Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2567095 C 2013/11/19

(11)(21) **2 567 095**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

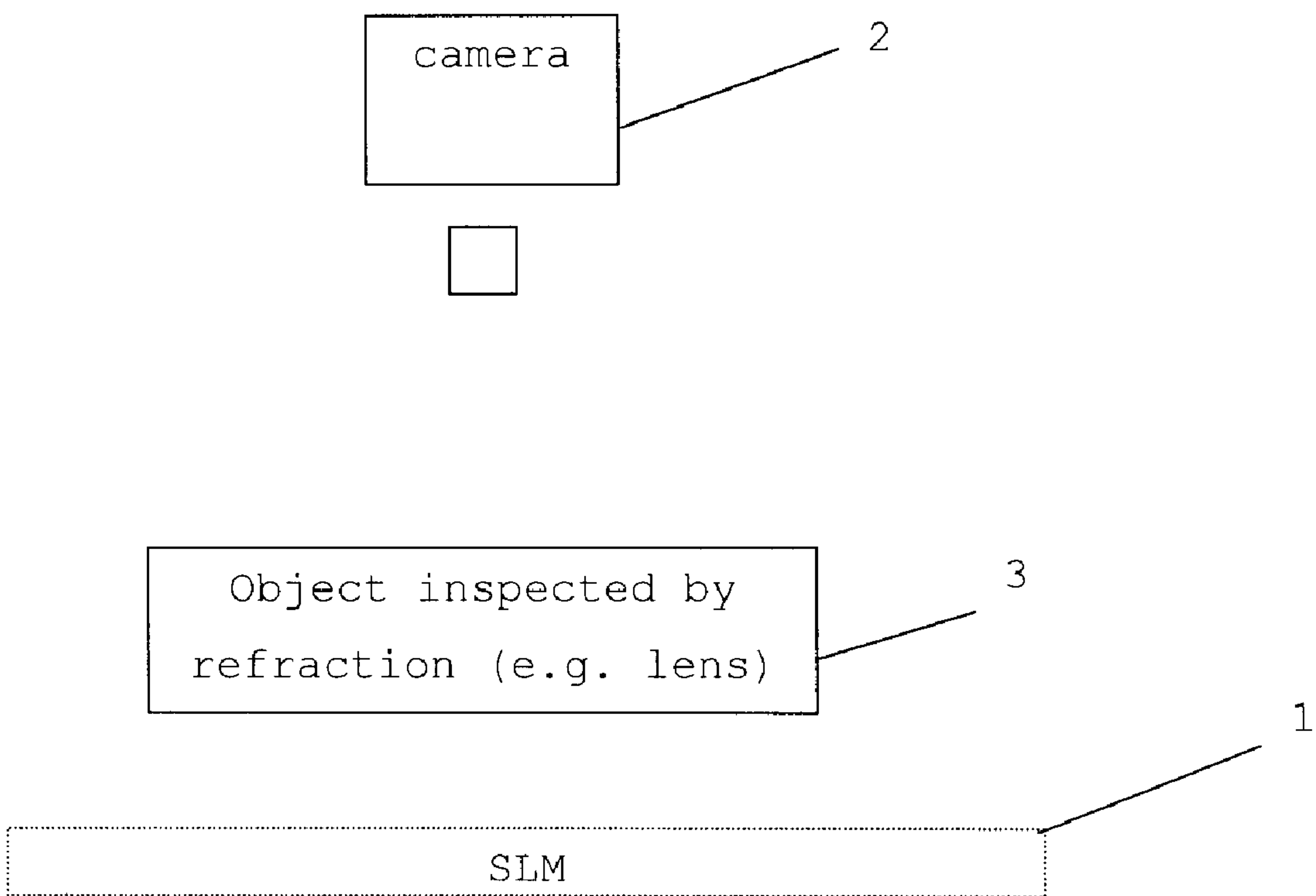
(86) **Date de dépôt PCT/PCT Filing Date:** 2005/06/08
(87) **Date publication PCT/PCT Publication Date:** 2005/12/22
(45) **Date de délivrance/Issue Date:** 2013/11/19
(85) **Entrée phase nationale/National Entry:** 2006/11/17
(86) **N° demande PCT/PCT Application No.:** BE 2005/000094
(87) **N° publication PCT/PCT Publication No.:** 2005/121740
(30) **Priorité/Priority:** 2004/06/09 (EP04447138.1)

(51) **Cl.Int./Int.Cl.** *G01M 11/02* (2006.01)
(72) **Inventeur/Inventor:**
LAURENT, CHRISTIAN, BE

(73) **Propriétaire/Owner:**
AUTOMATION & ROBOTICS, BE

(74) **Agent:** GOWLING LAFLEUR HENDERSON LLP

(54) **Titre :** PROCEDE DE VERIFICATION POUR EXAMINER DES ELEMENTS REFLECHISSANTS OU TRANSPARENTS
(54) **Title:** A METHOD FOR INSPECTING TRANSPARENT OR REFLECTIVE ELEMENTS



(57) **Abrégé/Abstract:**
The invention relates to an appliance for measuring or controlling an optical element (3) comprising illumination means (1) and an associated artificial vision system (2), in which the optical element (3) can be inserted between the illumination means (1) and the

(57) Abrégé(suite)/Abstract(continued):
artificial vision system (2), said illumination means (1) comprising programmable optoelectronic means for producing a luminous background with spatially and temporally variable brightness. The inventive appliance is characterised in that the programmable optoelectronic means are embodied in such a way as to consecutively generate a plurality of mires, each comprising a pattern which is repeated in a contrasted manner on a uniform background with a high spatial frequency of between 0.01 and 100 patterns/mm, or such that two adjacent patterns are separated by an angle between 0.1 and 30 degrees, said angle being measured from the point of the object on which the pattern is observed. Said generated mires are consecutively spatially staggered in such a way that a plurality of images corresponding to the mires is captured by the artificial vision system after reflection or transmission by the optical element (3), and recombined in the form of a single composed image.

(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

(19) Organisation Mondiale de la Propriété Intellectuelle
Bureau international

(43) Date de la publication internationale
22 décembre 2005 (22.12.2005)

PCT

(10) Numéro de publication internationale
WO 2005/121740 A1

(51) Classification internationale des brevets[7] : **G01M 11/02**

(21) Numéro de la demande internationale : PCT/BE2005/000094

(22) Date de dépôt international : 8 juin 2005 (08.06.2005)

(25) Langue de dépôt : français

(26) Langue de publication : français

(30) Données relatives à la priorité :
04447138.1 9 juin 2004 (09.06.2004) EP

(71) Déposant *(pour tous les États désignés sauf US)* **: AUTOMATION & ROBOTICS** [BE/BE]; Parc industriel de Lambermont, B-4800 Verviers (BE).

(72) Inventeur; et
(75) Inventeur/Déposant *(pour US seulement)* **: LAURENT, Christian** [BE/BE]; Rue de Jehanster 36, B-4800 Verviers (BE).

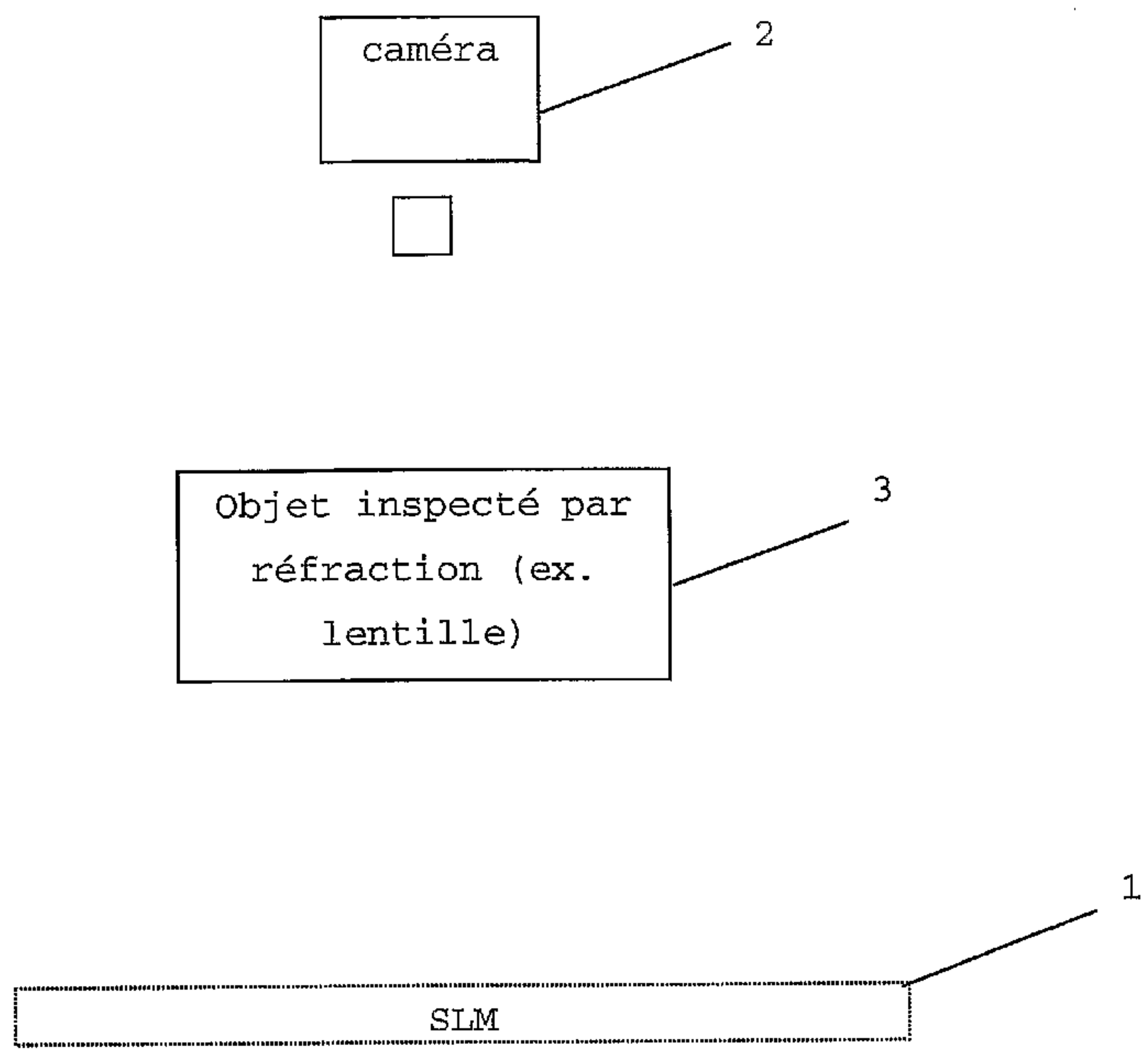
(74) Mandataires : VAN MALDEREN, Michel etc.; OFFICE VAN MALDEREN, Bld de la Sauvenière 85/043, B-4000 Liège (BE).

(81) États désignés *(sauf indication contraire, pour tout titre de protection nationale disponible)* **:** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

[Suite sur la page suivante]

(54) Title: APPLIANCE FOR CONTROLLING TRANSPARENT OR REFLECTIVE ELEMENTS

(54) Titre : APPAREIL POUR LE CONTROLE DE PIECES TRANSPARENTES OU REFLECHISSANTES



2. CAMERA
3. OBJECT INSPECTED BY REFRACTION (E.G. LENS)

(57) Abstract: The invention relates to an appliance for measuring or controlling an optical element (3) comprising illumination means (1) and an associated artificial vision system (2), in which the optical element (3) can be inserted between the illumination means (1) and the artificial vision system (2), said illumination means (1) comprising programmable optoelectronic means for producing a luminous background with spatially and temporally variable brightness. The inventive appliance is characterised in that the programmable optoelectronic means are embodied in such a way as to consecutively generate a plurality of mires, each comprising a pattern which is repeated in a contrasted manner on a uniform background with a high spatial frequency of between 0.01 and 100 patterns/mm, or such that two adjacent patterns are separated by an angle between 0.1 and 30 degrees, said angle being measured from the point of the object on which the pattern is observed. Said generated mires are consecutively spatially staggered in such a way that a plurality of images corresponding to the mires is captured by the artificial vision system after reflection or transmission by the optical element (3), and recombined in the form of a single composed image.

(57) Abrégé : La présente invention se rapporte à un appareil de mesure ou de contrôle d'une pièce optique (3) comprenant des moyens d'éclairage (1) et un système de vision artificielle associé (2), dans lequel la pièce optique (3) peut être interposée entre les moyens d'éclairage (1) et le système de vision artificielle (2), lesdits moyens d'éclairage (1) comprenant

[Suite sur la page suivante]

WO 2005/121740 A1

WO 2005/121740 A1

(84) États désignés *(sauf indication contraire, pour tout titre de protection régionale disponible)* **:** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasien (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), européen (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publiée :

— *avec rapport de recherche internationale*

— *avant l'expiration du délai prévu pour la modification des revendications, sera republiée si des modifications sont reçues*

En ce qui concerne les codes à deux lettres et autres abréviations, se référer aux "Notes explicatives relatives aux codes et abréviations" figurant au début de chaque numéro ordinaire de la Gazette du PCT.

des moyens optoélectroniques programmables pour produire un fond lumineux de luminance variable dans l'espace et dans le temps, caractérisé en ce que lesdits moyens optoélectroniques programmables sont configurés pour générer consécutivement une pluralité de mires, chacune comprenant un motif répété de manière contrastée sur un fond uniforme avec une haute fréquence spatiale, comprise entre 0,01 et 100 motifs/mm ou telle que deux motifs adjacents sont séparés par un angle compris entre 0,1 et 30 degrés, ledit angle étant mesuré à partir du point de l'objet sur lequel le motif est observé, lesdites mires générées consécutivement étant décalées spatialement, de sorte qu'une pluralité d'images correspondant auxdites mires est captée par le système de vision artificielle après réflexion ou transmission par la pièce optique (3) et recombinée sous forme d'une image composée unique.

A METHOD FOR INSPECTING TRANSPARENT OR REFLECTIVE ELEMENTS

Field of the invention

[0001] The present invention relates to a device for:

- detecting defects or locating semi-visible marks present in transparent or reflective optical parts, for example detecting deformations and appearance defects ("cosmetic control");
- measuring the optical properties of such optical parts (for example characteristics of divergence, refraction, transmission factor, power or vergence, curvature, diffusivity, etc.).

[0002] One example application area of the invention is the control of optical lenses and of all transparent and/or reflective products in the ophthalmic industry.

[0003] A reflective product is defined *a priori* as being a product with a surface that reacts to incident light according to the law of specular reflection.

[0004] The invention also relates to the control of the appearance of translucent products and/or products having a diffuse reflection.

Technological background, state of the art and technical problem to be solved

Detection and classification of appearance defects

[0005] Numerous methods are known and used in artificial vision for the automatic detection of defects, they implement lighting systems with properties that are adapted to the particular type of defect to be detected.

Mention may be made for instance of devices with bright and black fields, projection systems, systems of alternation observations for instance in the form of black and white strips, Schlieren methods, called "knife edge", etc.

[0006] Three main types of defects that may appear simultaneously are considered here (non-exclusive):

- diffusing defect: visible even if it affects a small area; "scatters" the light in the usual sense;
- deflecting defect: does not entail diffusion but a local modification of the refraction effect (for example "magnifying" effect);
- absorbing defect: locally decreases the transmission.

[0007] Known devices are often characterised by a motion requirement, either for the parts to be observed or for the lighting devices (FR-A-98 14417, EP-A-556 655, "Machine Vision System for Specular Surface Inspection: Use of Simulation Process as a Tool for Design and Optimization", R. SEULIN et al., Laboratory Le2i, QCAV-days, 21-23 May 2001, Le Creusot, France) or else by suitable projection devices (EP-A-856 728). One thus obtains systems with configurations that are determined by the goal to be achieved and by the mechanical, geometrical or optical means implemented.

[0008] Numerous lighting systems have their configuration determined by the size and shape of the object to be observed, as for instance the device described in document US-B-6,476,909. It proposes an device for inspecting an optical part, in which a diffusion means is interposed between the source of light and the part to be inspected. The diffusing element is preferably a two-dimensional LCD panel with three zones differing in terms of their diffusion transmission factor: a central zone with weak diffusivity, a peripheral zone with high diffusivity and an external mask surrounding these two zones and intercepting the light. The shapes of these first two zones depend on the shape of the object to be inspected. The size of the central zone depends on the size of the object. The images of the object are received on a CCD camera. In the absence of any defect, the image of the object is only formed by the light issuing from the homogeneous central zone. Thus, the absorbing defects or dusts, i.e. of a black or dark colour, have a weaker luminance than the rest of the image. By contrast, any diffusing particle scatters both the direct light issuing from the central zone and the indirect light issuing from the peripheral zone, which increases local luminance at the location of the defect. This device therefore allows to simultaneously detect several types of defects. This document essentially describes the observation of an optical part over a homogeneous central background. This is a "black field" method where the background is grey rather than black so that absorbing defects appear. It is easy to understand the limitations of such a device for classifying or even detecting defects with (little) deflection or defects, even major ones, that are at the same time absorbing and diffusing due to the antagonist effects of these two types of defects.

[0009] Moreover, and particularly for "large-size" objects, the various points of the object are not illuminated in the same way with this kind of device. This makes the sensitivity of defect detection dependent on the position and also on the orientation of the defect, when the latter scatters the light in an anisotropic way. A defect such as a scratch for instance located on the edge of the examined object may deflect the light differently depending on its orientation. Thus, with the above-described device, a tangential scratch may very well be detected whereas an identical radial scratch may possibly not be observed.

[0010] It is known that deflecting defects and defects diffusing light at a low angle or in a narrow cone are advantageously detected with great sensitivity by "Schlieren techniques" which are, however, hardly suitable for objects with variable surface characteristics or for switching from one model of object to another.

Measurement of optical properties

[0011] The situation is quite similar for measuring optical characteristics. Many types of devices may thus be found:

a) for instance, a first type of equipment provided with projection systems having (a) mask(s) of suitable shape for measuring the optical power (contrary of the focal length) according to the so-called "Hartmann" technique and comprising devices for measuring the light projected either onto a screen or directly onto a sensor. By a calculation based on the deformation of the pattern associated with the mask, these devices allow to analyse the wave front obtained after transmission or reflection on the component to be studied. The latter may be placed in the projection device before or after interception of the light by the mask;

b) in addition, devices that in particular allow to simply calculate the optical properties by analysing the enlargement, in general anisotropic and non-homogeneous, of the image of a pattern (called a "definition chart") observed by refraction or reflection on the surface of the object to be examined, depending on whether the latter is transparent or reflective. Thus, the Applicant developed a device for determining the mapping of the optical power of lenses. This product, called

Lensmapper™ has been sold to the ophthalmic industry since 1994. The principle of this device is similar to the subject matter of patent US-A-6,392,754 held by Innomess GmbH, Marl (DE) for reflective surfaces and to that of European patent application EP-A-1 061 329, held by a firm that is independent of the Applicant and essentially working for the ophthalmic industry.

[0012] Therefore, the problem that arises both for detecting defects in optical parts and for determining the optical properties of components, is that the existing measurement devices are limited, as a result of their relatively rigid configuration, to a restricted range of applications.

[0013] There is therefore a need for a device for the precise measurement or for the detection of appearance defects that would be flexible according to the application chosen over a wide range (for example detecting many types of different defects over the entire surface of the object) and that would allow the "pick and pay" implementation of various lighting methods (for example black or bright field, alternation of black/white fringes, spots or definition chart with dots, etc.).

Aims of the invention

[0014] The present invention aims to provide a device allowing to detect, in precision or quality optical parts, defects of any kind, whose characteristic sizes extend over a very wide range, typically between one micron and several millimetres for most lenses.

[0015] The invention aims in particular to provide a device for highlighting multiple categories of appearance defects or structural discontinuities such as marks, outlines, etc. which, as a result of their specific interaction, possibly strongly anisotropic, with the light and as a result of their orientation, may require very variable configurations of the lighting device used and hence a high degree of adaptability of the latter.

[0016] The invention also aims to provide a flexible device for measuring the characteristics of optical components, in particular in the ophthalmic industry.

Main characteristic elements of the invention

[0017] A method for inspecting a transparent, translucent or reflective optical part in order to detect aspect defects or structural discontinuities in the optical part or for measuring optical or geometrical properties of the optical part, by means of a testing apparatus comprising at least one lighting means and an associated artificial vision system. The optical part is interposed between the lighting means and the artificial vision system. The lighting means comprises a spatial light modulator (SLM) for producing a stationary luminous background with a definition chart that is made of a plurality of programmable pixels. The individual luminance of each pixel is variable independently of the others with respect to time. The method comprises the steps of:

- consecutively generating, over a defined period of time, a plurality of definition charts, each chart including a periodic pattern that is contrastingly repeated over a uniform background so that the consecutive definition charts are spatially shifted relative to one another;

- collecting a plurality of images, using the artificial vision system, in specular reflection or transmission by the optical part, each image being directly associated with one of the consecutively spatially shifted definition charts;

- combining the plurality of images in the artificial vision system so as to form a single compound image; and,

- extracting inspection or measurement data from the single compound image, wherein:

- the definition charts are generated so that the periodic pattern has a spatial frequency between 0.01 and 100 patterns/mm in a specified direction; and

- two adjacent periodic patterns are separated by an angle between 0.1 and 30 degrees, said angle being measured from a point of the object through which the patterns is observed.

[0018] The periodic pattern may have a spatial frequency between 0.01 and 100 patterns/mm in a specified direction.

[0019] Two adjacent patterns may be separated by an angle between 0.1 and 30 degrees, the angle being measured from a point of the optical port through which the pattern is observed.

[0020] The pattern may be a dot, a spot, a regular or irregular geometrical shape, a horizontal, vertical or diagonal line and any combination of at least two of the foregoing.

[0021] Definition charts with a central symmetry may be used, each pattern comprising the centre of symmetry and being shifted by one angular pitch that is constant relative to the adjacent pattern.

[0022] The single compound image may be obtained by retaining, for each pixel, the minimum grey level or any logical more or less complex combination of the pixels corresponding to the images corresponding to the shifted definition charts.

[0023] The spatial shift of the definition charts may be a translation or rotation shift.

[0024] The spatial light modulator (SLM) may be of a liquid crystal display type (LCD TFT).

[0025] The artificial vision system may comprise a linear or matrix image sensor or camera linked to an image-processing system, or even a direct or indirect projection screen.

[0026] The camera used may be a digital camera of a CCD or CMOS type with an object lens in front.

[0027] The extracted inspection or measurement data may be the reflection effect or the refraction effect.

[0028] A mask or mirror with periodic network may be used as an additional auxiliary optical device.

[0029] A colour of the generated periodic pattern may be adjusted.

[0030] The method may be used for detecting defects that deflect or scatter light, reading moulded or engraved marks, observing discontinuities on the surface of the object or tracing the outline of the object.

[0031] The above method may be used for measuring optical or geometrical properties of a transparent, translucent or reflective object.

[0032] The method may be used for measuring the optical power or the curvature of the optical part.

[0033] The used method may be the black or bright field method, at least partial, the knife-edge method, the alternation of black and white fringes or a use of (an) essentially point-shaped luminous zone(s).

[0034] The extracted inspection or measurement data may be the reflection effect determined by the anisotropic curvature, the slope or the distance of the surface.

[0035] The extracted inspection or measurement data are the refraction effect determined by the optical power through the analysis of the local or global shifts or enlargements.

Brief description of the figures

[0036] Figure 1 very schematically shows the device as in the present invention in the case of the inspection by refraction of an object, for example a lens.

[0037] Figure 2 shows an example image of a lens having appearance defects over a two-dimensional definition chart background, selected from a collection of consecutive images taken with the definition chart that is shifted by a constant pitch in the two main directions, by means of a preferred embodiment of the device as in the present invention.

[0038] Figure 3 shows a resulting image obtained by recombining the images of the type shown in Figure 2 by means of image processing.

Description of a preferred embodiment of the invention

[0039] As very schematically shown in Figure 1, the present invention relates to the use of a spatial light modulator or SLM 1, for example a liquid crystal display(LCD} screen providing in a flexible, variable and precise way a lighting device associated with a camera 2, for example a CCD or CMOS camera, with or without an object lens, in order to inspect an optical object 3, in particular, for example, for detecting defects, reading marks (moulded or engraved), observing discontinuities(edge of the lens) or tracing the outline of a segment of a multifocal lens, measuring optical properties, and to do this by generating suitable definition charts or dots of a suitable size at positions selected ad hoc.

[0040] In the broadest sense, an SLM is a lighting device that allows the digital or analogue control of the light intensity and of the local colour that it produces, transmits or reflects at any point, possibly in a determined direction.

[0041] An SLM is usually an electro-optical device comprising a 1D or 2D, and possibly 3D, network of pixels that can be used in reflection or in transmission and that can be individually and instantly activated by optical, electrical, etc . means. Each of these pixels may modulate the phase and/or the light intensity that is propagated through it or by reflection onto it. Most often, SLMs are produced by using liquid crystal displays (LCDs) but the invention may also be implemented by using an analogue lighting device.

[0042] According to a preferred embodiment of the invention, the installation comprises a system of artificial vision comprising a camera possibly associated with an object lens, a system for image digitalisation and an image processor, this artificial vision system being linked to a programmable LCD display possibly provided with mirrors if necessary in order to extend the observation field. The image of the display is viewed, after reflection or transmission, by the artificial vision system via the camera.

[0043] For example, a CCIR CCD camera with 752x582 pixels provided with an object lens of 50mm focal length will be used. The SLM may be an SVGA LCD display with 800x600 pixels displaying a periodic pattern such as a chequered pattern or contrasted alternating black and white lines, with variable shift. It will be noted that the definition charts are selected at least so that the contrast between the generated pattern and the background of the lighting means is high and so that this generated pattern has clean transitions. For the capture and processing, including the calculation of the maximum, minimum or average of images, etc., a PC will be used with a graphics card and a display card for LCD such as found in the state of the art.

[0044] Figure 2 shows the image of a lens, taken with a device of the above-described type and having appearance defects (circle marked with felt pen, scratches, fingerprints, etc.). Each particular image is taken over the background of a two-dimensional definition chart in the form of a strongly contrasting black and white chequered pattern. The distance between the lens and the support of the definition chart is of the order of 50mm and the distance between the lens and the camera is of the order of 500mm .

[0045] In this particular case, 9 different images were consecutively taken at intervals of about one second. Between one image and the next, the definition chart was shifted by a pitch corresponding to one third of the pattern repeat in the two main directions.

[0046] The recombined image shown in Figure 3 was obtained by retaining the minimum grey level among the 9 possible values for each position (pixel).

[0047] When this device is correctly used, it provides results of very high, even unequalled, quality for detecting appearance defects thanks to the logical, simple and rapid use of the multiple images obtained with suitable definition charts.

[0048] The synchronisation between the system for taking images and the display may be easily created without additional device. With this device, it is possible to vary the type of method used (partial black fields, bright fields, alternating contrasts of black and white, use of several positioning points with adjustment according to the optical power of the product or to the type of defect , etc.).

[0049] For a given type of method, the various adjustments that can be carried out at will on the contrasting definition charts and on the image combinations of these definition charts (analysis) allow to modify the various parameters, affecting for one thing the detection sensitivity and for another the appearance of the defect images depending on their type. This technique allows sensitive classification, identification and detection.

[0050] Optical control can also be achieved by using the principle described under a) above with an advantage in flexibility with regard to the shape and positioning of the light source(s), or by using the principle described under b) above with an advantage in flexibility with regard to the production of one or several patterns and the opportunity to adjust the pitch of the definition chart, to display particular reference points in order to identify the absolute shift of the image observed, which is moreover known only to within about an integer multiple of the pitch of the pattern in the case of a periodic pattern, etc.

[0051] Optical control of the parts may also be achieved by implementing Moiré techniques, the definition charts being chosen to allow the interference phenomenon between, on the one hand, a separate network or the CCD sensor of the control camera and, on the other hand, the pattern displayed.

[0052] Lastly, the properties relating to the colour information may be determined by analysing the grey levels obtained for various colours of the display and any 20 polarisability of the light emitted by the display, as is the case for example with an LCD display, may be exploited in order to verify the properties of the product as a function of its orientation.

[0053] According to the invention, defects of any nature may thus be advantageously detected, the definition charts being chosen in particular according to the scale of the discontinuities or the surface imperfections:

microscopic for diffusing defects, of the order of 0.1mm in size for most defects of surface distortion due to inclusions or marks, or even several mm or more for particular surface deformations.

CLAIMS

1. A method for inspecting a transparent, translucent or reflective optical part (3) in order to detect aspect defects or structural discontinuities in said optical part (3) or for measuring optical or geometrical properties of said optical part (3), by means of a testing apparatus comprising at least one lighting means (1) and an associated artificial vision system (2), the optical part (3) being interposed between the lighting means (1) and the artificial vision system (2), the lighting means (1) comprising a spatial light modulator (SLM) for producing a stationary luminous background with a definition chart that is made of a plurality of programmable pixels, the individual luminance of each pixel being able to vary independently of the others with respect to time, said method comprising the steps of :

- consecutively generating, over a defined period of time, a plurality of definition charts, each chart including a periodic pattern that is contrastingly repeated over a uniform background so that the consecutive definition charts are spatially shifted relative to one another ;
- collecting a plurality of images, using the artificial vision system (2), in specular reflection or transmission by the optical part (3), each image being directly associated with one of the consecutively spatially shifted definition charts ;
- combining the plurality of images in the artificial vision system (2) so as to form a single compound image; and,

- extracting inspection or measurement data from the single compound image,

wherein:

- the definition charts are generated so that the periodic pattern has a spatial frequency between 0.01 and 100 patterns/mm in a specified direction; and

- two adjacent periodic patterns are separated by an angle between 0.1 and 30 degrees, said angle being measured from a point of the optical part through which the periodic patterns are observed.

2. Method as in Claim 1, wherein the pattern used is selected from the group consisting of a dot, a spot, a regular or irregular geometrical shape, a horizontal, vertical or diagonal line and any combination of at least two of these elements.

3. Method as in Claim 1, wherein definition charts with a central symmetry are used, each pattern comprising the centre of symmetry and being shifted by one angular pitch that is constant relative to the adjacent pattern.

4. Method as in Claim 1, wherein the single compound image is obtained by retaining for each pixel the minimum grey level or any logical more or less complex combination of the pixels corresponding to the images corresponding to the shifted definition charts.

5. Method as in any one of claims 1 to 4, wherein the spatial shift of the definition charts is a translation or rotation shift.

6. Method as in Claim 1, wherein the spatial light modulator (SLM) is of a liquid crystal display type (LCD TFT).

7. Method as in any one of claims 1 to 6, wherein the artificial vision system used comprises a linear or matrix image sensor or camera linked to an image-processing system, or even a direct or indirect projection screen.

8. Method as in Claim 7, wherein said camera used is a digital camera of a CCD or CMOS type with an object lens in front.

9. Method as in any one of Claims 1 to 8, wherein the extracted inspection or measurement data are the reflection effect or the refraction effect.

10. Method as in any one of Claims 1 to 9, wherein a mask or mirror with periodic network is used as additional auxiliary optical device.

11. Method as in any one of Claims 1 to 10, wherein a colour of the generated periodic pattern can be adjusted.

12. Method as in any one of Claims 1 to 8, for detecting defects that deflect or scatter light, reading moulded or engraved marks, observing discontinuities on the surface of the object or tracing the outline of the object.

13. Method as in any one of Claims 1 to 12, for measuring the optical power or the curvature of the optical part.

14. Method as in Claim 13, wherein the used method is the black or bright field method, at least partial, the knife-edge method, the alternation of black and white fringes or a use of (an) essentially point-shaped luminous zone(s).

15. Method as in Claim 9 wherein the extracted inspection or measurement data are the reflection effect determined by the anisotropic curvature, the slope or the distance of the surface.

16. Method as in Claim 9 wherein the extracted inspection or measurement data are the refraction effect determined by the optical power through the analysis of the local or global shifts or enlargements.

Application number / Numéro de demande: 2567095

Figures: 2, 3

Pages: 2/2

Unscannable items received with this application
(Request original documents in File Prep. Section on the 10th floor)

Documents reçu avec cette demande ne pouvant être balayés
(Commander les documents originaux dans la section de la préparation des dossiers au 10ième étage)

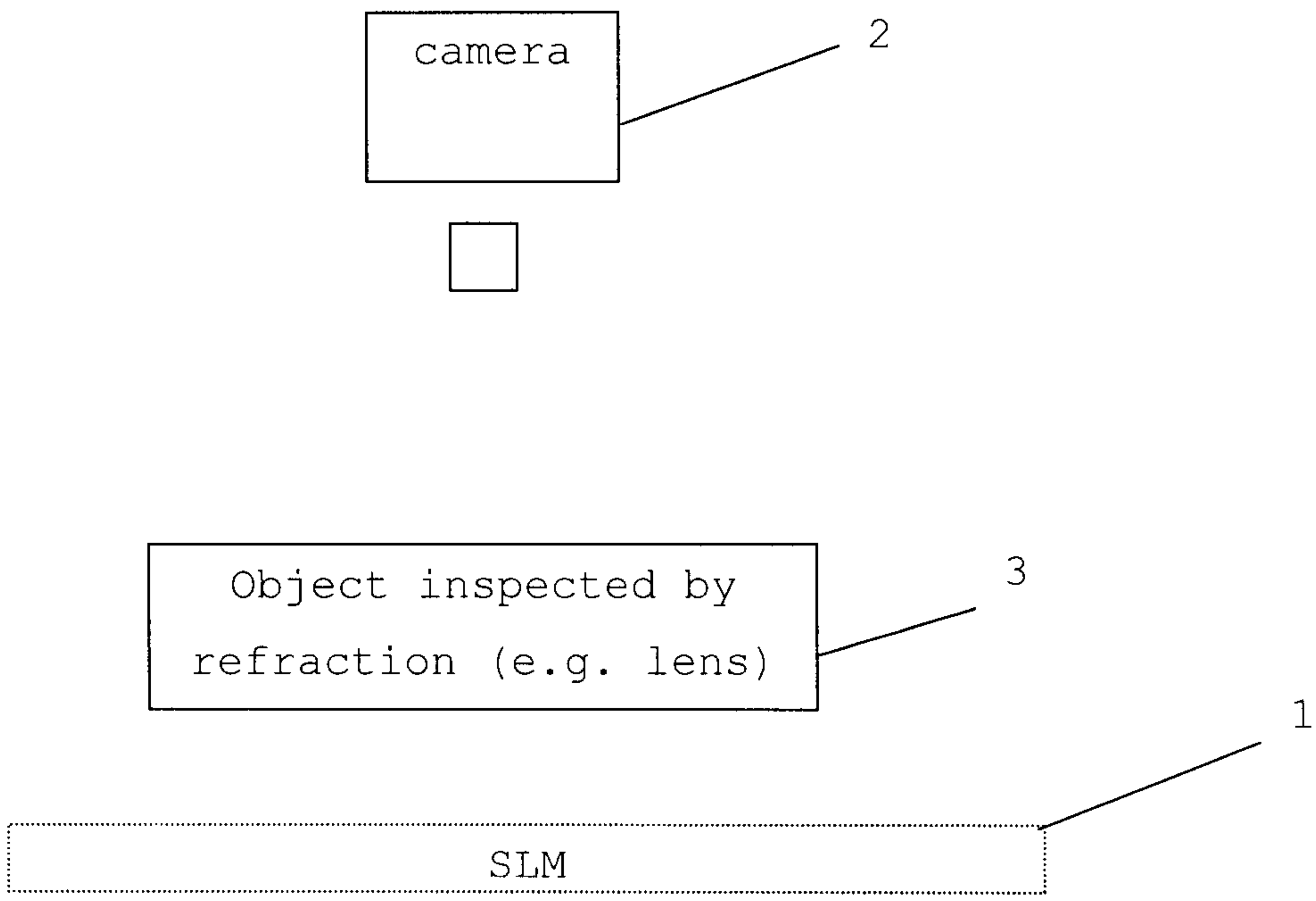
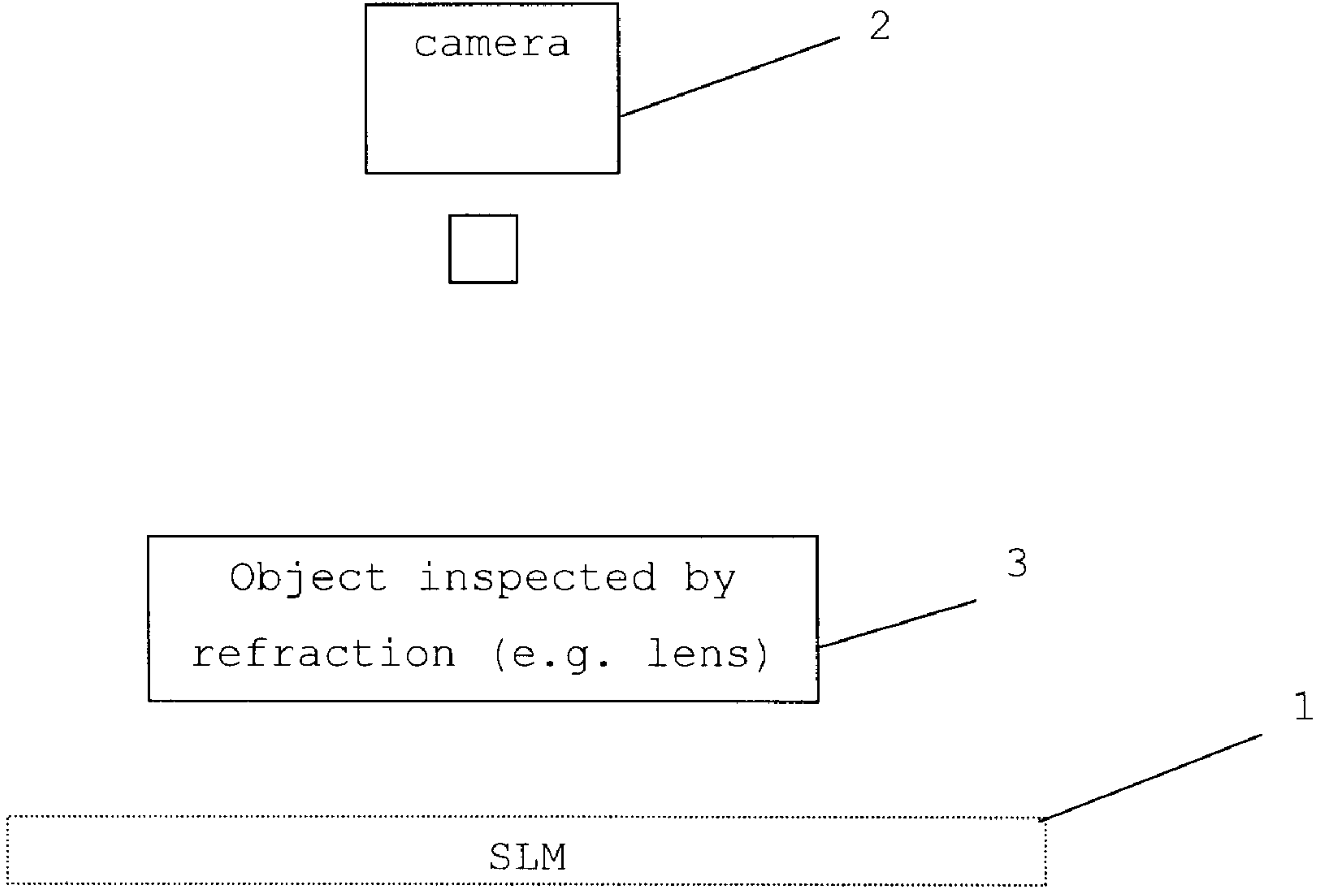


FIG.1


camera
2
Object inspected by refraction (e.g. lens)
3
1
SLM