"IMAGE-TAKING OPTIMISATION DEVICE, METHOD AND OPTICAL COMPONENT THEREFOR"

TECHNICAL FIELD

The present invention relates, in general, to image-taking optimisation devices and to optical components included in said devices.

In particular, the present invention relates to devices provided with photo-detecting elements with pixel-board processing.

PRIOR ART

Image-taking apparatuses such as digital cameras, digital camcorders, low light digital camcorders (L3TV – Low Light TeleVision) and the like are generally known.

Said apparatuses include, in general, optical devices including an optical element (objective), suitable for focusing an image (optical information) on a focal plane, generally having a flat surface and being situated at a fixed or variable distance from the objective itself, and analogue or analogue/digital photo-detecting elements placed in the focal plane of the objective.

Moreover, according to prior art, generally the photo-detecting elements substantially lack in whatever individual ability of processing the optical information received through the objective, so that the information that can be got by means of said optical devices is substantially equivalent to the information that could be got by means of image-taking apparatuses employing photo-sensitive films.

The applicant has found out that the need of a more effective handling of the information content of the image focused by the objective on the focal plane is continuously increasing.

As a matter of fact, this need is justified by the fact that, associating a suitable processing ability to each photo-sensitive element, it is possible to handle the image point by point and to determine, for instance, the distance, the spectrum features or other features thereof. As it will be easily understood by the person skilled in the art, the possibility of handling point by point the information content of an image can lead to surprising results, such as the possibility of taking 3D images, of making spectrum analysis, and so on.

In order to satisfy this need, photo-detecting elements called photo-detecting elements with pixel-board processing have been produced, such photo-detecting elements comprising a real photo-sensitive element 46 (see Figure 1a) and one ore more analogue or analogue/digital circuit elements 48.

The photo-detecting elements with pixel-board processing, that for sake of simplicity will be called PEP (Photo-detecting Elements with pixel-board Processing), suffer the drawback that the area (RA_{pixel}) covered by the real photo-sensitive element 46 turns to be much smaller than the total area, i.e. the sum of (RA_{pixel}) and of the area ($RA_{circuits}$) covered by the circuit elements 48 and determines a so-called fill factor η, defined as

$$\eta = RA_{pixel}/(RA_{circuits}+RA_{pixel}) .$$

The fill-factor, in general, provides for an indication of the exploited portion in percentage of the optical information collected by the objective 110 when, as in prior art, the PEP are placed on the focal plane.

By way of example, if a photo-sensitive element having an area RA_{pixel}=10x10 μm^2 is placed side by side with a control circuit covering for instance an area $RA_{circuits}$=70x70 μm^2, the fill factor will be:

$$\eta = 10x10/(70x70+10x10) = 1/50 = 2\%$$

Hence, the spectral sensibility of the PEP falls down to 2%. If, for instance, the reference value of the spectral sensibility were 500 mA/W, the operation value would be of about 10 mA/W.

This simple example clearly demonstrates, in the Applicant's opinion, how a low fill factor makes the PEP useless or scarcely interesting as to applications, notwithstanding the need of employing them.

In short, the Applicant notes that, in spite of the need of employing PEP in view to possible uses and surprising results, at present no effective technical solution has been developed for allowing the use of said elements in the typical use conditions of the image-taking apparatuses.

DISCLOSURE OF THE INVENTION

It is an object of the present invention to solve the above-captioned problems of the prior art.

According to the present invention, this object is accomplished by the image-taking device and the corresponding optical component as claimed in the appended claims.

The present invention further relates to a method for image-taking optimisation.

The appended claims are an integral part of the technical teachings herein provided with reference to the invention.

According to a preferred embodiment of the invention, the image-taking optimisation device includes at least an optical component placed on the focal plane of an objective and suitable for concentrating the image present on the focal plane on the real photo-sensitive elements of a photo-detecting element with pixel-board processing.

According to another feature of the present invention, the optical component comprises a plurality of frusto-conical or frusto-pyramidal optical elements for concentrating the image on the real photo-sensitive elements by reflection.

According to another feature of the present invention, in an alternative embodiment of the invention, the optical component comprises optical elements having at least a pair of lenses, for instance GRIN (Graded Index) lenses, in cascade arrangement, suitable for concentrating the image on the real photo-sensitive elements by refraction.

According to another embodiment of the invention, simplified and less effective, but still advantageously employable with respect to the total absence of concentration of the image, the optical component is a flat-convex lens suitable for concentrating the image on the photo-sensitive elements by refraction.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the present invention will become evident from the following description of a preferred embodiment, given by way of non limiting example, with reference to the attached drawings, wherein elements denoted with a same or similar numeral designate components having a same or similar function and structure:

- Figure 1a shows an example of photo-detecting element with pixel-board processing;
- Figure 1b shows an image-taking optimisation device according to the invention;
- Figures 2a,2b and 2c show examples of optical elements suitable for the manufacturing of the device shown in Figure 1b; and
- Figure 3 schematically shows the image transfer effect that can be obtained with the components of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

With reference to Figure 1b, an image-taking device (device) 10 according to the invention includes an objective 110, of known type, having a certain numerical aperture and suitable for focusing on a focal plane 12 (see Figure 1a, Figure 1b) an image (optical information), formed by light rays (rays) a, b, c (see Figure 2a, Figure 2b, Figure 2c) having a maximum angular aperture, and a plurality of photo-detecting elements with pixel-board processing (PEP or Photo-detecting Elements with pixel-board Processing) 112, of the known type, preferably shaped as an array or a chip (chip) 120 of PEP, for instance a square or rectangular chip.

Preferably, each PEP 112 includes a real photo-sensitive element 46 having a certain area RA_{pixel} and a circuit element 48 having a certain area $RA_{circuits}$ and comprising one or more control circuits.

According to a preferred embodiment of the invention, an optical component (concentrators plate or plate) 100 is placed in the focal plane 12, interposed, for instance, between the focal plane 12 and the chip 120; said chip 120, in the preferred embodiment of the invention, is placed on a chip plane 125 different from the focal plane 12.

The plate 100 has the function of concentrating on the chip plane 125, and more particularly on the real photo-sensitive element 46 of the chip 120, the image present on focal plane 12, as it will be disclosed later on in detail.

The concentrators plate 100 can be shaped as a component including a first base (inlet plane) 55 (see Figure 1b, Figure 3) in the focal plane 12 and a second base (outlet plane) 56 on the chip plane 125.

According to a preferred embodiment of the invention, the concentrators plate 100 includes a plurality of micro-concentrators (concentrators) 41, preferably as many as the PEP 112. Each concentrator 41 includes an optical inlet 51, having a certain optical area A_{pf}, in the first base 55 and an optical outlet 53, having a certain area A_{pixel} in the second base 56, smaller than the area A_{pf} and, preferably, substantially equivalent to the area of the real photo-sensitive element 46.

The optical inlets 51, adjacent to each other, are preferably shaped so as to “cover” the surface of the focal plane 12.

Each optical outlet 53 is preferably placed on a corresponding real photo-sensitive element 46, so as to obtain a bi-univocal correspondence between the optical inlets 51 “covering” the surface of the focal plane 12 and the real photo-sensitive elements 46.

Each concentrator 41 is shaped so as to concentrate the optical information focused by the objective 110 on a corresponding real photo-sensitive element 46, as it will be disclosed later on in detail.

In a first embodiment of the invention, each concentrator 41 includes an optical element 141 having, for instance, the shape of a frusto-cone (frusto-conical shape) 21 (see Figure 2a, Figure 2b) or of a frusto-pyramid (frusto-pyramidal shape) 11.

The optical element 141, made of a suitable optical material, for instance glass or plastics (polymer), and having a suitable height, for instance comprised between 100 and 500 μm, between optical inlet 51 and optical outlet 53, includes lateral walls shaped so as to concentrate on the chip plane 125 the image present on the focal plane 12, by reflection of the light rays.

In short, each optical element 141, having for instance frusto-conical 21 or frusto-pyramidal 11 shape, is shaped so as to concentrate by reflection on the corresponding real photo-sensitive element 46 the rays incident on the focal plane 12.

For instance, if each single concentrator has a surface A_{pf} of 70x70 μm^2, in the optical inlet 51, and a surface A_{pixel} of 10x10 μm^2, on the optical outlet 53, each concentrator could concentrate the information content of the optical information from the focal plane 12 to the chip plane 125 on each corresponding real photo-sensitive element 46 without any loss of optical information.

In order to further explain the above disclosed embodiment and making reference in particular to the optical elements 141 with frusto-conical shape 21, it can be pointed out that the manufacturing constraints of the concentrator 41, associated for instance to the definition of an interior angle α_{int} to be associated to the optical element 141, are generally imposed by the angular aperture α of the rays coming from the objective 110.

In fact, as it can be easily understood by the person skilled in the art, given a numerical aperture of the rays

$NA = \sin \alpha$;

and being:

$NA = R/\sqrt{(F^2+R^2)}$;

wherein

2 x R= diameter of the objective 110, e

F= focal length of the objective 110,

the rays can be concentrated by a factor:

$C = A_{pixel}/A_{pf}$;

which, as it will be easily understood by the person skilled in the art, is equal, at its maximum, to the inverse square of the numerical aperture of the objective 110.

In other words, the limit of concentration that can be achieved is

$C = 1/NA^2$.

For obtaining this value, the optical element 141 with frusto-conical shape 21 must have a summit angle not greater than a certain maximum that is substantially equal – as it results from a numerical evaluation – to the interior angular aperture of the optical element 141 of frusto-conical shape 21 itself:

$\alpha_{int} = \arcsin NA/n$;

wherein n is the refraction index of the material of the optical element 141.

Lower values of the interior angle α_{int}, as it will be easily understood by the person skilled in the art, improve the gathering of the rays but they lead to very long optical elements 141 and, consequently, to cumbersome optical components 100, while higher values of the interior angle α_{int} lead to more compact optical components 100, but also to a loss in the gathering of the rays.

By way of practical example, if $\alpha=19°$ and $NA=\sin\alpha=0.33$, the rays can be concentrated up to C=1/0.332=11 times; using, for instance, an optical element 141 made of glass, a summit angle of $\alpha_{int}=\arcsin 0.33/1.45 = 13°$ will be used, and, consequently, a prism having a length of about four times the semi-difference of the bases, that will have a length of W and W x NA = 0.33W respectively.

The first embodiment has been illustrated making reference to optical elements 141 having frusto-conical 21 and frusto-pyramidal 11 shape.

Actually, for obtaining the maximum effectiveness in the rays concentration, the optical element 41 should theoretically have a frusto-conical shape with parabolic generatrix (theoretical shape). Nevertheless, owing to the micrometric dimensions, the applicant considers that the suggested shapes, corresponding to a linear approximation of the theoretical shape, are appropriate for the purpose of concentrating the rays.

The first embodiment of the invention, disclosed above in detail, can also be improved facilitating the concentration of the rays on the real photo-sensitive elements 46 by means of a metalled coating applied to the walls of the optical elements 141 with frusto-conical 21 or frusto-pyramidal 11 shape.

Such a solution, indeed, as it will be easily understood by the person skilled in the art, allows to increase the recovery of effectiveness of the optical element 141 employed.

In a second embodiment of the invention, each concentrator 41 (see Figure 2c) includes an optical element 141 obtained, for instance, employing elements or optical systems of the GRIN (GRaded INdex) type, for instance with quarter-pitch (re-focalisation period or pitch) features and placed, for instance, in cascade arrangement. Such a solution, as it will be easily understood by the person skilled in the art, allows to obtain a concentrator 41 based on refraction.

According to this second embodiment of the invention, it is possible, for instance, to place a first GRIN optical system or GRIN lens (first optical system) 31, for instance with a focal length or re-focalisation length P1, at optical inlet 51 in the focal plane 12, and a second GRIN optical system or GRIN lens (second optical system) 32, having a focal length P2 = (P1 x η), wherein η is the fill-factor as already discussed above, at a distance of P1/4 from the first optical system 31.

Even this second embodiment of the invention allows, as it will be easily understood by the person skilled in the art, to concentrate the information content of the optical information from the optical inlet 51 on the focal plane 12 to the optical outlet 53 on each corresponding real photo-sensitive element 46 without any loss of optical information.

Indeed, as known in the art, each GRIN lens, 31 and 32 in the example, periodically re-focalises a beam of rays that is applied thereto, for instance along an axis orthogonal to the lens and facing a face thereof (inlet face), respectively 33 and 34 in the example.

The re-focalisation length or period or pitch, respectively P1 and P2 in the example, is a characteristic of each GRIN lens.

With reference to this second embodiment of the invention, if, for instance, a cylinder of GRIN lens having a length equal to a quarter of pitch of the first GRIN lens (P1/4) is used, a beam of rays having an angular aperture α in the inlet face 33 of the first GRIN lens 31 is converted, at the outlet, in a spatial distribution having a width

$r = \alpha \times P1/4$;

and at the outlet the rays are parallel to the axis orthogonal to the lens (axis).

If now the second GRIN lens 32 is placed in cascade arrangement to the first one, with a lower pitch P2, always using a length of a quarter of pitch (P2/4), a beam of rays contained in an angle α_0 greater than the initial angle is obtained on the optical outlet 53, placed at P2/4, said angle turning out to be $\alpha_0 = \alpha \times (P1/P2)$.

In the same way, by applying in the inlet of the two GRIN lenses 31 and 32 a beam of rays parallel to the axis and contained within a width r, after the first GRIN lens 31 a beam focalised on the axis and contained in an angle

$$\alpha = r/(P1/4)$$

is obtained; and after the second GRIN lens 32, again a beam of rays parallel to the axis and contained in a width

$$r_0 = r \times (P2/P1)$$

is obtained; wherein r_0 is a radius of size equal or substantially equivalent to the size of the real photo-sensitive element 46.

Thus, a concentration factor P2/P1 in the linear dimension and $C = (P2/P1)^2$ in optical power has been obtained, C having even in this case a maximum value equal to the inverse square of the numerical aperture of the incoming beam

$$NA = \sin \alpha,$$

still depending on the kind of objective 110 employed, i.e.

$$NA = R/\sqrt{(F^2+R^2)}.$$

Finally, in a third possible embodiment of the invention, each concentrator simply consists in an array of flat-convex lenses. Each lens collects the radiation of the objective 110 and focalises it on the real photo-sensitive element 46. In this case the concentration factor is still equal to the inverse square of the numerical aperture of the incoming beam $1/NA^2$ but multiplied by the square of the numerical aperture of the employed lens NA^2_L.

As it will be easily understood by the person skilled in the art, this solutions turns out to be convenient in all those cases wherein it is possible to obtain a square of the numerical aperture of the incoming beam NA^2_L sufficiently close to 1.

In the practical application of the invention, the maximum value of the concentration factor $1/NA^2$ does not represent a limitation.

In short, both the first and the second embodiment of the invention (see Figure 2a, Figure 2b, Figure 2c) allow to avoid any loss of optical information, with the only difference that in the first embodiment the incoming light rays are led to the optical outlet 53 of the concentrator 41 by total reflection on the lateral walls of the frusto-cones 21 or of the frusto-pyramids 11, while in the second and third embodiments the rays are led to the outlet by refraction in the used optical systems, such as the GRIN lenses 31 and 32 or the array of flat-convex lenses.

The manufacturing of the concentrators plate 100 according to the first embodiment of the invention, both in case it includes optical elements 141 having frusto-conical shape 21 and in case it includes optical elements 141 having frusto-pyramidal shape 11, can be preferably carried out through techniques of simultaneous manufacturing of single elements 141, considered that, in general, for the applications in the image-taking apparatuses the chip 120 includes a large number of PEP 112, typically from 20 x 20 = 400 in a small size array up beyond 500 x 500 = 250.000, for instance, in an array for video equipment.

The technological processes that may be employed for manufacturing in a simultaneous manner the concentrator plate 100 can be chosen for instance among the following ones:

i. hot forming: this process provides, for instance, that parallelepipeds in thermoplastic material (e.g. poly-methyl-methacrylate, and the like) undergo a mechanical axial stress and that, simultaneously, a base undergoing said axial stress is heated to the plasticity temperature; said kind of process allows to give to the thermoplastic material the frusto-pyramidal shape 11;

ii. moulding: this process provides that a thermoplastic resin is poured in a mould, for instance made in Nickel, that has, in negative, the shape of the plate 100 to be manufactured, either frusto-pyramidal 11 or frusto-conical 21;

iii. selective etching: this process can be carried out by selectively etching, for instance with hydrofluoric acid, crown glass cylinders placed side by side; the same process can also be carried out by selectively etching a crystalline semiconductor material, for instance silicon; the selective etching allows, in the first case, to impart to the crown glass a frusto-pyramidal 11 or similar shape and, in the second case, of exploiting the crystallographic layers of the crystalline semiconductor as generators of the optical elements 141 with frusto-pyramidal 11 or similar shape.

In order to describe the operation of the device 10 according to the invention and of the corresponding optical component 100, reference is made to the embodiment shown in Figure 2a, wherein an example of optical elements 141 having frusto-pyramidal shape 11 is illustrated. Nevertheless, as it will be easily understood by the person skilled in the art, the same operating features can be retrieved also in the other embodiments disclosed.

The device 10 and the corresponding optical component 100 operate as follows.

The image taken by the objective 110 is collected on the focal plane 12 of the objective 110 itself, so as to obtain an array of optical inlets 51, each having an area A_{pf}.

Reference is made, by way of example only, to three rays a, b, c, incident on the area A_{pf}, which, according to the prior art, could not be collected in the area A_{pixel}. Said rays, thanks to the internal total reflection of the concentrator 41, are reflected one or more times and they reach the area A_{pixel} of the frusto-pyramid 11.

According to the above disclosure, the image collected by the objective 110 on the array of optical inlets 51 with an area A_{pf} is concentrated on a corresponding array of optical outlets 53, wherein each optical outlet 53 has an area A_{pixel} smaller than A_{pf} and corresponding, according to a preferred embodiment of the invention, to the area RA_{pixel} of the real photo-sensitive element 46 of the chip 120.

According to the present example of carrying out the invention, the fill factor, which without the optical component 100 would be

$$\eta = RA_{pixel}/(RA_{pf}+RA_{pixel}),$$

becomes substantially equal to 1.

It is evident that, for making possible the concentration of the rays a, b and c shown in Figure 2a, the interior angular aperture α_{int} of each optical element 141 with frusto-pyramidal shape 11 should be small and defined, for instance, in the manner indicated in the description and the incoming rays on the focal plane 12 of the objective 110 should not be too inclined with respect to an axis orthogonal to the focal plane 12 itself.

Indeed, too inclined rays, as it will be easily understood by the person skilled in the art, are refracted off the single concentrator 41instead of undergoing a total reflection and being concentrated on the single real photo-sensitive element 46.

Another reason according to which the recovery can have a high value is that in the current practice it is necessary to assure a good depth of focus of the image formed on the focal plane and this is normally achieved by reducing the numerical aperture of the objective.

Indeed, as well known, the depth of focus is given by $p = \lambda \times (F/R)^2$ wherein λ is the (average) wavelength of the employed illumination.

By fixing, for instance, p= 5 μm with λ = 0.5 μm, $(F/R)^2$= 10 is obtained, i.e. NA= 0.31. A recovery of the fill factor $1/NA^2$= 10 corresponds to said value of NA.

In other embodiments of the invention, wherein the numerical aperture is limited to values of NA = 0.1, …, 0.2, it is possible to obtain even higher concentration factors, in the order of 100, …, 25, with a corresponding higher recovery of the fill factor η.

Therefore, in any case, however the optical component 100 and the concentrators array 41 are obtained, the device 10 as disclosed allows the array of PEP 112 to recover spectral sensibility, without the need of increasing the sensibility of the real photo-sensitive elements 46.

In short, the device 10, thanks to the presence of at least one optical component 100 suitable for concentrating on the real photo-sensitive elements 46 the image or optical information collected by the objective allows to use substantially the whole information content of the optical information by the photo-detecting elements with pixel-board processing 112.

The above disclosed device 10 includes an optical component 100 having as many concentrators 41 as the photo-detecting elements with pixel-board processing 112 on the chip 120.

In other embodiments of the invention, as it will be easily understood by the person skilled in the art, it will be also possible to provide that the concentrators plate includes a number of concentrators lower than the photo-detecting elements with pixel-board processing 112, for instance located so as to concentrate the optical information on a central area only of the chip, or even on the whole area but selectively “covering” a pre-defined number of photo-detecting elements with pixel-board processing 112.

In the above disclosure concentrators 41 suitable for working by reflection or by refraction have been illustrated.

In other embodiments of the invention, as it will be easily understood by the person skilled in the art, the concentrators could be obtained by combining, for instance, in the single concentrators optical elements working by reflection and optical elements working by refraction without departing from the scope of the disclosed and claimed invention.

In the above disclosure, reference has been made to a focal plane 12 having a flat surface.

It is herein specified that in other embodiments of the invention, as it will be easily understood by the person skilled in the art, the focal plane can have, for instance, a non flat surface and that the wording “focal plane” used in the above disclosure should be intended as a not necessarily flat surface onto which the objective projects or collects an image.

Obviously, without prejudice of the principles underlying the present invention, the details and the embodiments thereof can vary, even significantly, with respect to what has been herein disclosed, by way of example only, without departing from the invention as defined by the appended claims.

CLAIMS

1. Device for optimising image- or optical-information-taking comprising:

- an objective (110) arranged for focalising the optical information on the focal plane (12); and
- at least one chip (120) comprising a plurality of photo-detecting elements with pixel-board processing (112) arranged for processing the optical information and including at least one corresponding photo-sensitive element (46) and at least one corresponding circuit element (48);

characterised by

- at least one optical component (100) comprising a plurality of optical elements (141) shaped so as to collect at least one portion of said optical information present in said focal plane (12) and to concentrate said at least one portion of optical information on at least one portion of said photo-sensitive elements (46).

2. Device according to claim 1, characterised in that said at least one optical component (100) is interposed between said objective (110) and said at least one chip (120).

3. Device according to claim 1 or 2, characterised in that said optical elements (141) are shaped so as to concentrate said optical information by reflection and/or by refraction on said photo-sensitive elements (46).

4. Device according to any one of claim 1 to 3, characterised in that said optical elements (141) comprise optical inlets (51) in said focal plane (12) and optical outlets (53) on said photo-sensitive elements (46).

5. Device according to claim 4, characterised in that said optical elements have a shape chosen among the following:

- frusto-conical;
- frusto-pyramidal;

and comprise a first base having a first optical area (A_{pf}) in said optical inlet (51) and a second base having a second defined optical area (A_{pixel}), smaller than said first area (A_{pf}), on said optical outlet (53).

6. Device according to claim 4, characterised in that said optical elements (141) comprise at least one pair of lenses (31,32) wherein at least one of said lenses (31) is placed in said optical inlet (51) and in that said lenses (31,32) are shaped so as to refract and concentrate said optical information onto said optical outlet (53).

7. Method for optimising image- or optical-information-taking through a chip (120) having a plurality of photo-detecting elements with pixel-board processing (112), said plurality of photo-detecting elements including at least one corresponding photo-sensitive element (46) and at least one corresponding circuit element (48),

the method comprising the step of

- collecting the optical information in a focal plane (12); and being characterised by the step of

- concentrating by means of an optical component (100) on at least one portion of said photo-sensitive elements (46) the optical information collected in said focal plane (12).

8. Method according to claim 7, characterised in that said step of concentrating the optical information comprises the step of acting on said optical information by reflection or by refraction.

9. Optical component (100) for concentrating images or optical information from an inlet plane (55) to an outlet plane (56) characterised in that it comprises a plurality of optical elements (141) having an optical inlet (51) with a first optical area (A_{pf}) in said

inlet plane (55) and an optical outlet with a second optical area (A_{pixel}), smaller than said first area (A_{pf}), on said outlet plane (56), said elements being shaped so as to optically concentrate on said second optical area (A_{pixel}) at least one portion of the optical information present in said first optical area (A_{pf}).

10. Optical component according to claim 9, characterised in that said optical elements (141) are shaped so as to concentrate said optical information by reflection and/or by refraction.

11. Optical component according to claim 9 or 10, characterised in that

- said inlet plane (55) corresponds to a focal plane (12); and in that
- said outlet plane (56) corresponds to a chip of photo-detecting elements with pixel-board processing (112) comprising corresponding photo-sensitive elements (46), having an area (RA_{pixel}) substantially equivalent to said second optical area (A_{pixel}), and at least one corresponding circuit element (48).

12. Optical component according to any one of claims 9 to 11, characterised in that said optical elements have a shape chosen among the following:

- frusto-conical shape;
- frusto-pyramidal shape.

13. Optical component according to any one of claims 9 to 11, characterised in that said optical elements (141) comprise at least a pair of lenses (31,32) wherein at least one of said lenses (31) is placed in said optical inlet (51) and in that said lenses (31,32) are shaped so as to refract and concentrate the optical information on said optical outlet (53).

14. Optical component according to any one of claims 9 to 11, characterised in that it is made of glass or polymer material.

15. Optical component according to any one of claims 9 to 12, characterised in that it

is realised through a hot forming process wherein parallelepipeds in thermoplastic material are subjected to a mechanical axial stress and, simultaneously, a base of said parallelepipeds, subjected to said axial stress, is heated to a temperature corresponding to the plasticity temperature of said thermoplastic material.

16. Optical component according to any one of claims 9 to 12, characterised in that it is obtained through a moulding process wherein a thermoplastic resin is poured in a mould having in negative the shape of the component (100).

17. Optical component according to any one of claims 9 to 12, characterised in that it is obtained through a selective etching process of crown glass cylinders placed side by side or of a crystalline semiconductor material.

"IMAGE-TAKING OPTIMISATION DEVICE, METHOD AND OPTICAL COMPONENT THEREFOR"

ABSTRACT

The present invention relates, in general, to devices for optimising image-taking, to optical components comprised in said devices and to a method for optimising image-taking in applications wherein photo-detecting elements with pixel-board processing are provided. The device comprises an objective (110) arranged for focalising the image or optical information on a focal plane (12) and at least one chip (120) of photo-detecting elements with pixel-board processing (112) having photo-sensitive elements (46) and circuit elements (48). The device further comprises at least one optical component (100) having a plurality of concentrators (41) and corresponding optical elements shaped so as to collect the optical information present in the focal plane (12) and concentrate said optical information on the photo-sensitive elements (46).

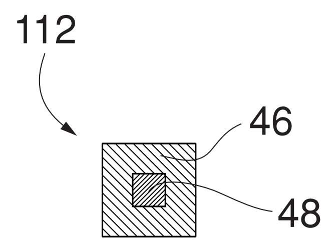

Fig. 1a

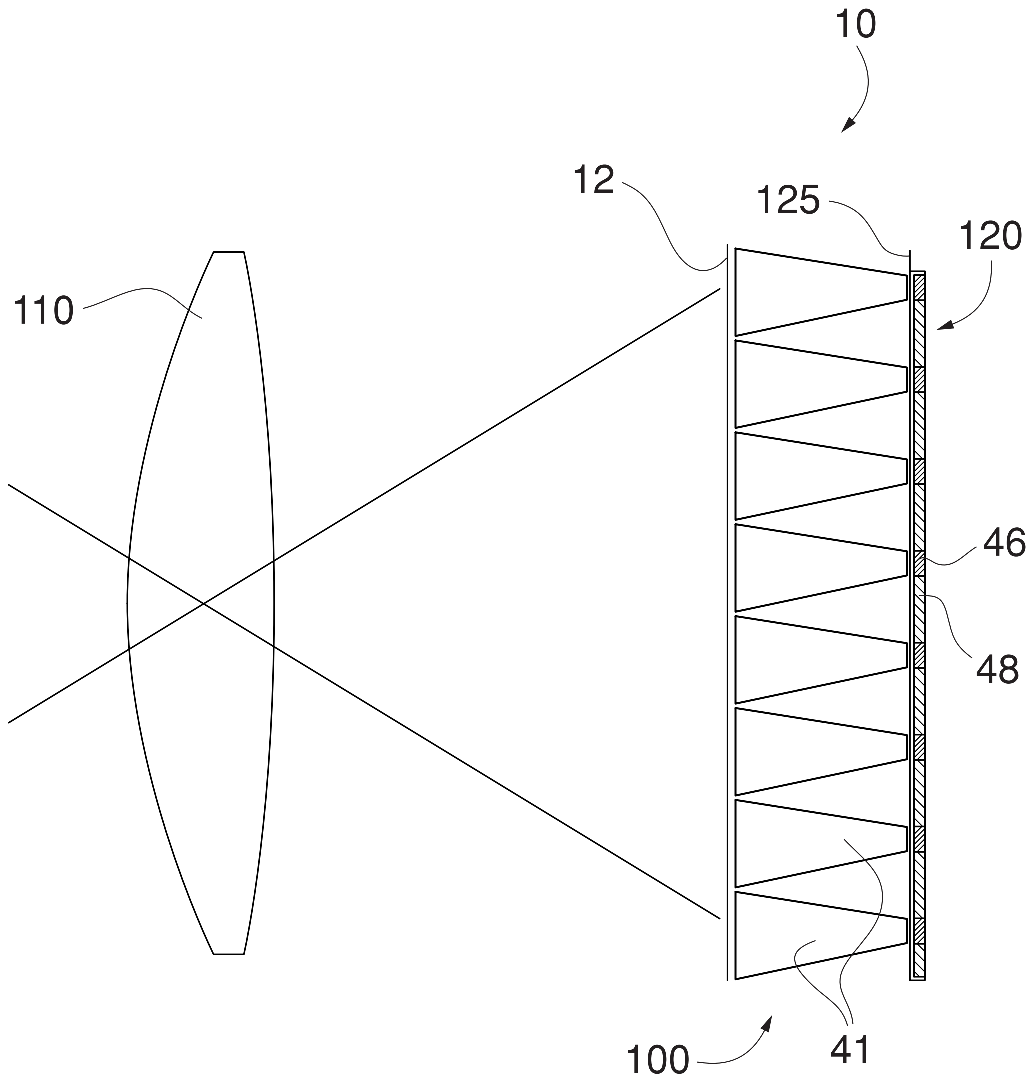

Fig. 1b

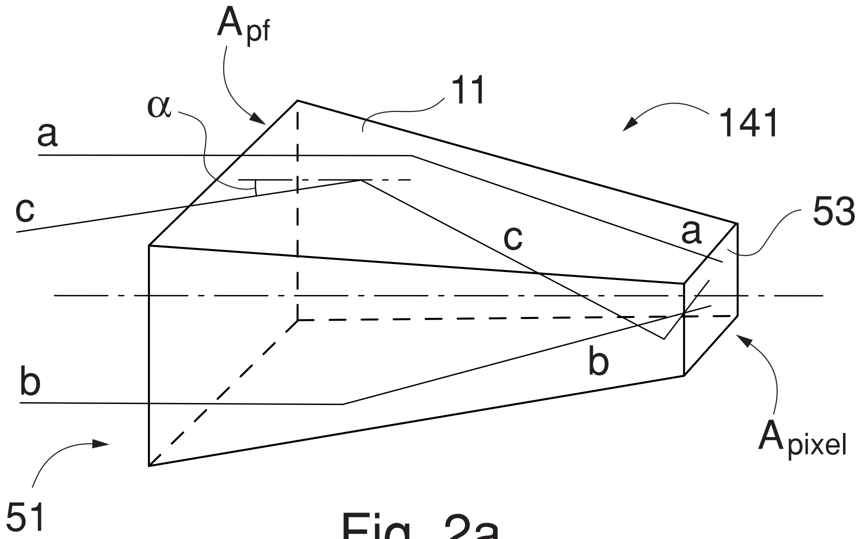

Fig. 2a

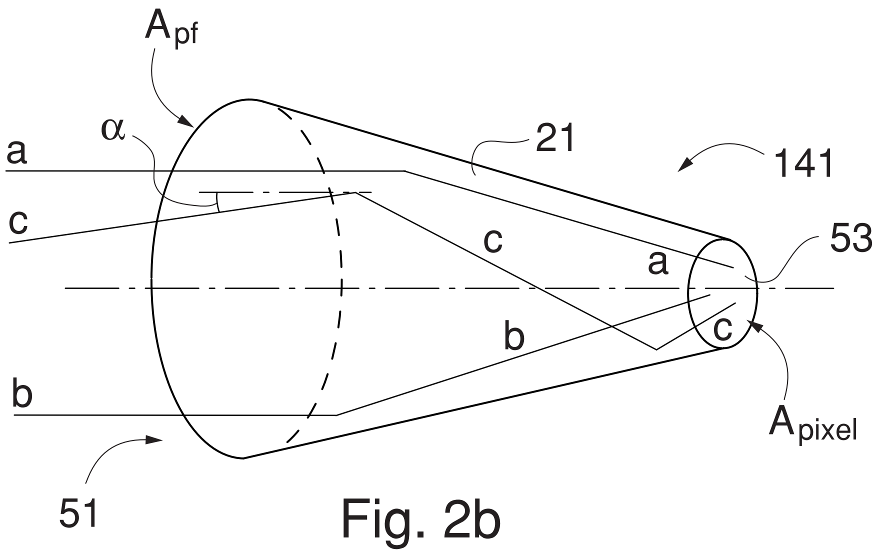

Fig. 2b

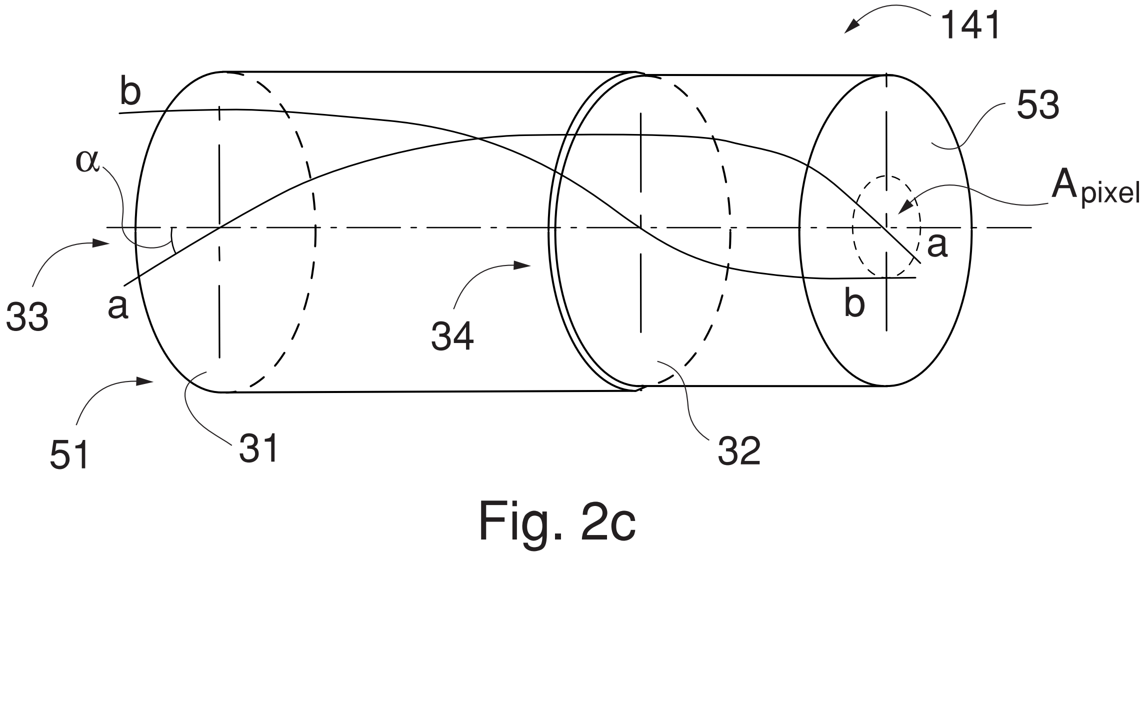

Fig. 2c

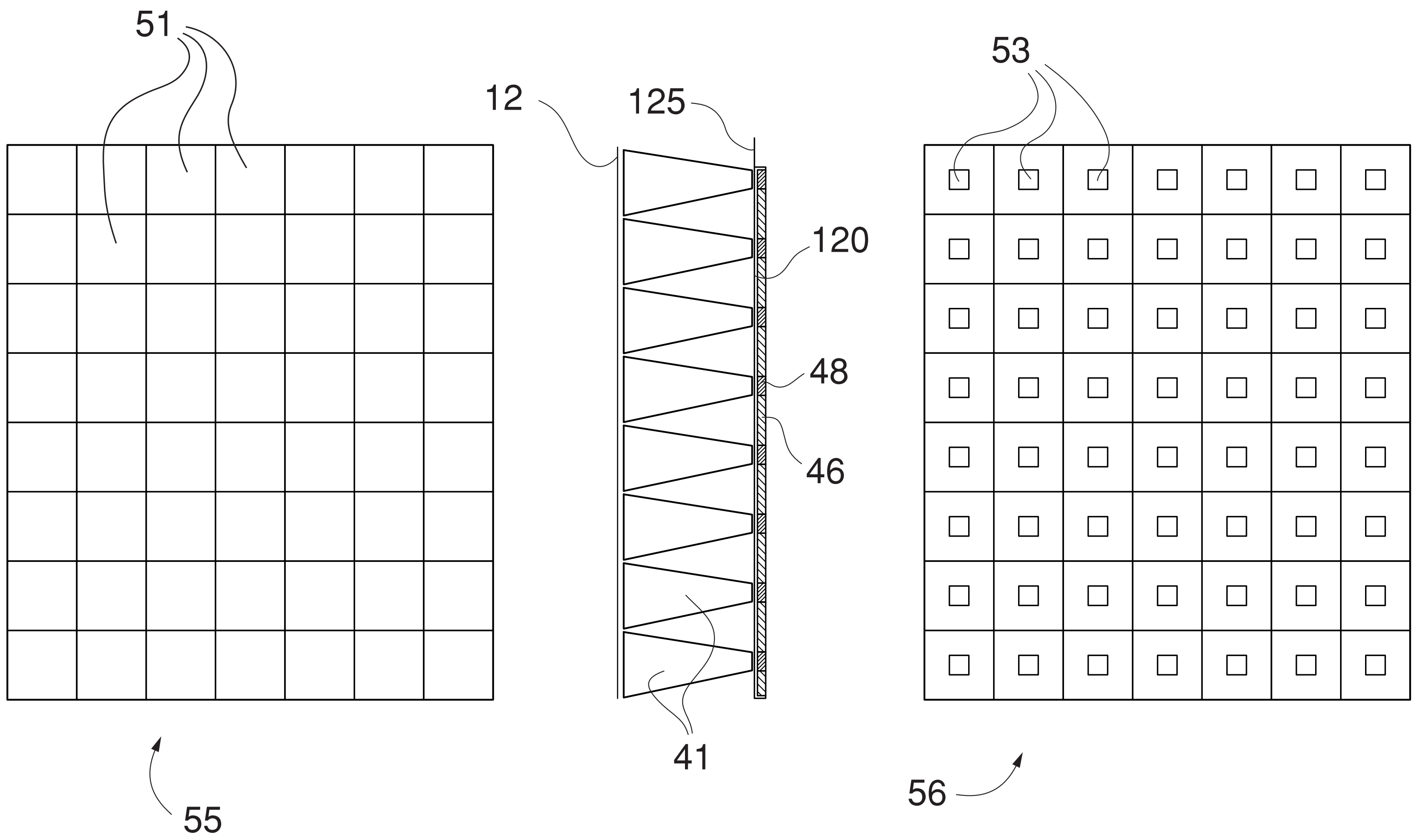

Fig. 3