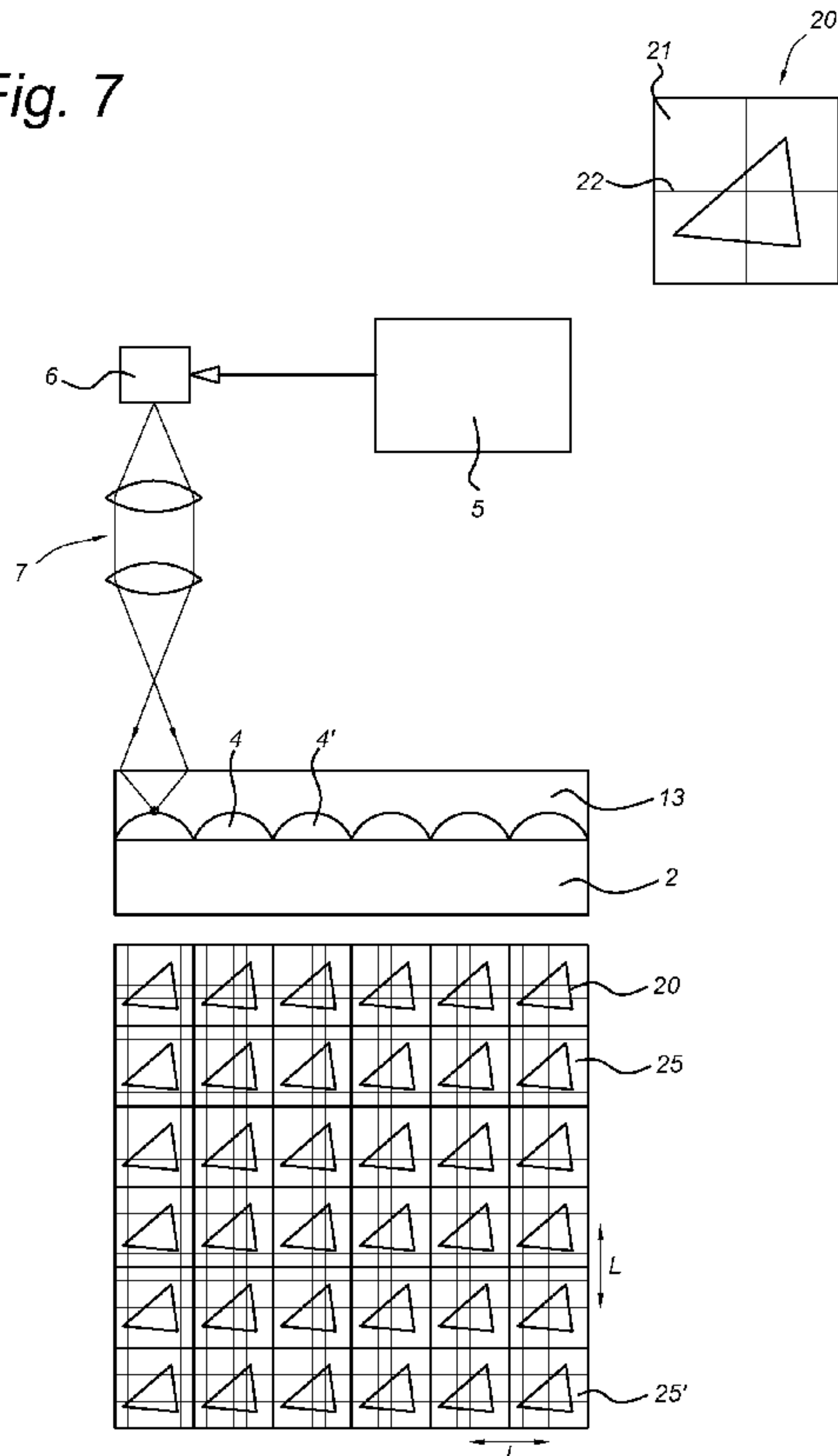
(74) Agent: NEDERLANDSCH OCTROOIBUREAU; Anna van Buerenplein 21 A, 2595 DA The Hague (NL).

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(54) Title: METHOD OF PROVIDING AN IMAGE THROUGH A MULTIPLE LENS ARRAY

Fig. 7



(57) Abstract: The invention relates to a method of providing an image on a carrier, comprising the steps of: providing the carrier comprising an array of lenses having a predetermined focal length, a distance between adjacent lenses being P micron, providing a removable optically active layer over the lenses whereby the focal length of the combined lenses and layer is increased, providing an image of an object in an image processing unit, providing the image through the array of lenses and through the optically active layer, and removing the active layer from the lenses, defining an array of target areas on the carrier and providing the image onto each target area via a projection lens system, a distance between adjacent target areas being L micron, and wherein the image is composed of pixels, the pixels of a first image being imaged via a laser onto a predetermined target area.

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Method of providing an image through a multiple lens array

Field of the invention

- 5 The invention relates to a method of providing a floating image onto a carrier comprising an array of lenses having a predetermined focal length.

Background of the invention

- 10 Such a method is known from Dunn, Potts, Chen-Ho and Emans, Optical Document Security Conference, “personalised, three-dimensional floating images for ID documents, *** date, pages 3-6 and from WO 2013/090586. In these publications, a layer of microlenses is provided and a laser is focussed above or below these microlenses. Each lens in the multiple lens array images the laser spot onto the focal
15 plane in the material of the carrier, which may be made of polycarbonate. Looking at the multiple lens array, the observer sees the spot of the laser beam, which may correspond to a pixel in a digital image, floating above or below the surface of the carrier at the position of the laser focal point after the image has been applied to the carrier. An example containing 40 micrometer planoconvex microlenses with a back
20 focal length of 50 microns arranged in a hexagonal pattern is given.

- In the known floating image, a partial image is formed in the polycarbonate material underlying each lens. These partial images are recombined by the lenses to present a floating image to the viewer. Due to lack of resemblance of the partial images in the
25 array of images to the combined, to the floating image, the known partial images in the carrier are less suitable to serve as an authentication for a security or identity card or document. Furthermore, the known partial images are produced by combined imaging of the laser beam via a projecting lens and the microlenses on the carrier, so that these microlenses affect the image quality of the represented object.

30

In EP 1077426, a method for providing human readable information on a data carrier is disclosed, where human readable information is the form of a stereo image. The method comprises providing the data carrier having a lens array provided on top of a

laser sensitive layer. Optical means in negative form of a liquid are provided onto the surface of the lens array to compensate for lens effect of relief during laser writing. Laser writing is performed through the optical means and then optical means is removed. Card surface relief allows information to be viewed from different angles.

5

DE102010019766 discloses a method for producing a microstructure on a carrier by manufacturing a donor foil by forming an embossed structure with elevations and depressions in a foil material and applying a transfer layer to the embossed structure, forming microstructures. A number of micro lenses forming a lens array are applied to the surface of the microstructures, in such a way that the pitch of the microstructures differs slightly from the pitch of the lenses forming the lens array. By having this specific configuration, a desired moiré effect is provided.

Moreover, DE102009035413 discloses an identification document having a first image region comprising polycarbonate material being configured to blacken upon laser irradiation is performed. The identification document comprises a first and a second image region having an image of a person corresponding to an image region provided in the first image region.

In DE102011117677, a security element for security documents comprising a number of laser produced micro elements, forming a security element, that are associated with a number of microlenses. The micro elements are visible when the security element is viewed through the associated microlenses.

It is an object of the present invention to provide a method of producing an image on a carrier, utilizing a lens array while reducing effects of the lenses on the image during image formation on the carrier. It is a further object to provide a high quality image formed below the lenses, which image is suitable for use as a security or authentication image on a security object such as a bank card, access card or badge or an identity card or document.

Summary of the invention

Hereto the method according to the invention comprises the steps of:

- 5 - Providing the carrier comprising an array of lenses having a predetermined focal length, a distance between adjacent lenses being P micron,
- providing a removable optically active layer over the lenses whereby the focal length of the combined lenses and layer is increased,
- providing an object image of an object in an image processing unit,
- 10 - providing the image of the object through the array of lenses and through the optically active layer,
- removing the optically active layer from the lenses,
- defining an array of target areas (25,25';32,32') on the carrier (2) and providing the image (20) of the object onto each target area via a projection lens system (7)
- 15 through the array of lenses (4,4') and through the optically active layer (13), a distance between adjacent target areas (25,25';32,32') being L micron, wherein L is different from the distance P,
- applying the image (20) of the object onto a first inspection area (31) measuring at least 1 cm by 1 cm, the inspection area being spaced from the target areas (32,32') by
- 20 at least 1 cm, and
- wherein in the image processing unit (5), the image of the object is composed of pixels (21,22), the pixels of a first image being imaged via a laser (6) onto a predetermined target area (25,25'), whereafter the carrier (2) is displaced relative to the projection lens system (7) by L micron and the pixels of a subsequent image are imaged
- 25 onto an adjacent target area (25,25'), and wherein the number of target areas (25,25') is at least 50 x 50.

By applying the optically active layer during image formation, the combined focal length of the layer and the lenses is increased, preferably to infinity, so that the lenses

30 can be "switched off" during production of the image in the carrier layer. Hereby it is possible to form an image which is independent of the lens array geometry, which image in the inspection stage is viewed by an inspection person through the lenses. It

hereby becomes possible to produce multiple images in the carrier having a different pitch than the pitch of the lenses so that a Moiree magnification effect can be obtained.

Alternatively, it is possible to produce 3D pictures below a lenticular array of
5 cylindrical lenses, or other pictures that during formation are not adversely affected by the geometry and/or the quality of the lenses. Again, alternatively, by alteration of the focal distance of the lenses during image forming through the lenses by means of laser engraving, the focus of the laser can be altered to provide a slight “out of focus” effect, such that upon viewing of the image by optical filtering a smoother image is obtained.
10 This method of producing images in a lenticular array with an out of focus effect is described in WO 2011/074956 in the name of the applicant.

On the carrier material, a complete image is formed in each target area. During formation of the images, for instance by projection of a laser beam onto the carrier, the
15 lenses overlying the target areas are covered by the optically active layer and hence do not function to focus the laser beam. This allows the formation of an image on each target area with a pitch that differs from the pitch of the lenses. In this way, after removal of the optically active layer, a floating, magnified image is formed that may be situated above the carrier if the pitch of the image is smaller than the pitch of the lenses
20 ($L < P$) or below the carrier if the pitch of the image is larger than the pitch of the lenses ($L > P$). This so-called Moire magnification is based on forming an array of identical images, the pitch of which in relation to the pitch of the lenses is accurately controlled.

On each target area, a complete image is formed of the object in the inspection area, so
25 that each target area forms an authentication image for comparing with the object image in the first inspection area and hereby determining its authenticity. An inspection person can in this way, for instance by using a simple magnifier, compare each target area image with the inspection image and can notice alterations to the image in the inspection area from this comparison.

30

The optically active layer may comprise a liquid such as for instance water, the carrier and the lenses being immersed in the liquid such that the lenses are situated below the liquid surface. The liquid may be contained in a reservoir into which the carrier is

placed so as to be below the liquid surface. In this way the laser can be focussed onto (or into) the carrier without effect of the lenses, and each pixel of the object image can be imaged onto a corresponding section of the target areas. After forming of the images onto the target areas, the liquid may be drained from the reservoir and the carrier may
5 be removed and dried.

In the image processing unit, the image of the object may be composed of pixels, the pixels of a first image being imaged via a laser beam onto a predetermined target area. Hereafter, the carrier may be displaced relative to the projection lens system in the x-y
10 direction by L micron and the pixels of a subsequent image are imaged onto an adjacent target area. By placing the carrier on an x-y stepping table, a relevant target area may each time be positioned below the projecting lens system so that it can be impinged on by the laser beam.

15 The method of the invention is preferably used for forming an ID document or a security document such as a card or a booklet and the image may be formed by the portrait of the holder of the card or document. Suitable material for the image carrier comprises polycarbonate.

20 Each target area may have a length and a width of between 100 micrometer and 1000 micrometer. The number of target areas may be at least 50 x 50. The number of pixels in each target area may be at least 50x50. The relative dimensions of L and P may be such that $(L-P)/P$ is at least 1%.

25 **Brief description of the drawings**

An embodiment of the method according to the invention will, by way of non-limiting example, be described in detail with reference to the accompanying drawings. In the drawings:

30

Fig. 1 shows a schematic representation of a method of forming an image on a carrier comprising an array of lenses,

Figs. 2a and 2b show a top view of an image carrier comprising respectively an array of cylindrical and of spherical lenses,

Fig. 3 shows a cross-sectional view of the carrier of fig. 2,

Fig. 4 shows a cross-sectional view of the carrier of fig. 3 combined with an optically
5 active layer covering the lenses,

Figs. 5 and 6 show magnified floating images formed for a pitch of the multiple images on the carrier that is respectively smaller and larger than the pitch of the overlying lenses,

Fig. 7 shows a multiple image formed on a carrier,

10 Fig. 8 shows a first step in an inspection process by observing and comparing an enlarged floating image with the portrait image or with the face of the bearer of the security document,

Fig. 9 schematically shows as a second step in the inspection process the verification of the authenticity of the portrait image by an inspection person observing a magnified
15 version of the multiple images, and

Fig. 10 shows a magnifier used for inspection of the multiple images.

Detailed description of the invention

20 Fig. 1 shows a movable stepping table 3 that is displaceable by a motor drive 10 in x and y directions by predefined steps of for instance 100 micrometers. On the table 3, a carrier 2 is placed comprising an array of lenses 4,4'. The carrier 2 may comprise multiple layers made of polycarbonate, polyester, pvc or combinations thereof. The lenses 4,4' may be formed by cylindrical lenses or spherical lenses or lenses having any
25 other suitable geometry. A laser 6 generates a laser beam that is focussed into a point 8 via a lens system 7. The focus point 8 is imaged by the lenses 4,4' into a blackened area 9 of the image carrier 2 where energy dissipated by the laser beam produces a discoloration or blackening of the transparent carrier material. A computer 5 controls the laser 6 and the motor drive 10 in such a manner that either interlaced line images
30 are formed with groups of lines 14, 14' below each of the cylinder lenses 4,4' such as schematically shown in fig. 2a, and in accordance with for instance EP 219 012. Alternatively, as shown in fig. 2b, one complete image may be formed each time below each one of the individual spherical lenses 4,4' such as described in WO 2013/090586.

Fig. 3 shows a parallel bundle 11 being focussed by the lenses 4,4' into the carrier layer 2 at a focal distance f of for instance 50-100 micrometer. In fig. 4 it is shown that an optically active layer 13 overlies the lenses 4,4', such that a parallel bundle 12 remains parallel without being focussed by the lenses 4,4'. In this manner it is possible to direct
 5 the bundle 12 into the substrate 2 without being influenced by the lenses 4,4' that are later used for viewing of the image by a user.

Fig. 5 shows an example wherein images 16,16' are formed in the carrier 2 at a pitch L which is smaller than the pitch P of the lenses 4, 4'. Hereby a viewer 17 observes an
 10 enlarged image 18 that is parallel to the images 16,16' and is located below the carrier 2. In fig. 6, the pitch L of the images 16,16' in the carrier 2 is larger than the pitch P of the lenses 4,4' such that an image 18 is observed by an inspection person 17 floating above the carrier 2, and being flipped with respect to the images 16,16'.

15 Fig. 7 shows how an image 20 is stored in the image processing memory of computer 5, the image 20 being for instance formed of 50 by 50 pixels 21, 22. The carrier 2 defines for instance 50x 50 target areas 25,25', on each target area a complete image 20 consisting of 50x50 pixels being projected via the projection lens system 7, the optically active layer 13 and the lenses 4,4', so that an array of 50x50 micro images are
 20 formed at a pitch L . After removal of the optically active layer 13, which may be formed by a liquid layer such as water, a viewer will observe the multiple images on the target areas 25,25' as a single enlarged image floating above or below the carrier 2.

Fig. 8 shows a security object 30 such as an identity document or bank card carrying in
 25 an inspection area a portrait picture 31, with dimensions of for instance at least 1x1 cm. Onto target areas spaced at a distance of at least 1 cm from the portrait picture 31, an array of small images 32,32' of the portrait 31 is formed below spherical lenses, which multiple images 32,32' are viewed as a single enlarged floating image 33 of the portrait picture 31. By inspecting the enlarged floating image 33, the inspection person can
 30 verify the authenticity of the portrait picture 31 and detect if any alterations have been made. In case the observing person doubts the authenticity of the portrait 31, it can further verify the authenticity of the portrait picture 31 by directly viewing the multiple images 32,32' by utilizing a magnifier 35 overlying the multiple images 32,32' and

viewing the enlarged array of multiple images 36, as shown in fig. 9. The magnifier 35 comprises an optically active layer 38 that compensates for the action of the lenses 4,4' overlying the multiple images 32, 32' so that the array of 36 of images is viewed. In this way an additional authentication of the portrait picture 31 can be obtained and
5 modification of the enlarged floating image 33 can be detected by observing each individual multiple image 32,32'.

Claims

1. Method of providing an image on a carrier (2), comprising the steps of:
 - 5 - Providing the carrier comprising an array of lenses (4,4') having a predetermined focal length, a distance between adjacent lenses being P micron,
 - providing a removable optically active layer (13) over the lenses (4,4') whereby the focal length of the combined lenses and layer is increased,
 - providing an object image (20) of an object in an image processing unit (5),
 - 10 - providing the image of the object through the array of lenses (4,4') and through the optically active layer,
 - removing the optically active layer (13) from the lenses
 - defining an array of target areas (25,25';32,32') on the carrier (2) and providing the image (20) of the object onto each target area via a projection lens system (7)
 - 15 through the array of lenses (4,4') and through the optically active layer (13), a distance between adjacent target areas (25,25';32,32') being L micron, wherein L is different from the distance P,
 - applying the image (20) of the object onto a first inspection area (31) measuring at least 1 cm by 1 cm, the inspection area being spaced from the target areas (32,32') by
 - 20 at least 1 cm, and
 - wherein in the image processing unit (5), the image of the object is composed of pixels (21,22), the pixels of a first image being imaged via a laser (6) onto a predetermined target area (25,25'), whereafter the carrier (2) is displaced relative to the projection lens system (7) by L micron and the pixels of a subsequent image are imaged
 - 25 onto an adjacent target area (25,25'), and wherein the number of target areas (25,25') is at least 50 x 50.
2. Method according to claim 1, wherein the optically active layer (13) is a liquid, the carrier (2) and the lenses (4,4') being immersed in the liquid such that the lenses are
- 30 situated below the liquid surface.
3. Method according to claim 1 or 2, wherein the image is a portrait.

10

4. Method according to any of the claims 1-3, wherein the carrier (2) is formed of polycarbonate.

5. Method according to any of the preceding claims, wherein the length and width
5 of the target areas (25,25') are between 100 micrometer and 1000 micrometer.

6. Method according to claim 1, wherein the number of pixels (21,22) in each target area (25,25') is at least 50x50.

10 7. Method according to any of the preceding claims, wherein (L-P)/P is at least 1%.

8. Method according to any of the preceding claims, wherein the optically active layer (13) is formed of water.

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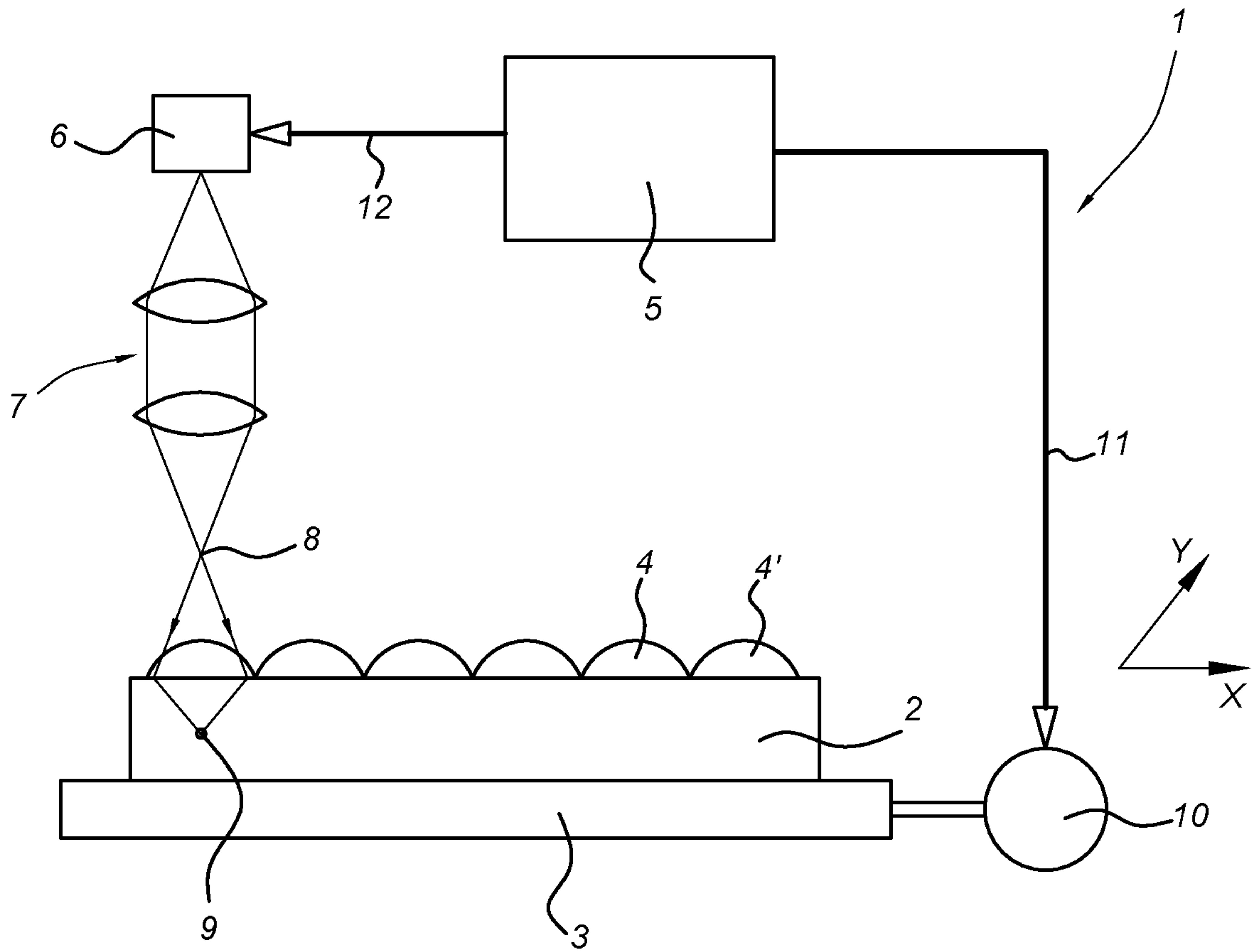
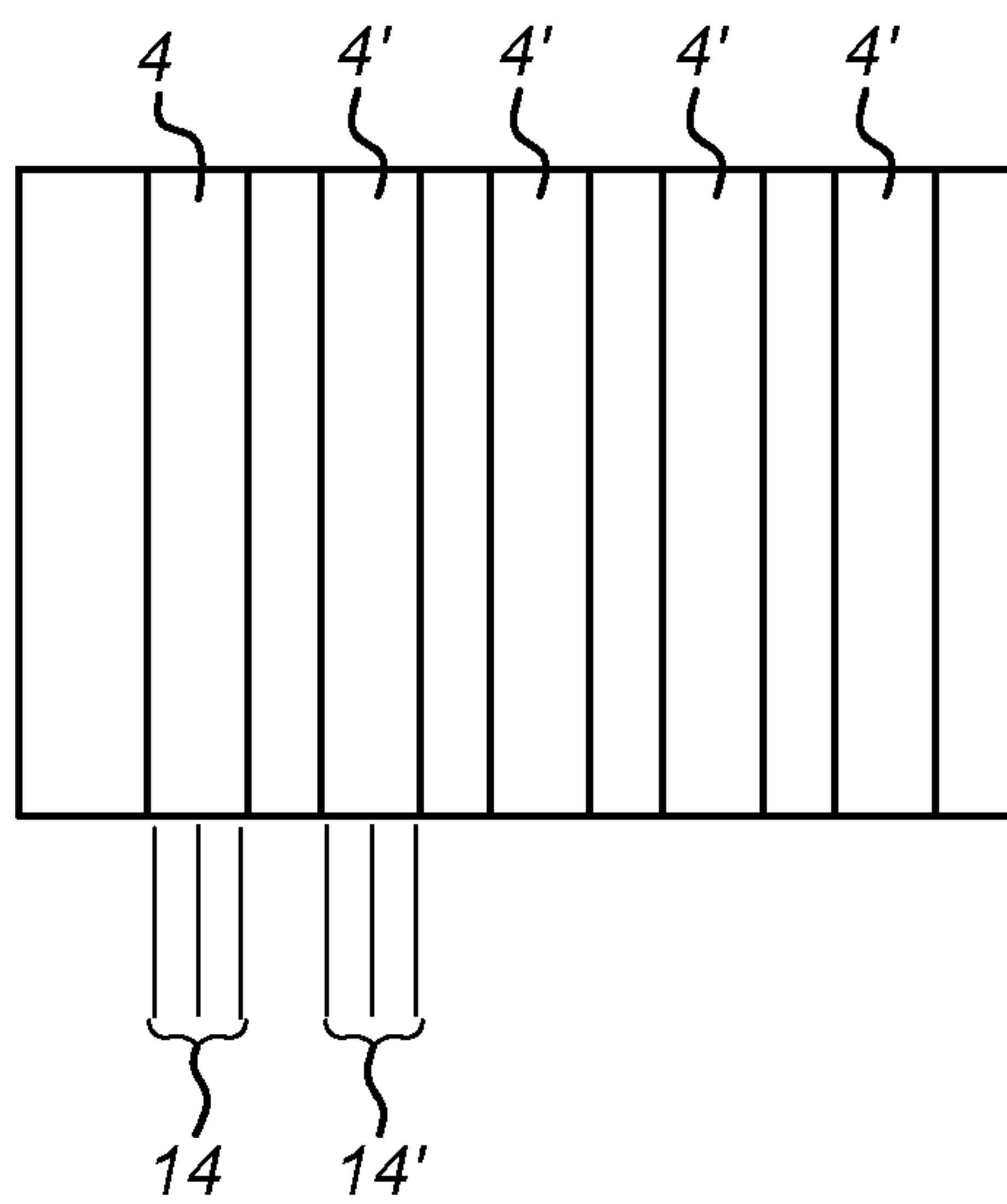
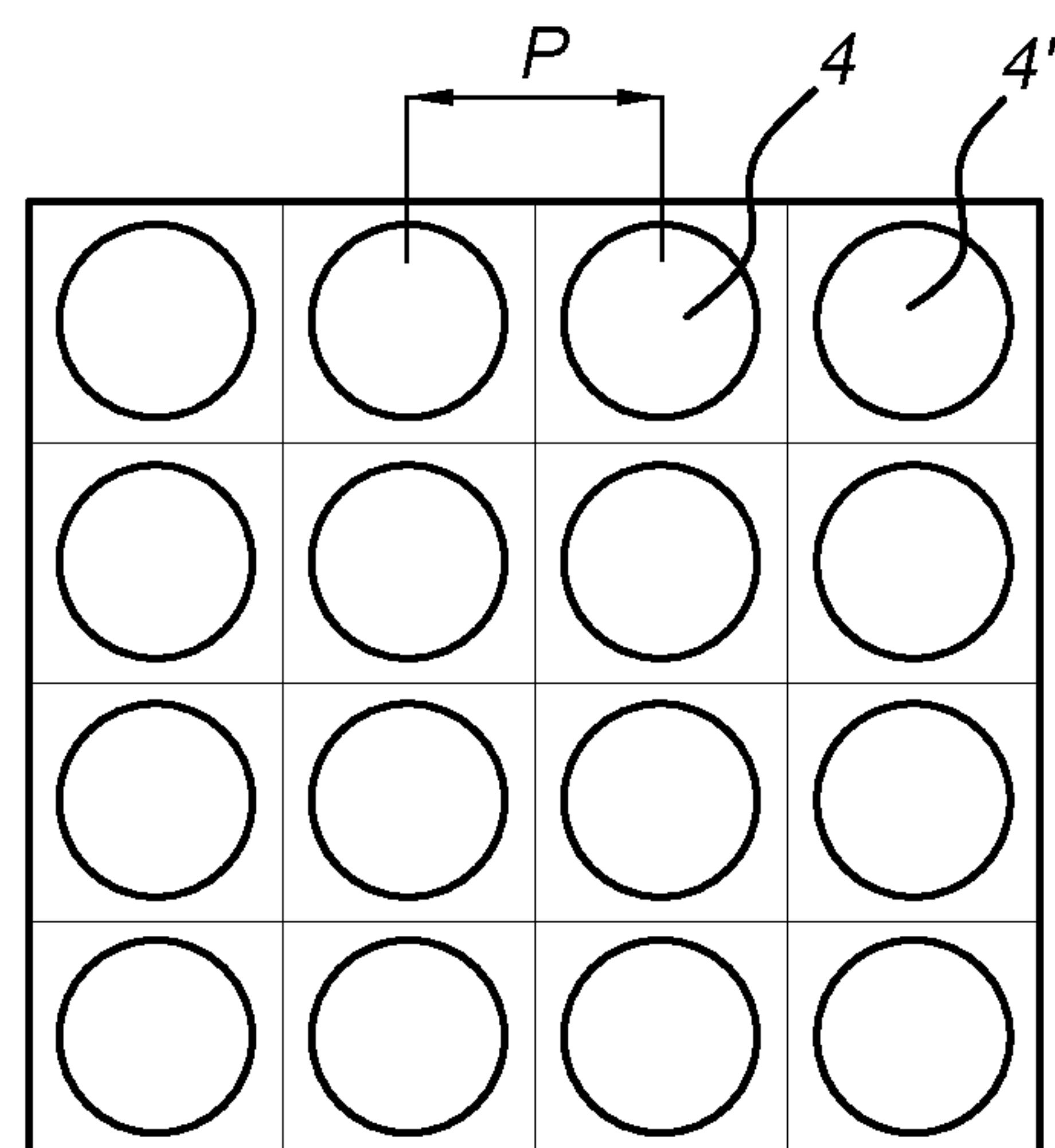
Fig. 1*Fig. 2a**Fig. 2b*

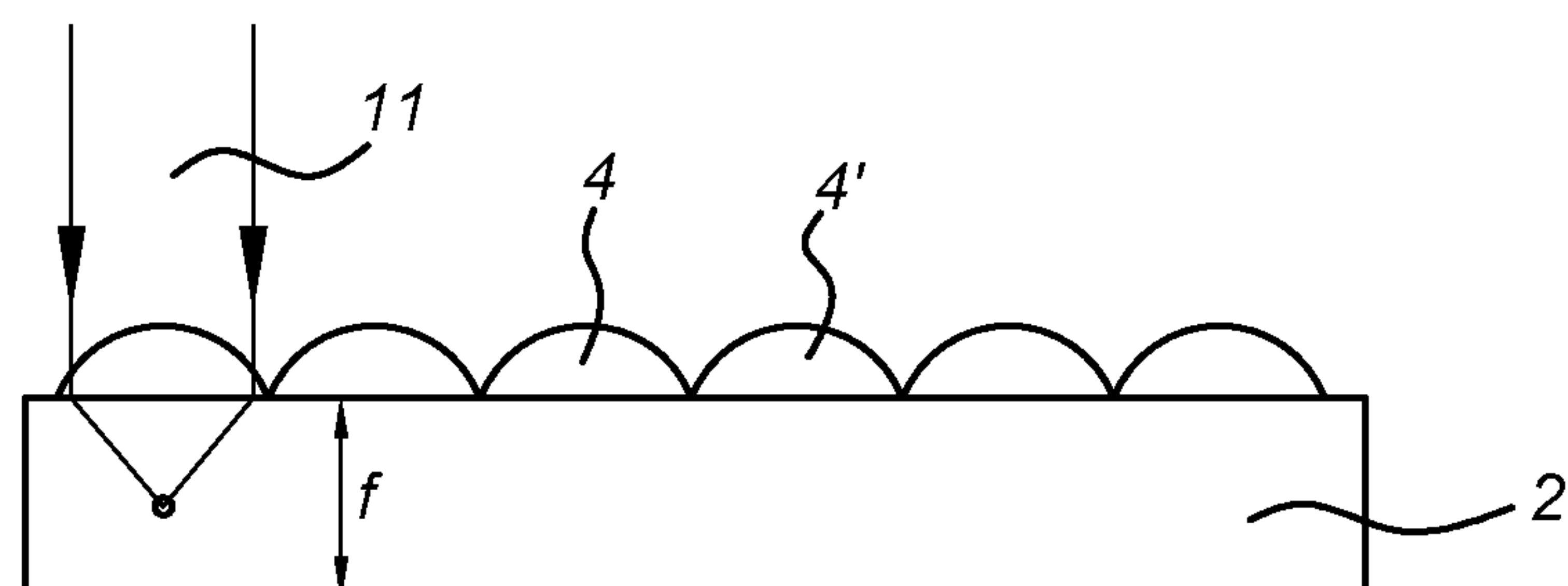
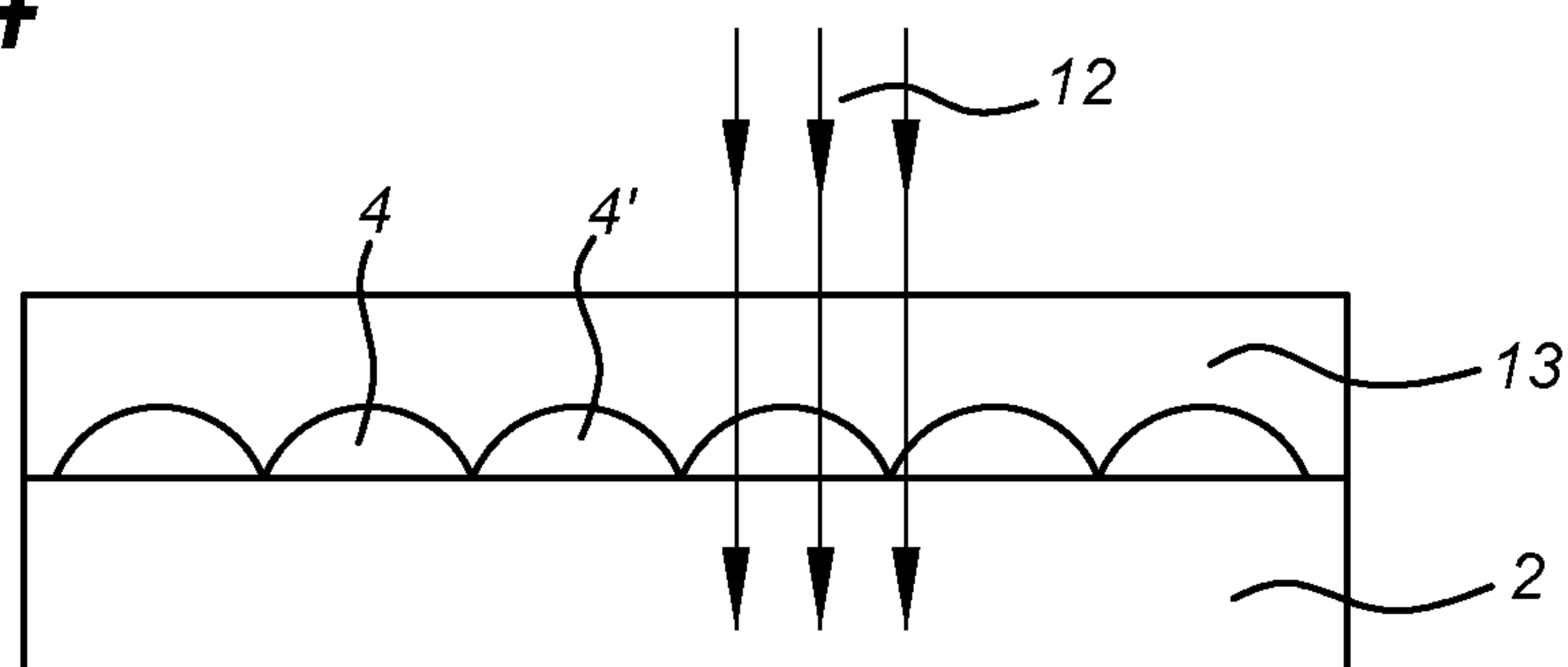
Fig. 3*Fig. 4*

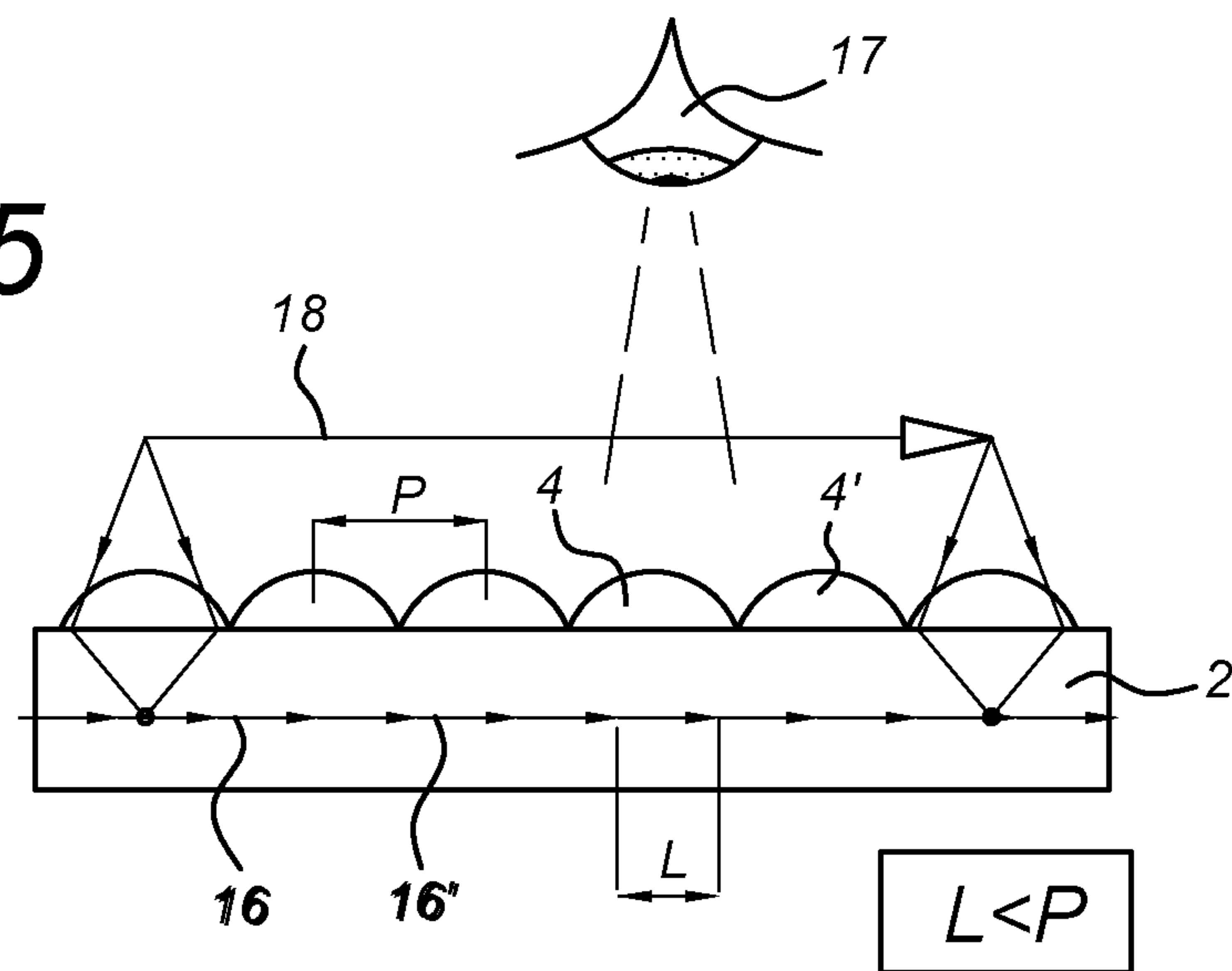
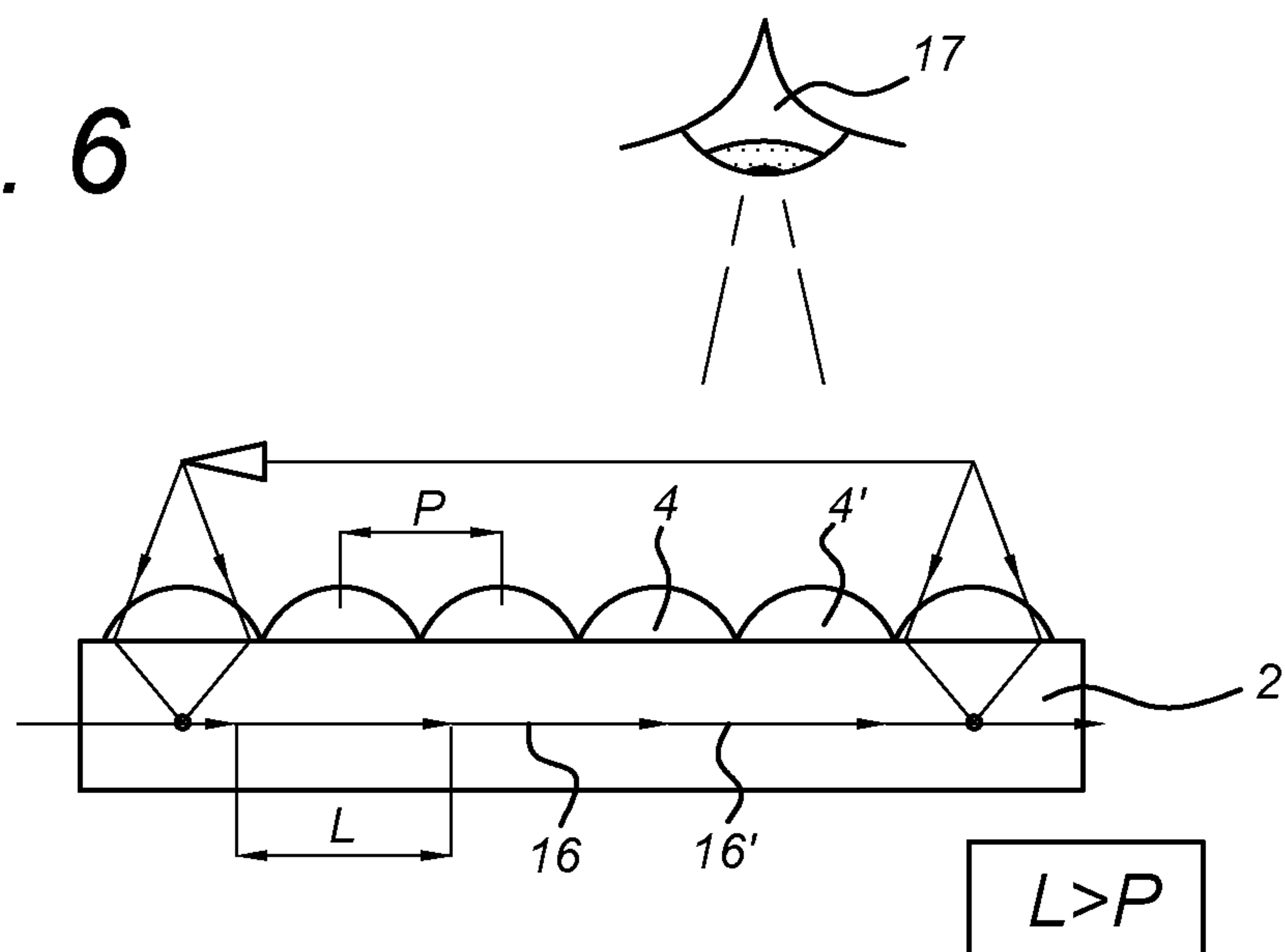
Fig. 5*Fig. 6*

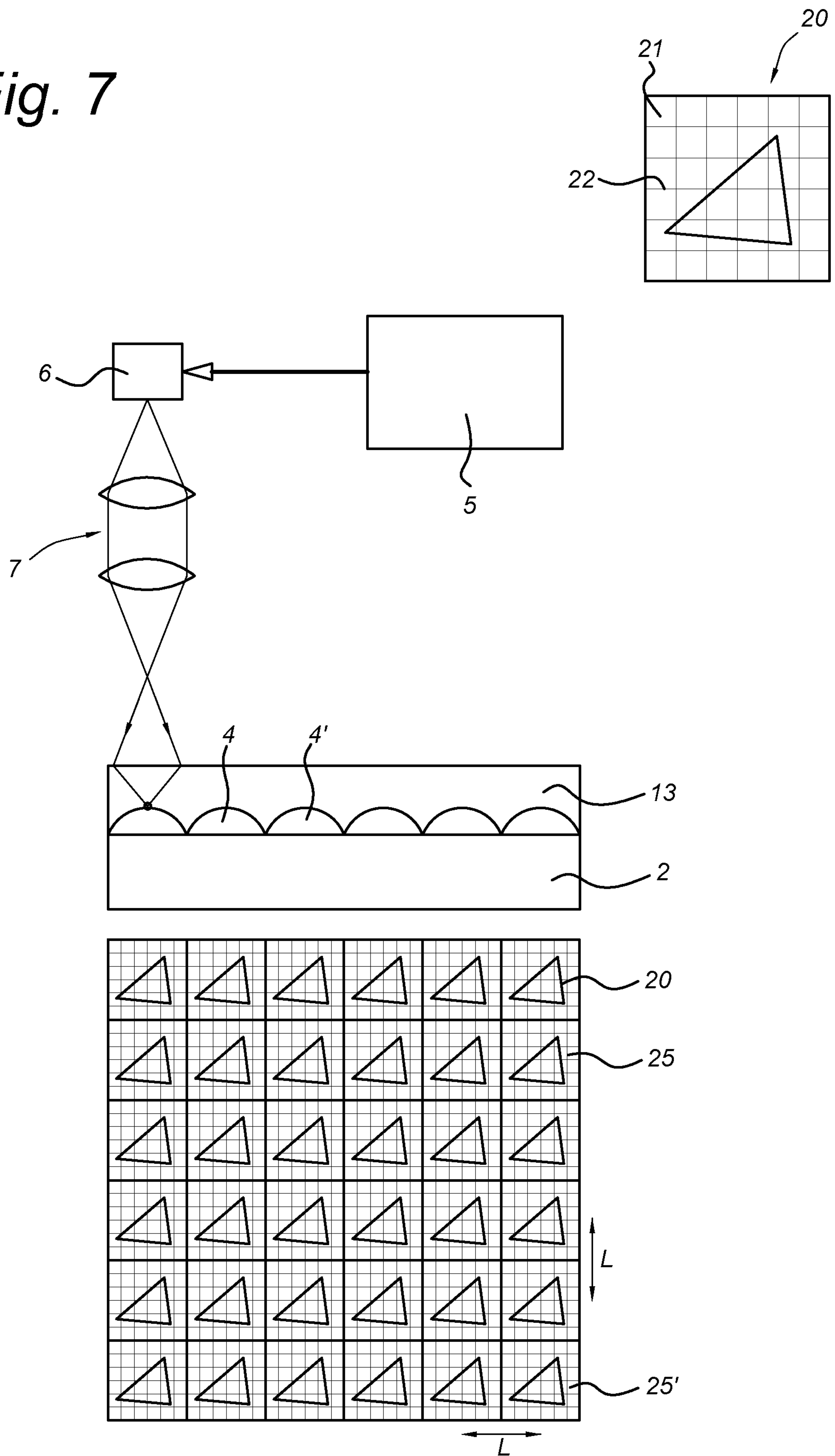
Fig. 7

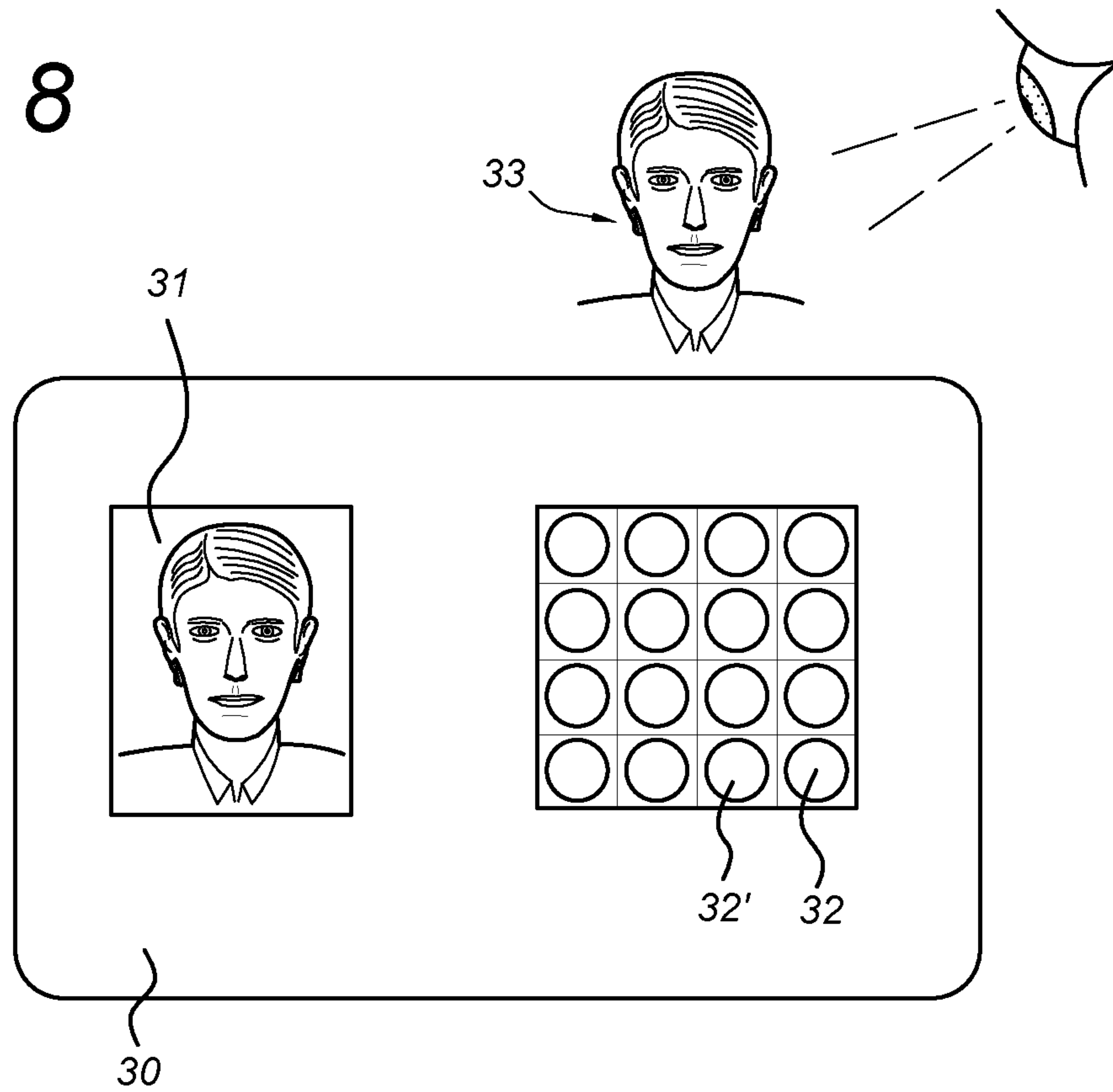
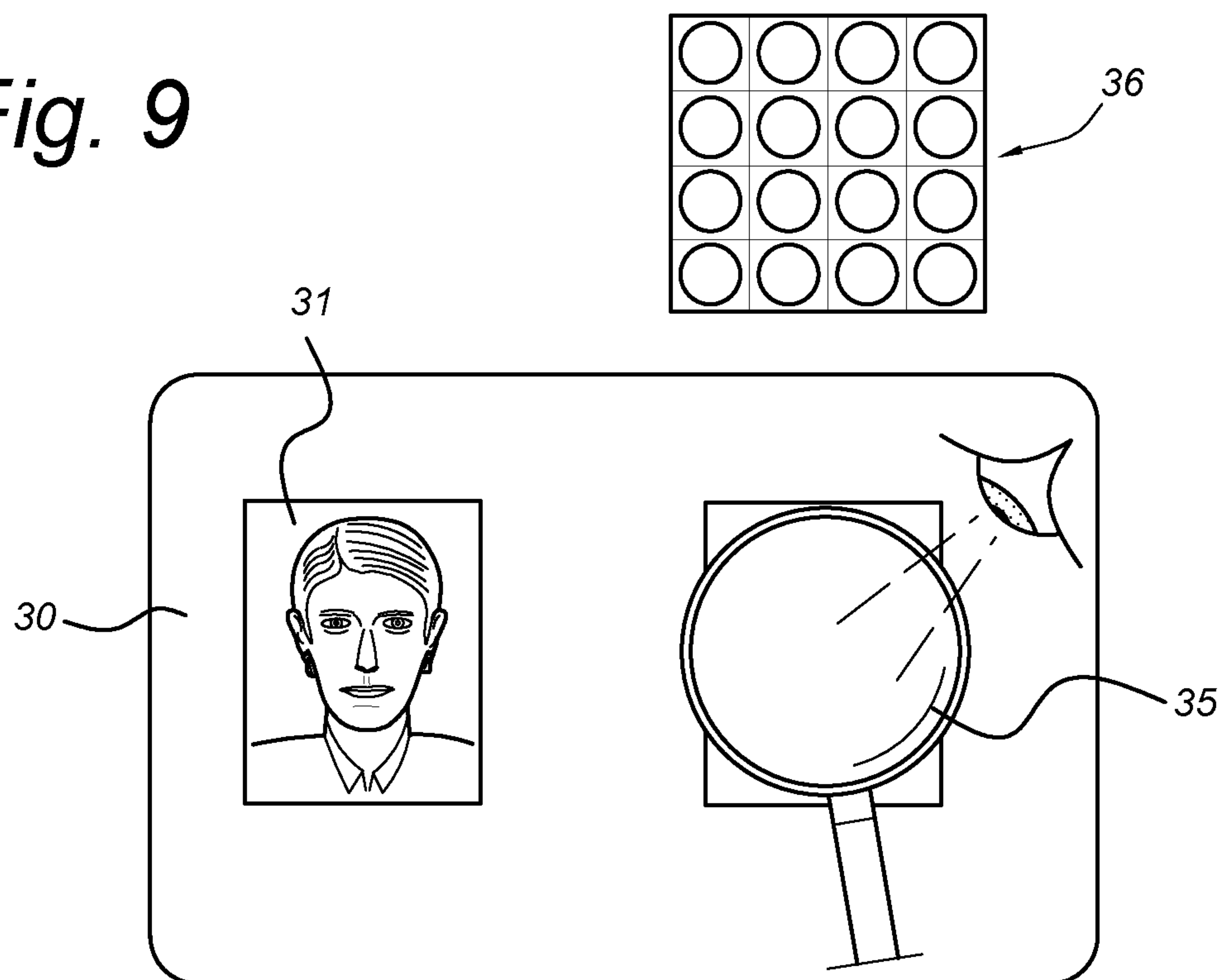
Fig. 8*Fig. 9*

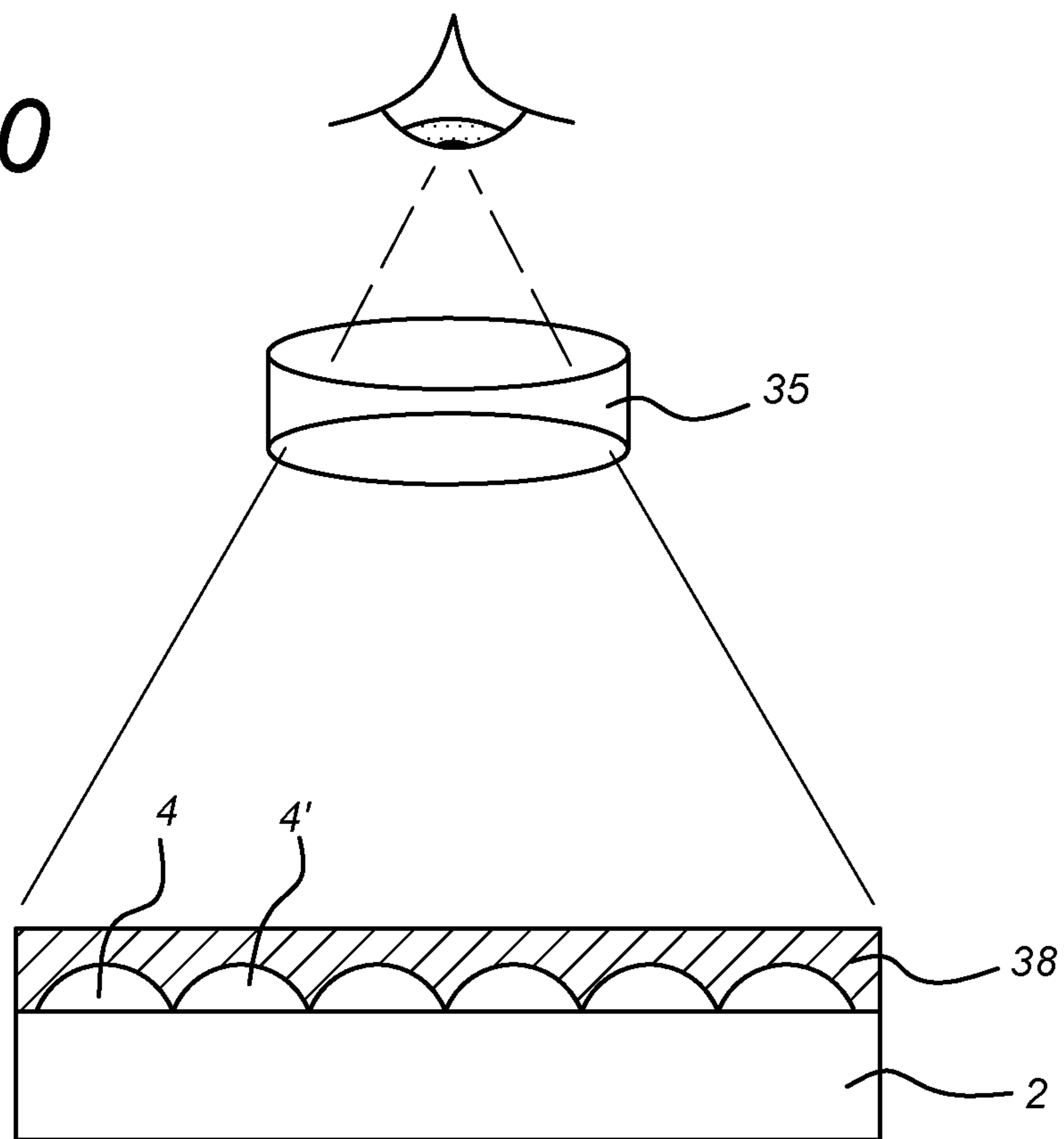
Fig. 10

Fig. 7

