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(54) **Title:** A MICROSCOPE MODULE, ASSEMBLY, AND METHOD FOR ANALYSING SAMPLES

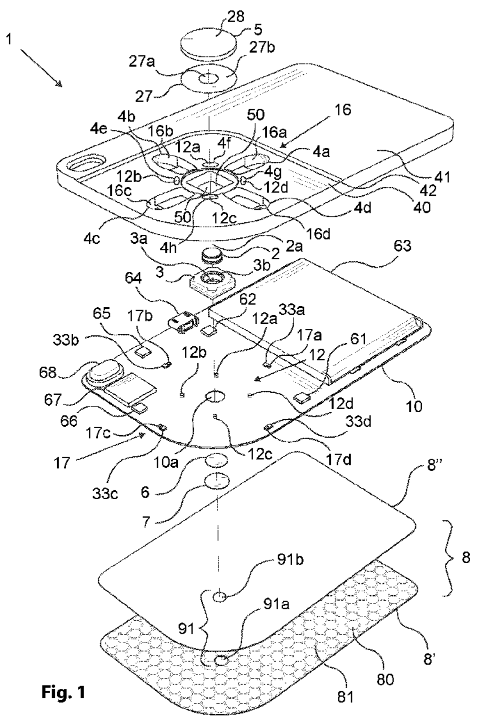

Fig. 1

(57) **Abstract:** According to the present invention there is provided a microscope module, suitable for cooperating with a mobile device having a camera, the microscope module comprising, one or more lenses wherein the one or more lenses are arranged so that a centre of each of the one or more lenses line on a single common axis, a plurality of light sources arranged symmetrically with respect to the single common axis. There is further provided a corresponding assembly and method for analyzing samples.

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A Microscope Module, Assembly, and Method for Analysing Samples

Field of the invention

[0001] The present invention concerns a microscope module, suitable for cooperating with a mobile device having a camera, which is configured such that it can be used for performing analysis, such as dark field analysis, bright field analysis and fluorescence analysis, of samples. There is further provided a corresponding assembly and method for analyzing samples.

Description of related art

[0002] Microscopy analysis of samples typically includes performing dark field analysis and/or bright field analysis and/or fluorescence analysis of samples.

[0003] In bright-field microscopy, the sample should be illuminated in such a way, that light emitted from the illumination sources is collected by the microscope objective after being reflected at the sample or after being transmitted through the sample. Transmission-type bright-field (t-BF) microscopes require for an optically transparent sample that is being illuminated from that side of the sample that is opposite to the microscope objective. In this way, light travels through the sample and wherever light-absorbing features block the way of the light, a darker signal will occur in the final image, wherein the background is generally brightest. t-BF microscopy is the method of choice for most applications in the areas of life-sciences and medical-sciences. Reflection-type bright-field (r-BF) microscopy is obtained when illuminating the sample from that side of the sample where the microscope objective is located. Light rays are being generated such that they hit the sample surface, are reflected and then eventually collected by the microscope objective. In this form of microscopy it will be the features that are white or mirrored that appear brightest, while features that transmit or absorb light will appear darker. r-BF microscopy is mostly used with solid, non-transparent samples, e.g. in the area of material science or in automation.

[0004] While t-BF and r-BF microscopes directly collect the illumination light, a dark-field (DF) microscope will not. In DF microscopy the sample is generally illuminated from the side of the microscope objective but due to the specific angle of illumination, the light rays should not be directly collected by the microscope objective. However, when hitting the sample, some light rays may change their direction in a non-specular manner, particularly due to scattering at small, solid objects, and eventually be collected by the microscope objective. In DF microscopy the background is generally dark, especially if the sample has a mirrored surface. A bright signal will appear on the image wherever small features are positioned on the sample that can scatter the light. DF microscopy may be employed with transparent as well as opaque samples. Fluorescence microscopy is similar in its outcome to DF microscopy while the illumination characteristics are generally similar to that of r-BF microscopy. However, instead of using a white light illumination source, there is generally used a light source that only emits wavelengths of a narrow bandwidth, preferably in the blue or near-UV range. When hitting the sample this light can cause fluorescent light emission from certain features contained on said sample. Fluorescently emitted light has gone through a Stokes shift, which means that the fluorescent light has a longer wavelength than the light emitted by the illumination source. By letting all collected light hit a color filter, only that light may be allowed to pass that has been generated by fluorescent emission, while the illumination light will either be absorbed or be reflected. The final image does therefore show a dark background, wherever there are no objects that have caused fluorescent light emission. Because the intensity of the fluorescent signal will be very small compared to the illumination, a highly effective filter has to be employed.

[0005] Microscopy is currently performed in the field with stationary devices. These stationary devices are heavy and space-consuming meaning that they are not portable. There is a need in the art to provide a portable means for carrying out various analysis (such as dark field analysis and/or bright field analysis) of samples.

[0006] To date there has been some attempts to provide a portable means for carrying out a single type of analysis only (such as dark field analysis exclusively or bright field analysis exclusively) of samples. Existing solutions do not allow a user to carry out different types of sample analysis, consecutively or simultaneously. Moreover existing solutions are not adequately optimised to be selectively cooperated with a mobile device to form an assembly which can be used to perform high quality sample analysis.

[0007] The present invention aims to obviate or mitigate at least some of the disadvantages of existing solutions.

Brief summary of the invention

[0008] According to the invention, these aims are achieved by means of a microscope module, suitable for cooperating with a mobile device having a camera, the microscope module comprising, one or more lenses wherein the one or more lenses are arranged so that a centre of each of the one or more lenses line on a single common axis, and a plurality of light sources arranged symmetrically with respect to the single common axis.

[0009] The module may further comprise a plurality of curved reflective surfaces, arranged symmetrically with respect to the single common axis, wherein each reflective surface is arranged to receive light from a respective light source. Preferably each reflective surface is arranged to direct received light away from the microscope module.

[0010] Preferably each of the curved reflective surfaces have a concave profile.

[001 1] The microscope module may comprise,

a first group of light sources arranged symmetrically with respect to the single common axis and a first group of curved reflective surfaces, each curved reflective surface of the first group being arranged to receive light from a respective light source in the first group of light sources and to direct received light away from the microscope module; and

a second group of light sources arranged symmetrically with respect to the single common axis and a second group of curved reflective surfaces, each curved reflective surface being arranged to receive light from a respective light source in the second group of light sources and to direct received light away from the microscope module; and

wherein the distance between each of the light sources in the first group and the single common axis is less than the distance between each of the light sources in the second group and the single common axis.

[0012] The distance (di) between each of the light sources in the first group and the single common axis may be between 1 mm - 40 mm, preferably between 4 mm - 20 mm. The minimum distance between each of the light sources in the first group and the single common axis is larger than the radius of the one or more lenses.

[0013] The distance (di) between each of the light sources in the second group and the single common axis may be equal to or larger than five times the radius of the one or more lenses, or it is more than ten times the width of the one or more lenses, but preferably it is smaller than 100 mm

[0014] Each of the plurality of light sources may be positioned at a focal point of a respective curved reflective surface.

[0015] A focal point of each of the plurality of curved reflective surfaces lie on said single common axis.

[0016] Each of the curved reflective surfaces may have a first and a second focal point, and wherein the first focal point of each curved reflective surface is located on the single common axis, and wherein a respective light source is positioned at the second focal point of each respective curved reflective surface.

[0017] The microscope module may further comprise a casing. The casing may have cut-outs defined therein, and wherein a surface which defines the cut-out comprises reflective material to define a respective curved reflective surface.

[0018] Each of curved reflective surfaces are curved along two orthogonal planes. Each of the curved reflective surfaces is concave curved in a plane which is perpendicular to a plane of the casing and is concave curved in a plane which is parallel to a plane of the casing.

[0019] Each of the curved reflective surfaces may each have a profile that is at least partly described by the following formula:

$$\frac{\vec{x}^2}{a^2}+\frac{\vec{y}^2}{b^2}=1$$

where $\vec{x}$ is a vector that points from the position of the respective light source towards the single common axis, and which is perpendicular to the single common axis. And where $\vec{y}$ is a vector that is perpendicular to both the single common axis and to $\vec{x}$, wherein the length of both vectors is measured from a reference point that is situated along the $\vec{x}$-direction halfway between the single common axis and the respective light source. ***a*** is equal to the distance between the reference point and a point on the reflective surface where $\vec{y} = 0$, and wherein ***b*** is smaller than ***a***. If the curved reflective surface is a member of the first group of reflective surfaces, then the length of ***b*** is preferably not less than one fifth of the length of **a**. If the curved reflective surface is a member of the second group of reflective surfaces, than ***b*** does preferably not have less than half the length of ***a***. ***a*** is preferably chosen larger than half the distance between the respective light source and the single common axis.

[0020] Each of the curved reflective surfaces of the first group of reflective surfaces may each have a profile that is at least partly described by the following formula

$$\frac{\vec{x}^2}{a^2}+\frac{\vec{y}^2}{b^2}=1$$

where $\vec{x}$ is a vector that points from the position of the respective light source towards the single common axis, and which is perpendicular to the single common axis. And where $\vec{y}$ is a vector that is perpendicular to both the single common axis and to $\vec{x}$, wherein the length of both vectors is measured from a reference point that is situated at a distance from the single common axis along the $\vec{x}$-direction, said distance being equal to 1.5 times the distance between the single common axis and the respective light source. a is equal to the distance between the reference point and a point on the reflective surface where $\vec{y} = 0$, and wherein b is smaller than a. b is equal to or greater than half the value of a. Preferably a is larger than half the distance between the respective light source and the single common axis.

[0021] The microscope module may further comprise a plurality of curved reflective surfaces, each of which has a first and a second focal point, wherein a respective light source is located at said second focal point.

[0022] Each of the curved reflective surfaces may each be profiled to define a part of a spheroidal volume.

[0023] The first focal point of each curved reflective surface may be located on the single common axis.

[0024] The microscope module may further comprise a first glass window which is arranged along the single common axis so as to overlay the one or more lenses, and wherein the first focal point of each of the curved reflective surfaces is located at the perimeter of the first glass window, so that the glass window can receive light reflected by the curved reflective surface and internally reflect light received.

[0025] Each of the curved reflective surfaces of the first group of curved reflective surfaces may each have a profile that is described by the following formula:

$$\frac{x^2 + y^2}{a^2} + \frac{z^2}{c^2} = 1$$

where $\vec{z}$ is a vector that points from the position of the respective light source towards the perimeter of the glass window and crosses the single common axis. And where $\vec{x}$ is vector that is perpendicular to the single common axis and to $\vec{z}$ and where $\vec{y}$ is a vector that is perpendicular to $\vec{z}$ and to $\vec{x}$. $\vec{x}$, $\vec{y}$ and $\vec{z}$ are measured from a reference point that is situated along the $\vec{x}$-direction halfway between the perimeter of the glass window and the position of the respective light source. The value of a is equal to the distance along the $\vec{x}$- or $\vec{y}$-direction between the reference point and a point of the reflective surface and wherein c is larger than a, preferably c is more than 1.5 times larger than a but smaller than 5 times a. c is preferably chosen larger than the distance along the $\vec{x}$-direction between the respective light source and the perimeter of the glass window.

[0026] At least part of the perimeter of the first glass window may comprise reflective material. Preferably portions of the perimeter at which the first focal point of each of the curved reflective surfaces is located are without reflective material so that the first glass window can receive light at these portions.

[0027] In another embodiment the first group of light sources and the corresponding first group of reflective surfaces are arranged asymmetrical with respect to the single common axis, such that no two light sources are oriented directly opposite one another. The first focal point of each of the curved reflective surfaces is located at the perimeter of the first glass window. At least part of the perimeter of the first glass window may comprise reflective material. Preferably portions of the perimeter at which the first focal point of each of the curved reflective surfaces is located are without reflective material so that the first glass window can receive light at these portions. Preferably in this embodiment the second group of light sources and the corresponding second group of reflective surfaces are arranged symmetrical with respect to the single common axis; thus the microscope module comprises a first group of light sources and corresponding first group of reflective surfaces which are arranged asymmetrical with respect to the single common axis, and a second group of light sources and corresponding second group of reflective surfaces are arranged symmetrical with respect to the single common axis.

[0028] In another embodiment the first group of light sources comprises an odd number of light sources and the first group of reflective surfaces comprise a corresponding odd number of reflective surfaces, such that no two light sources are oriented directly opposite one another. In this embodiment the curved reflective surfaces are also be arranged asymmetrical with respect to the single common axis. The first focal point of each of the curved reflective surfaces is located at the perimeter of the first glass window. At least part of the perimeter of the first glass window may comprise reflective material. Preferably, portions of the perimeter at which the first focal point of each of the curved reflective surfaces is located are without reflective material so that the first glass window can receive light at these portions.

[0029] The microscope module may comprise curved reflective surfaces which overhangs a respective light source.

[0030] The microscope module may further comprises a diffuser which is arranged to diffuse light which has been captured in a wave-guide mode inside the first glass window so that at least part of the internally reflected light is directed away from the microscope module.

[0031] The diffuser may be integral to the first glass window.

[0032] The diffuser may be defined by an area of the first glass window which comprises a roughness which is larger than the roughness of another area of the first glass window. Preferably the diffuser is defined by an area of the first glass window which comprises a surface roughness which is larger than a surface roughness of another area of the first glass window, wherein surface roughness is understood as the arithmetic average of the vertical deviations of the roughness profile from the mean line of the surface.

[0033] The area which has a larger roughness may have a roughness of between 100 nm - 10 μm, preferably between 200 nm - 2 μm.

[0034] The area which has a larger roughness is ring shaped, and the area of the first glass window which is contained within the ring and the area of the first glass window which is outside of the ring has a roughness which is less than the roughness of the ring shaped area, preferably has a roughness of less than 100 nm, and more preferably has a roughness of less than 10 nm.

[0035] In another embodiment the diffuser may be formed of a diffusing element, the diffusing element being formed as a ring-shaped element, the ring-shaped diffusing element being attached to the surface of the glass window that is on that side of the glass window that faces the one or more lenses.

[0036] The ring-shaped diffusing element can be made of a material with diffuse reflection properties, for example it can be made of a white painted material or it can be made of a retro-reflective film.

[0037] The contact between ring-shaped diffusing element and glass window is made by an optically clear adhesive.

[0038] The microscope module may further comprise a reflective element which is provided on the first glass window, wherein the reflective element has an aperture defined therein through which light can pass, and wherein the reflective element is arranged so that the centre of the aperture lies on the single common axis.

[0039] The dimensions of the aperture may be smaller than, or equal to, the dimensions of the diffuser so that light diffused by the diffuser does not directly pass through the aperture and is collected by the lens.

[0040] The aperture may be circular, and the diffuser is ring shaped, and the dimensions of an inner perimeter of the diffuser match the dimensions of the perimeter of the circular aperture or are larger than the dimensions of the perimeter of the circular aperture.

[0041] The reflective element may be a disk-shaped element, which is stacked on the first glass window so that a reflective surface of the reflective element abuts the first glass window.

[0042] The reflective element may comprise a reflective surface which is deposited on a surface of the first glass window.

[0043] The reflective element incorporates reflective material with mirror-like reflection properties (i.e. mostly specular reflection). The reflective element comprises reflective material which is configured for specular reflection. For example, the mirror-like reflective element can be made from a metal that has a surface roughness of less than 10 nm.

[0044] The reflective element may further comprise an area of consecutive rings of reflective material with interposing gaps. The gaps are absent of reflective material. The gaps comprise air. The consecutive rings of reflective material may define a diffuser. When the diffuser is formed as a regular grating, the grating being preferably formed as a circular grating wherein the pitch of the grating is on the order of the wavelength of visible light such that by Bragg interference it can be defined a range of specific emission angles at which light is emitted away from the microscope module. The circular grating is formed from two materials of different permittivity, preferably the first material being a metal that forms the reflective element and the second material being air or another dielectric material, for example by forming the reflective element with circular gaps on the glass window, the gaps being filled with air and having a width which is smaller the pitch of the grating.

[0045] The aperture that is defined within the reflective element can be chosen larger than the dimensions of the diffuser, particularly in case a ring-shaped diffusing element is employed.

[0046] Each of the plurality of light sources may be supported on a surface of a platform, wherein the surface of a platform lines on a single plane only, and each of the plurality of light sources extend a distance above the single plane and

wherein the microscope module may further comprise a holder which extends above the single plane and which holds the one or more lenses; and

wherein the distance above the single plane to which each of the plurality of light sources extend is less than, or equal to, the distance between the single plane and that surface of the one or more lens that is furthest away from the single plane.

[0047] The platform may be defined by a printed circuit board ("PCB").

[0048] The microscope module may further comprise a casing, and wherein the casing comprises a first surface and second surface, wherein the first and second surfaces lie on different planes and there is a step between the first and second surfaces; wherein the plane on which the second surface lies intersects a focal point of the one or more lenses.

[0049] The microscope module may further comprise a motor assembly which is operably connected to the one or more lenses such that when operated the motor can effect movement of the one or more lenses in a direction along the single common axis so as to allow the movement of a focal point of the one or more lenses along the single common axis, thereby allowing selective focusing of the one or more lenses. The motor assembly may comprise at least two parts that can be moved with respect to each other, in direction of the single common axis, wherein the one of more lenses are mounted to exactly one of this at least two parts.

[0050] The motor assembly may be driven by a voice coil motor or a microelectromechanical system, preferably of such kind that are commonly found in the camera of a mobile device.

[0051] The one or more lenses may be moved along the single common axis, in a direction away or towards the platform, by the motor assembly. Preferably the plane on which the second surface lies intersects a focal point of the one or more lenses when the one or more lenses are focused so that the focal point is at half its maximum distance from the platform. Preferably the plane on which the second surface lies intersects a focal point of the one or more lenses when the one or more lenses are moved by the motor to half its full movement extension, such that fine-focusing is possible into both direction.

[0052] The one or more lenses may comprise a plurality of aspheric lens. The lenses may be situated along a single common axis and within a barrel. They may be fixed within the barrel by clamping.

[0053] The dimensions of the one or more lenses are between 0.1 mm - 20 mm, preferably between 0.5 mm - 10 mm, so that the size of the lens corresponds to the size of the lens of the camera of the mobile device. The microscope module may comprise a stack of lenses, each with different diameters. The lens which is closest to the first glass window may be larger than a lens in the stack which is positioned further from the first glass window.

[0054] The microscope module may further comprise an attachment means which allows the microscope module to be removably attached to a surface of the mobile device.

[0055] The microscope module may further comprise an attachment means which allows the microscope module to be removably attached to a surface of the mobile device, wherein the attachment means comprises an elastic layer which is mounted on a non-elastic layer and wherein the non-elastic layer is mounted on the microscope module. The elastic layer has a

Shore hardness in the Shore 00 hardness range, preferably between Shore 00 20 and Shore 00 70. The non-elastic layer preferably has a Shore hardness in the Shore D hardness range, preferably above Shore D 50. The elastic layer further comprises a plurality of projections, and wherein channels are defined between the plurality of projections, and wherein the elastic layer further comprises an adhesive material which is either formed on the projections or is a surface property of the elastic layer itself. The adhesive material has an adhesiveness of between 1N/1 00mm and 20N/100mm, which enables the microscope module to be removably attached to the surface of a mobile device when the elastic layer is positioned to abut said surface. The non-elastic layer also comprises an adhesive material which is formed on both main surfaces of the non-elastic layer. The adhesiveness of the adhesive material of the non-elastic layer is between 20N/100mm and 100N/mm, such that it allows a connection between elastic layer and non-elastic layer, and between non-elastic layer and microscope module that is stronger than the connection between the elastic layer and the mobile device.

[0056] The plurality of projections may have a hexagonal cross section.

[0057] The attachment means may further comprise a cut-out portion, the centre of which lies on the single common axis, which allows light to pass through the attachment means into the lens of the microscope module.

[0058] In case the mobile device features a portion of the camera that protrudes from the rest of the mobile device, then the cut-out portion is chosen larger than the size of the protruding portion of the camera of the mobile device.

[0059] The thickness of the attachment means is preferably equally thick or thicker than the thickness of the protruding portion of the camera of the mobile device. Preferably the thickness of the attachment means is less than 1mm thicker than the protruding part of the camera of the mobile device, such that the attachment means can be attached to the flat portion of the mobile device, and such that the protruding portion of the camera of the mobile device fits into the cut-out portion of the attachment means.

[0060] The thickness of the attachment means is preferably less than 1mm.

[0061] The platform may further comprise a cut-out portion, the centre of which lies on the single common axis, which allows light to pass through the attachment means into the lens of the microscope module.

[0062] The microscope module may further comprise a second glass window which is arranged to overlay the cut-out portion of the attachment means, and wherein the centre of the second glass window lines on the single common axis. The second glass window is located in a groove which defined in the platform (e.g. a groove in the PCB).

[0063] The microscope module may further comprise a UV filter layer.

[0064] The UV filter layer may be stacked on the second glass window. The UV filter layer may be stacked on the first glass window. The UV filter layer may be arranged between the first and the second glass window.

[0065] The UV filter layer may be arranged to be parallel to the one or more lenses and so that the centre of the UV filter layer lies on the single common axis.

[0066] The microscope module may further comprise one or more UV light sources which are selectively operable to emit UV light.

[0067] Each of the one or more UV light sources may be positioned such that the distance between each UV light source and the single common axis is equal to the distance between each of the light sources in the second group and the single common axis.

[0068] According to a further aspect of the present invention there is provided a slide holder which is suitable for cooperating with the microscope module, the slide holder comprising,

a platform having,

a groove defined therein which can receive a slide, and

a trench defined therein, the trench having a depth which is deeper than the depth of the groove, and wherein a surface which defines a base of the trench comprises reflective material.

[0069] A surface which defines a base on the groove and the surface which defines a base of the trench may be parallel and lie on different planes.

[0070] The trench may have a width between 5 mm and 100 mm and a length between 5 mm and 100 mm. The length of the trench may be smaller than the length of a slide such that an airgap is provided between the slide and the reflective surface of the trench when a slide is positioned in the groove.

[0071] The trench may have a depth between 0.1cm-2cm.

[0072] The trench may have a depth between 0.5mm-5mm

[0073] In a preferred embodiment the groove comprises a first groove subsection and a second groove subsection. Thus in this embodiment the platform may comprise a first groove subsection and a second groove subsection wherein the trench is interposed between the first groove subsection and the second groove subsection wherein the depth of the first groove subsection and the second groove subsection is equal.

[0074] The first groove subsection, second groove subsection and trench may cumulatively extend the full length of the platform.

[0075] The first groove subsection and a second groove subsection may each have a depth 0.5mm - 5mm.

[0076] The first groove subsection may have a width between 5mm - 50mm and a length between 1mm - 100mm.

[0077] The second groove subsection may have a width between 5mm - 50mm and a length between 1mm - 100mm.

[0078] The reflective surface of the trench of the slide holder incorporates reflective material with mirror-like reflection properties (i.e. mostly specular reflection). For example, the mirror-like reflective surface can be made from a metal that is prepared with a surface roughness of less than 10 nm.

[0079] In one embodiment the slide holder comprises a first groove and a first trench and it contains a second groove and a second trench defined in the platform. Preferably the first and second trenches further comprise a base which comprises reflective material. Preferably the reflective material on the base of the second trench has different reflective properties to the reflective material provided on the base of the first trench. In one embodiment the base of first trench comprises material which has a higher reflectivity than the reflectivity of the base of the second trench. In one embodiment the base of the first trench comprises material which has a lower degree of diffuse reflection (i.e. the ratio of diffuse reflection against specular reflection) than the degree of diffuse reflection of the base of the second trench. In one embodiment the base of first trench comprises material which has a higher reflectivity and higher degree of diffuse reflection (i.e. the ratio of diffuse reflection against specular reflection) than the reflectivity and the degree of diffuse reflection of the base of the second trench. In one embodiment the base of first trench comprises mirror material or is black colored and the base of the second trench is white colored.

[0080] The reflective surface of the trench incorporates reflective material with partly diffuse reflection properties such that a more uniform illumination can be achieved. For example, the diffuse reflective surface can be made from a metal that is prepared with a surface roughness greater than 10 nm. The degree of diffuse reflection can be controlled by the roughness value, wherein higher roughness results in a more diffuse reflection.

[0081] Any surface of the slide holder besides the reflective surface of the trench is colored in black.

[0082] According to a further aspect of the present invention there is provided an assembly comprising a microscope module according to any one of the above-mentioned microscope modules, and a mobile device having an integrated camera with a lens, and wherein the microscope module is arranged to abut the mobile device and is positioned such that the one or more lenses of the microscope module overlay the lens of the camera of the mobile device.

[0083] The assembly may further comprise a slide holder as mentioned above, wherein the slide holder is arranged such that the single common axis intersects the reflective surface which defines a base of the trench.

[0084] The slide holder is arranged such that the reflective surface defining the base of the trench is within the field of view of the camera of the mobile device. The slide holder is arranged such that the reflective surface defining the base of the trench is within the field of view of the one or more lenses of the microscope module. For example the reflective surface should be within the field of view and extend by an additional distance that has at least the same length as the distance between single common axis and second group of light sources so that the light of the second group of light sources can be reflected from the reflective surface.

[0085] The assembly may further comprise a slide, which supports a sample on a surface thereof, the slide being positioned within the groove of the slide holder so that the slide overlays the reflective material on the surface which defines a base of the trench, and wherein an airgap is provided between the slide and reflective surface of the trench.

[0086] The distance (di) between each of the light sources in the first group and the single common axis may be less than "**tan** (**CRA**$_{m\,a}$x+ α_{N}**A)**·(**i**+**2**(/2i+/22)) + tan(sin(CRA $_{max}$+α_{N}**A)**·«-1)-2^ + *r*" but be larger than the radius of the glass window, wherein CRA_{max} is the maximum critical ray angle of the one or more lenses; α_{NA} is equal to arcsin(NA), where NA is the numerical aperture of the one or more lenses; *t* is the distance along the single common axis between each light source and a surface of the first glass window; h_1 is the distance between a surface of the first glass window and the focal point of the one or more lenses; h_2 is the thickness of the airgap; *g* is the thickness of the slide; and wherein the first glass window is circular and *r* is the radius of the first glass window.

[0087] The distance (di) between each of the light sources in the second group and the single common axis may be larger than "**tan** (**CRA**$_{m}$ax+a $_{NA}$)·(t+2(h_1+h2)) + tan(sin(CRA $_{max}$+α_{N}A)·«-1)·2g + *r*", wherein CRAmax is the maximum critical ray angle of the one or more lenses; α_{NA} is equal to arcsin(NA), where NA is the numerical aperture of the one or more lenses; *t* is the distance along the single common axis between each light source and a surface of the first glass window; h_1 is the distance between a surface of the first glass window and the focal point of the one or more lenses; h_2 is the thickness of the airgap; *g* is the thickness of the slide; and wherein the first glass window is circular and *r* is the radius of the first glass window

[0088] The thickness of the slide is typically 1mm.

[0089] The distance (di) between each of the light sources in the first group and the single common axis may be less than "**tan** (**CRA**$_{m\,a}$x+ α_{N}**A)**·(**i**+**2**(/2i+/22)) + tan(sin(CRA $_{max}$+α_{NA})·«-1)·2g + *r*" but be larger than the radius of the glass window, wherein CRA_{max} is the maximum critical ray angle of the one or more lenses; α_{NA} is equal to arcsin(NA), where NA is the numerical aperture of the one or more lenses; *t* is the distance along the single common axis between each light source and a surface of the first glass window; h_1 is the distance between a surface of the first glass window and the focal point of the one or more lenses; h_2 is the thickness of the airgap; g is the thickness of the slide; and wherein the first glass window is circular and r is the radius of the first glass window.

[0090] The distance (di) between each of the light sources in the second group and the single common axis may be larger than "$\tan(CRA_{max}+\alpha_{NA})\cdot(t+2(h_1+h_2)) + \tan(\sin(CRA_{max}+\alpha_{NA})\cdot«-1)\cdot 2g + r$", wherein CRAmax is the maximum critical ray angle of the one or more lenses; α_{NA} is equal to arcsin(NA), where NA is the numerical aperture of the one or more lenses; t is the distance along the single common axis between each light source and a surface of the first glass window; h_1 is the distance between a surface of the first glass window and the focal point of the one or more lenses; h_2 is the thickness of the airgap; g is the thickness of the slide; and wherein the first glass window is circular and r is the radius of the first glass window

[0091] According to a further aspect of the present invention there is provided a method of analyzing a specimen using any one of the above-mentioned assemblies the method comprising the steps of,

attaching the microscope module to a mobile device having an integrated camera with a lens, such that the one or more lenses of the microscope module overlay the lens of the camera of the mobile device;

inserting a slide having a sample thereon, into the groove of the slide holder, and arranging the slide so that the sample overlays the reflective surface which defines a base of the trench, wherein there is an airgap between the reflective surface which defines a base of the trench and the slide;

operating one of the one or more light sources of the microscope module;

receiving light at the one or more lenses of the microscope module;

passing the light received at the one or more lenses to the lens of the camera of the mobile device;

processing the light in the mobile device to generate an image of the specimen; and

displaying the image on a screen of the mobile device.

[0092] The method may comprise placing the microscope module onto the slide holder such that the reflective surface which defines a base of the trench is within the field of view of the one or more lenses of the microscope module.

[0093] The method may comprise the step of placing the microscope module onto the slide holder, such that the single common axis intersects with the sample and the reflective surface of the slide holder.

[0094] The method may comprise performing bright field analysis by,

operating a first group of light sources to emit light;

reflecting the light emitted by the one or more light sources using the reflective surface which defines a base of the trench;

passing the reflected light through the sample on the slide, and

receiving the light which passes through the sample at said one or more lenses of the microscope module;

passing the light received at the one or more lenses of the microscope module to the lens of the camera of the mobile device;

processing the light in the mobile device to generate an image of the specimen; and

displaying the image on a screen of the mobile device.

[0095] The method may comprise performing bright field analysis by,

operating a first group of light sources to emit light;

collecting the light at the perimeter of the glass window and coupling this light into the glass window;

internally reflecting the light along the glass window towards the diffuser;

diffusing the light using the diffuser and using at least a portion of the diffused light to illuminate a sample;

reflecting the diffused light using the sample and receiving reflected light which is reflected in said one or more lenses of the microscope module;

passing the light received at the one or more lenses of the microscope module to the lens of the camera of the mobile device;

processing the light in the mobile device to generate an image of the specimen; and

displaying the image on a screen of the mobile device.

[0096] The method may comprise the step of reflecting light one or more times using the reflective element which overlays the first glass window. So the light bounces back and forth between the first glass window and reflective element, before entering the one or more lenses.

[0097] The method may further comprise reflecting the light using a first group of curved reflective surfaces.

[0098] The method may comprise performing dark field analysis by,

operating the second group of light sources to emit light;

directing the light towards the single common axis and away from the one or more lenses of the microscope module, and illuminating the sample using said light;

receiving light scattered from the sample at the one or more lenses of the microscope module;

passing the light received at the one or more lenses of the microscope module to the lens of the camera of the mobile device;

processing the light in the mobile device to generate an image of the specimen; and

displaying the image on a screen of the mobile device.

[0099] The method may further comprise reflecting the light using a second group of curved reflective surfaces.

[00100] Each of the curved reflective surfaces in the second group of curved reflective surfaces may be each positioned further away from the singe common axis as each of the curved reflective surfaces in the first group of curved reflective surfaces.

Brief Description of the Drawings

[00101] The invention will be better understood with the aid of the description of an exemplary embodiment which is given by way of example only, and illustrated by the figures, in which:

Fig. 1 shows an exploded view of a microscope module according to an embodiment of the present invention;

Fig. 2 illustrates the positioning of the curved reflective surfaces and light sources of the microscope module of Fig. 1;

Fig. 3 provides a cross sectional view of the microscope module shown in Fig. 1;

Fig. 4 is an exploded perspective view of a microscope module according to a further embodiment of the present invention;

Fig. 5 is a magnified, part cross-section, view of a portion of the microscope module shown Fig. 4;

Fig. 6 provides a perspective view of a slide holder according to a further aspect of the present invention;

Fig. 7 provides a perspective, part cross section, view of the trench of the slide holder in Figure 6;

Fig. 8 provides a cross-section view of an assembly according to an embodiment of the present invention which comprises a mobile device, a microscope module (of Fig. 1 or 4), and slide holder (of Fig. 6) which supports a slide having a sample thereon;

Fig. 9 provides a perspective view of the assembly shown in Fig. 8;

Fig. 10 illustrates the positioning of the curved reflective surfaces and light sources of the microscope module of Fig. 4;

Fig. 11a shows the light path when performing bright field analysis with an assembly of Fig. 8 that has the microscope module of Fig. 1;

Fig. 11b shows the light path when performing dark field analysis with the assembly of Fig. 8;

Fig. 12 shows the light path when performing bright field analysis with an assembly that has the microscope module of Fig. 4;

Fig. 13 is a perspective view of another embodiment of a slide holder according to a further aspect of the present invention;

Fig. 14 shows the light path when performing bright field analysis using the slide holder of Fig. 13.

Detailed Description of possible embodiments of the Invention

[00102] Fig. 1 shows an exploded view of a microscope module 1 according to an embodiment of the present invention. The microscope module 1 is suitable for cooperating with a mobile device having a camera to form an assembly which can be used to inspect or analyze samples (e.g. to perform dark field analysis and/or bright field analysis and/or fluorescence analysis).

[00103] The microscope module 1 comprises one or more lenses 2 wherein the one or more lenses are arranged so that a centre of each of the one or more lenses line on a single common axis 2a. In this example the microscope module 1 comprises three lenses 2; however it will be understood that any number and any type of lenses may be provided e.g. two lenses 2. The dimensions of the lenses 2 are between 0.5mm - 5mm so that the size of the lenses 2 substantially correspond to the typical size of an opening defined in a mobile device (e.g. smart phone) through which a lens of the camera of the mobile device receives light.

[00104] The lenses 2 are held by a holder 3 which has a passage 3a defined therein; the passage 3a extends all the way through the holder 3. The lenses 2 are positioned within the passage 3a and light can pass from above the holder 3, through one end of the passage 3a and into the lenses 2 and/or light can pass from below the holder 3, through an opposite end of the passage 3a and into the lenses 2.

[00105] The PCB 10 further has an aperture 10a defined therein through which light can be passed so as to allow light to enter the lenses 2; a centre of the aperture 10a lies along the single common axis 2a.

[00106] The microscope module 1 comprises a UV filter layer 6 and a second glass window 7, both of which are contained within the volume defined by the aperture 10a; in this embodiment the volume which is defined by the aperture 10a is cylindrical shaped. In a variation of the embodiment the aperture 10a is configured to define a first cylindrical volume portion which has a first diameter and a second cylindrical volume portion which has a second diameter; and wherein the first diameter is larger than the second diameter. In this variation of the embodiment the second glass window 7 is positioned within the first cylindrical volume portion and the UV filer layer 6 is positioned within the second cylindrical volume portion.

[00107] The UV filter layer 6 is arranged to be parallel to the lenses 2 and so that a centre of the UV filter layer 6 lies on the single common axis 2a. The second glass window 7 is also arranged so that its centre lies on the single common axis 2a. The second glass window 7 is shown to have dimensions which are larger than the dimensions of the UV filter layer 6.

[00108] The microscope module 1 is shown to further comprise a plurality of light sources 9a-d, 17a-d. Each of the light sources 9a-d, 17a-d are arranged symmetrically with respect to the single common axis 2a. In this example the microscope module 1 comprises, a first group 9 of light sources 9a-d arranged symmetrically with respect to the single common axis 2a and a second group 17 of light sources 17a-d arranged symmetrically with respect to the single common axis 2a. The distance between each of the light sources 9a-d in the first group 9 and the single common axis 2a is less than the distance between each of the light sources 17a-d in the second group 17 and the single common axis 2a. The distance between each of the light sources 9a-d in the first group 9 and the single common axis 2a is between 7-1 1mm in this example and the distance between each of the light sources 9a-d in the first group 9 and the single common axis 2a is 9mm. The distance between each of the light sources 17a-d in the second group 17 and the single common axis 2a is between 11-40mm; in this example the distance between each of the light sources 17a-d in the second group 17 and the single common axis 2a is 21mm. The light sources 9a-d of the first group 9 are offset from the light sources 17a-d of the second group 17 so that a line joining any of the light sources 17a-d of the second group 17 to the single common axis 2a will not intersect any of the light sources 9a-d of the first group 9.

[00109] Each of the plurality of light sources 9a-d, 17a-d is secured to and supported on the PCB 10. A surface 10b of the PCB 10 lies on a single plane only. Each of the plurality of light sources 9a-d, 17a-d extend a distance above surface 10b of the PCB 10; preferably each of the plurality of light sources 9a-d, 17a-d extend an equal distance above the surface 10b of the PCB 10. The holder 3 holds the lenses 2 at a distance above the surface 10b of the PCB 10. The distance above the surface 10b of the PCB 10 to which each of the plurality of light sources 9a-d, 17a-d extend is less than, or equal to, the distance between the plane of the surface 10b of the PCB 10 and the lenses 2.

[001 10] The microscope module comprises a casing 4. The casing 4 comprises a first surface 40 and second surface 41, wherein the first and second surfaces 40,41 lie on different planes and there is a step 42 between the first and second surfaces 40,41. The second surface is configured so that the plane of the second surface 41 intersects a focal point of the lenses 2.

[001 11] The microscope module 1 will further comprise a motor assembly (shown best in Figure 3) which is operably connected to the lenses 2 such that when operated the motor can effect movement of the lenses 2 in a direction along the single common axis 2a, so as to allow the movement of a focal point of the lenses 2 along the single common axis 2a; this allows for selective focusing of the lenses 2. In an embodiment the motor assembly also defines the lens holder 3. In the embodiment shown in Fig. 1 the motor assembly comprises an anchor member 3b and arms 3c which hold the lenses 2 and can move relative to the anchor member 3b, along tracks defined in the anchor member 3b, in a direction which is along the common axis 2a; a motor is provided which moves the arms 3c in a direction which is along the common axis 2a thus enabling focusing of the lenses 2 (i.e. enabling movement of a focal point of the lenses 2 along the single common axis 2a). The second surface 41 of the casing is configured so that the plane of the second surface 41 intersects the focal point of the lenses 2 when the arms 3c are mid-way along the tracks defined in the anchor member 3b (i.e. when the motor assembly is at half its full extension).

[001 12] The casing 4 further comprises an aperture 50 which can receive the holder 3. Cut-outs 4a-h define respective surfaces 12a-d,16a-d which are each concave curved along a plane which is perpendicular to a plane of the casing 4 and are also concave curved along a plane which is parallel to a plane of the casing 4. Each of the respective surfaces 12a-d,16a-d is provided with reflective material to define a respective curved reflective surface 12a-d,16a-d. Thus there is provided a first group 12 of curved reflective surfaces 12a-d and the second group 16 of curved reflective surfaces 16a-d.

[001 13] Each of curved reflective surfaces 12a-d,16a-d are concave curved along two orthogonal axes; specifically each of curved reflective surfaces 12a-d,16a-d is concave curved along a plane which is perpendicular to a plane of the casing 4 and is concave curved along a plane which is parallel to a plane of the casing 4. Preferably, the cut-outs 4a-h define surfaces, a slice of which taken along a plane parallel to the plane of the casing 4, have a part-elliptical shape; thus a slice of each curved reflective surface

12a-d,16a-d taken along a plane parallel to the plane of the casing 4, have a part-elliptical shape.

[00114] In this embodiment the whole of the surface defined by the cut-outs 4e-h are completely covered with reflective material. Part of each of the surfaces defined by the cut-outs 4a-d are colored black to maximize light absorption so as to achieve a reduction in stray light (i.e. the surface of the cut-out 4a-d which does not comprise a reflective surface 16a-d is colored black). In this example only the surfaces defined by the cut-outs 4a-d are portions colored black. It should be understood that the first group 12 of curved reflective surfaces and the second group 16 of curved reflective surfaces could be provided in the microscope module 1 in any other suitable manner; for example curved refractive or reflective elements (such as a lens(es)) could be provided in the module e.g. could be provided in the cut-outs 4a-d).

[00115] The first group 12 of reflective surfaces comprises a plurality of curved reflective surfaces 12a-d, each curved reflective surface 12a-d has a profile which has a shape (e.g. part of an ellipse) so that it has a first (f1) and a second (f2) focal point. Preferably, a slice of each curved reflective surface 12a-d, taken along a plane parallel to the plane of the casing 4, will have the shape of a part of an ellipse. Each curved reflective surface 12a-d may comprise two reflective surfaces 12', 12" which face one another. In this embodiment all of the surface which are contained within the volume defined by the cut-outs 4e-h are reflective (i.e. there is no non-reflective surface). In another embodiment each one of the curved reflective surfaces 12a-d may comprise two reflective surfaces 12', 12" and surfaces which are interposed between two reflective surfaces 12', 12" are colored black.

[00116] The curved reflective surfaces 12a-d are arranged symmetrically with respect to the single common axis 2a. Each curved reflective surfaces 12a-d of first group 12 is arranged to receive light from a respective light source 9a-d in the first group 9 and to direct received light away from the microscope module 1. More details about the configuration of the curved reflective surfaces 12a-d of the first group 12 will be provided later with respect to Figure 2

[001 17] The second group 16 of curved reflective surfaces 16a-d are arranged symmetrically with respect to the single common axis 2a. Each curved reflective surface 16a-d is arranged to receive light from a respective light source 17a-d in the second group 17 of light sources 17a-d and to direct received light away from the microscope module 1. Each of the curved reflective surfaces 16a-d in the second group 16 has a profile which has a shape of part of an ellipse so that each of the curved reflective surfaces 16a-d has a first (f1) and a second (f2) focal point. More details about the configuration of the curved reflective surfaces 16a-d of the second group 16 will be provided later with respect to Figure 2. In one embodiment for each curved reflective surface 16a-d there is provided a curved surface which is colored black, which is located opposite to that respective curved reflective surface 16a-d (for example a part of the surface which defines the volume of a respective cut-out 4a-h in the casing 4 may be provided with a reflective coat so as to be defined as a curved reflective surface 16a-d; and art of the surface which is opposite to the reflective coat may be colored black).

[001 18] It should be understood that each group of light sources 9,1 7 may comprise any suitable number of light sources (e.g. between one-ten light sources); and that each group of curved reflective surfaces 12,16 may contain any suitable number of curved reflective surfaces (e.g. between one-ten curved reflective surfaces). Furthermore in a variation of the embodiment only one single group of light sources are provided and only one single group of curved reflective surfaces is provided.

[001 19] It should be understood that in this description "part elliptical" means that the surface does not form a complete elliptical shape but rather only part of a complete elliptical shape e.g. a semi-elliptical shape; in the example shown in Figure 1 the reflective surfaces 12a-d, 16a-d have a shape such that, a slice of the reflective surface 12a-d, 16a-d, taken along a plane which is parallel to the plane of the casing 4, has a part elliptical shape; this implies that the radius of curvature, of the reflective surface 12a-d, 16a-d increases in a direction moving from an apex of the curve, or more specifically the radius of curvature of a slice of the reflective surface 12a-d, 16a-d, taken along a plane which is parallel to the plane of the casing 4, has a part elliptical shape. However it will be understood that in the embodiment shown in Figure 1 the curved reflective surfaces 12a-d of first group 12 can have any shape which ensures that each curved reflective surface 12a-d has a focal point located on the common axis 2a, and each curved reflective surface 16a-d in the second group 16 of reflective surfaces each has a shape such that it has a focal point located on the common axis 2a. The focal point of each of the curved reflective surface 16a-d in the second group 16 is also preferably located at the position of a sample to be tested.

[00120] The microscope module 1 further comprises a plurality of UV light sources 33a-d, each of which is operable to emit UV light. In this example a UV light source 33a-d is provided adjacent to a respective light source 17a-d in the second group 17. Each of the UV light sources 33a-d is arranged symmetrically with respect to the single common axis 2a; and the distance between each light source 17a-d in the second group 17 and the single common axis 2a is equal to the distance between each UV light source 33a-d and the single common axis 2a. Each of the plurality of UV light sources 33a-d is secured to and supported on the surface of the PCB 10.

[00121] A first glass window 5 which is arranged to overlay the lenses 2. The first glass window 5 is positioned in a socket which is defined in the first surface 40 of the casing 4.

[00122] The microscope module 1 further comprises a reflective element 27 which is provided on the first glass window 5. In this example the reflective element 27 is a reflective disk 27, which is stacked on the first glass window 5, preferably on the side of the glass window 5 facing the lenses 2, so that a reflective surface 27b of the reflective element 27 abuts the first glass window 5. In another embodiment the reflective element 27 comprises a reflective surface 27b which has been deposited on a surface of the first glass window 5, for example by vacuum-deposition of a metal layer, preferably on the side that faces the lenses 2. The reflective element 27 has an aperture 27a defined therein through which light can pass. The reflective element 27 is arranged so that the centre of the aperture 27a lies on the single common axis 2a.

[00123] The microscope module 1 comprises an attachment means 8 which allows the microscope module 1 to be removably attached to a surface of a mobile device. The attachment means 8 comprises an elastic layer 8' which is mounted on and secured to a non-elastic layer 8". The non-elastic layer 8" in turn is secured to the PCB 10. The elastic layer 8' and non-elastic layer 8" preferably have equal shape and dimensions to which they can align with one another when secured.

[00124] The elastic layer 8' further comprises a plurality of projections 80 which have a hexagonal cross section; channels 81 are defined between the plurality of projections 81, in order to allow air removal. Adhesive material is provided on the projections 81 or the elastic layer itself contains adhesive properties such as to enable the microscope module 1 to be removably attached to the surface of a mobile device when the elastic layer 8' is positioned to abut said surface.

[00125] The attachment means 8 has a cut-out portion 91 defined by a first cut-out 91a provided in the elastic layer 81' and a second cut-out 91b provided in a corresponding position in the non-elastic layer 81"; the first and second cut-outs 91a,91b are aligned when the elastic layer 81' and non-elastic layer 81" are stacked so as to define the cut-out portion 91. Centres of both the first and second cut-outs 91a,91b lie on the single common axis 2a, thus allowing light to pass through the attachment means 8 into the lenses 2 of the microscope module 1.

[00126] In addition there is provided in the microscope module 1, a driver 61 for the different light sources 9a-d,17a-d,33a-d (referred to as "illumination driver" in the following). The illumination driver 61 supplies a current to the various light sources 9a-d,17a-d,33a-d and therefore drives an intensity of light emission from the respective light sources 9a-d,17a-d,33a-d. The illumination driver 61 can be chosen with multiple channels such that each one of the light sources can be connected to at least one individual channels of the illumination driver 61.

[00127] In addition there is provided in the microscope module 1, a motor driver 62. The motor driver 62 supplies a current to the motor assembly 3 and thereby can drive the arms 3c of the motor assembly 3 relative to the anchor member 3b. For example, if the motor assembly 3 comprises a voice-coil motor, the motor driver 62 is equipped to drive a voice-coil motor.

[00128] The microscope module 1 comprises a battery 63 that can guide as a source of electrical current. In this example, there is provided a rechargeable lithium-ion battery 63. A charging connector 64 is formed on the microscope module 1 in order to enable recharging of the rechargeable battery 31 and a power management integrated circuit (PMIC) 65 is formed on the microscope module 1 in order to handle the correct amounts of charge- and discharge-currents. Preferably, the charging connector 64 employs a micro-USB interface.

[00129] A micro-controller 66 is formed on the microscope module in order to control the different electronic units (e.g. illumination driver 61, motor driver 62 and PMIC 65) that the microscope module 1 comprises. To provide input to the micro-controller 66 there is also formed a communication unit 67 on the microscope module 1. The communication unit 67 enables forwarding of a digital signal from a mobile device to the micro-controller 66 and enables translation of said digital signal, if necessary. Preferably it is employed a wireless Bluetooth module, most preferably a low-energy Bluetooth module, as a communication unit 67. However, it is understood that the communication unit 67 can also comprise a cable-bound communication solution, such as a micro-USB interface. The micro-USB interface.

[00130] The microscope module 1 may further comprise a button 68 with haptic feedback, the button enabling simple control of certain electronic units (e.g. illumination driver 61, motor driver 62 and PMIC 65 and communication unit 67). For example, the button 68 can be used to turn on power when pressed shortly. The button could also enable initiation of a pairing mode, in case the communication unit 67 is made as a Bluetooth module.

[00131] Figure 2 illustrates the configuration and positioning of the curved reflective surfaces 12a-d of the first group 12, configuration and positioning of the curved reflective surfaces 16a-d of the second group 16, and the configuration and positioning of the first group 9 of light sources 9a-d and second group 17 of light sources 17a-d, in the microscope assembly shown in Figure 1.

[00132] As mentioned curved reflective surfaces 12a-d are arranged symmetrically with respect to the single common axis 2a. Each of the curved reflective surfaces 12a-d of the first group 12 is arranged to receive light from a respective light source 9a-d in the first group 9 of light sources 9a-d and to direct received light away from the microscope module 1.

[00133] As illustrated in Figure 2 each curved reflective surface 12a-d is profiled so that it has a first (f1) and second (f2) focal point.

[00134] The curved reflective surfaces 12a-d are each profiled so that the second (f2) focal points are located at the position of a respective light source 9a-d belonging to the first group 9. Thus each of the plurality of light sources 9a-d of the first group 9 of light sources 9a-d is positioned at the second focal point of a respective pair 12a-d. The curved reflective surfaces 12a-d are profiled such that their first focal point (f1) lies on the single common axis 2a such that light emitted by the light sources 9a-d at the second focal point (f2) is guided by the curved reflective surfaces 12a-d towards the first focal point (f1), which intersects with the single common axis 2a.

[00135] The second group 16 of curved reflective surfaces 16a-d is also arranged symmetrically with respect to the single common axis 2a. Each curved reflective surface 16a-d is arranged to receive light from a respective light source 17a-d belonging to the second group 17 and to direct received light away from the microscope module 1. Each of the curved reflective surfaces 16a-d in the second group 16 has a profile which has a shape of part of an ellipse so that each of the curved reflective surfaces 16a-d has a first (f1) and second (f2) focal point. The reflective surfaces 16a-d of the second group 16 are each profiled such that a first focal point (f1) of each of the plurality of curved reflective surfaces 16a-d lie on said single common axis 2a. A respective light source 17a-d belonging to the second group 17 is positioned at a second focal point (f2) of a respective curved reflective surface 16a-d of the second group 16.

[00136] Each of the curved reflective surfaces 16a-d,12a-d may each have a profile that is at least partly described by the following formula:

$$\frac{\vec{x}^2}{a^2}+\frac{\vec{y}^2}{b^2}=1$$

where $\vec{x}$ is a vector that points from the position of the respective light source towards the single common axis 2a, and which is perpendicular to the single common axis 2a. And where $\vec{y}$ is a vector that is perpendicular to both the single common axis 2a and to $\vec{x}$, wherein the length of both vectors is measured from a reference point that is situated along the $\vec{x}$-direction halfway between the single common axis 2a and the respective light source 17a-d,9a-d. a is equal to the distance between the reference point and a point on the respective reflective surface 16a-d,12a-d where $\vec{y}$ = 0, and wherein b is smaller than a. If the curved reflective surface is a member of the first group 12 of reflective surfaces 12a-d, then the length of b is preferably not less than one fifth of the length of a. If the curved reflective surface is a member of the second group 16 of reflective surfaces 16a-d, than b does preferably not have less than half the length of a. a is preferably chosen larger than half the distance between the respective light source 17a-d,9a-d and the single common axis 2a.

[00137] Each of the curved reflective surfaces 12a-d of the first group of reflective surfaces 12 may each have a profile that is at least partly described by the following formula

$$\frac{\vec{x}^2}{a^2}+\frac{\vec{y}^2}{b^2}=1$$

where $\vec{x}$ is a vector that points from the position of the respective light source 9a-d towards the single common axis 2a, and which is perpendicular to the single common axis 2a. And where $\vec{y}$ is a vector that is perpendicular to both the single common axis 2a and to $\vec{x}$, wherein the length of both vectors is measured from a reference point that is situated at a distance from the single common axis 2a along the $\vec{x}$-direction, said distance being equal to 1.5 times the distance between the single common axis 2a and the respective light source 9a-d. a is equal to the distance between the reference point and a point on the respective reflective surface 12a-d where $\vec{y} = 0$, and wherein b is smaller than a. b does preferably not have less than half the length of a. Preferably a is larger than half the distance between the respective light source 9a-d and the single common axis 12.

[00138] Figure 3 provides an illustration of the microscope module 1 of Figure 1, taken along line A-B of Figure 1.

[00139] As can be best seen in Figure 3a, a UV filter layer 6 and a second glass window 7 is contained within the volume define by the aperture 10a; the UV filter layer 6 and second glass window 7 are stacked one on top of the other and are secured to the PCB 10. The second glass window 7 is shown to have dimensions which are larger than the dimensions of the UV filter layer 6.

[00140] The holder 3 is secured to a PCB 10; the lenses 2 are held within the passage 3a above a plane of a surface 10b of the PCB 10. The first glass window 5 seals the passage 3a at one end of the holder 3. The holder 3 is longer than the length of the stack of three lenses 2 so that a first airgap 88a is provided between the first glass window 5 and the lenses and a second airgap 88b is provided between the lenses 2 and the UV filter layer 6. In the example shown in Figure 3 the holder 3 is defined by a motor assembly 3 which comprises an anchor member 3b and arms 3c which hold the lenses 2 and can move relative to the anchor member 3b, along tracks defined in the anchor member 3b, in a direction which is along the common axis 2a; a motor is provided which moves the arms 3c in a direction which is along the common axis 2a thus enabling focusing of the lenses 2 (i.e. enabling movement of a focal point of the lenses 2 along the single common axis 2a)

[00141] The light sources 9a,9c from the first group 9 of light sources are shown secured to and supported on the PCB 10. A surface 10b of the PCB 10 lies on a single plane only. The light sources 9a,9c extend a distance above surface 10b of the PCB 10. The holder 3 holds the lenses 2 at distance above the plane of the surface 10b of the PCB 10. The distance above the surface 10b of the PCB 10 to which each of light sources 9a,9c extend is less than, or equal to, the distance between the plane of the surface 10b of the PCB 10 and the lenses 2. Preferably the distance above the surface of the PCB 10 to which each of light sources 9a,9c extend is less than, or equal to, the distance between the plane of the surface 10b of the PCB 10 and a surface 2b of the lenses 2 which is furthest away from the PCB 10.

[00142] The curved reflective surfaces 12a-d belonging to the first group 12 are also illustrated. As can be seen the portion 12' of the curved reflective surfaces 12a-d which is furthest from the single common axis 2a overhangs a respective light source 9a,9b. The portion 12" of the curved reflective surfaces 12a-d which is closest to the single common axis 2a is slanted towards the common axis 2a moving away from the PCB 10, such that light is reflected from both surfaces 12' and 12" is directed towards the single common axis 2a. It will be understood that all of the curved reflective surfaces 12a-d will have a similar configuration; thus each curved reflective surface 12a-d will have a portion 12' that will overhang a respective light source 9a-d of the first group of light sources 9, and a portion 12" which slants towards the common axis 2a moving away from the PCB 10.

[00143] Figure 4 is an exploded view of a microscope module 100 according to a second embodiment of the present invention. The microscope module 100 has many of the same features as the microscope module 1 shown in Figure 1 and like features are awarded the same reference numbers.

[00144] In the microscope module comprises a first group 412 of reflective surfaces 412a-d (in this case four). In this example the plurality of reflective surfaces 412a-d are arranged symmetrically with respect to the single common axis 2a. Each of the reflective surfaces 412a-d of the first group 412 is arranged to receive light from a respective light source 9a-d in the first group 9 of light sources 9a-d and to direct received light away from the microscope module 100. Each reflective surface 412a-d is profiled to define an part-ellipsoidal volume; a respective light source 9a-d is located within the part-ellipsoidal volume.

[00145] Figure 5 shows a magnified, part cross-section, view of a portion of the microscope module 100. Figure 5 illustrates the main features which differentiate the microscope module 100 from the microscope module 1 of Figure 1.

[00146] Unlike the microscope module 1 of Figure 1, in the microscope module 100, each reflective surface 412a-d is arranged such that it has a first focal point (f1) which lies on the perimeter 5c of the first glass window 5, and not at the common axis 2a. Accordingly the first glass window 5 can receive light from each reflective surface 412a-d at its perimeter 5c; the received light will enter the interior of the first glass window 5 and at least part of the light will be internally reflected along the glass window 5 (in a wave-guide mode).

[00147] The microscope module 100 further comprises a diffuser 28 which is arranged to diffuse light which has been internally reflected in the first glass window 5 so that at least part of the internally reflected light is directed away from the microscope module 1. In this example the diffuser 28 is integral to the first glass window 5 and is defined by an area of the

first glass window 5 which has been treated to provide it with an increased roughness; specifically the diffuser 28 comprises a ring-shaped area 28 of the first glass window 5 which has increased roughness. The roughness of the ring-shaped area 28 is between 100nm - **10**μm and is preferably between 200nm - **2**μm**.** An area 5a of the first glass window 5 which is contained within the ring-shaped area 28 defining the diffuser 28 and an area 5b of the first glass window 5 which is outside the ring-shaped area 28 defining the diffuser 28 has a roughness which is less than the roughness of the ring shaped area 28; preferably the roughness of these areas 5a,5b is less than 100nm and is preferably less than 10nm.

[00148] In the microscope module 100 the dimensions of the aperture 27a which is defined in the reflective element 27 are smaller than the dimensions of the diffuser 28 so that light diffused by the diffuser 28 cannot pass through the aperture 27a and directly enter the lenses, but instead is reflected away from the microscope module. In this example the diffuser 28 is a ring-shaped area 28 of the first glass window 5 and the aperture 27a defined in the reflective element 27 is circular shaped to correspond to the shape of the diffuser 28. The dimensions of an inner perimeter of the diffuser 28 match the dimensions of the circular aperture 27a defined in the reflective element 27; thus in this example the reflective element 27 overlays the portion of the first glass window 5 which does not have any diffuser 28 and the reflective element 27 does also overlay the diffuser 28.

[00149] In a variation of this embodiment the perimeter 5c of the first glass window 5 is provided with a reflective material. The portions of the perimeter 5c of the first glass window 5 which are located at the focal point of the reflective surfaces 4 12a-d are without reflective material, so as to allow light to enter into the first glass window 5 and be internally reflected within the first glass window 5. The reflective material can be part of the casing 4 that locally encloses the perimeter 5c of the glass window 5. The reflective material at the perimeter 5c will reflect light which has been internally reflected all the way through the entire width of the first glass window 5 (i.e. which has passed through the diffuser 28 without being diffused); the reflected light will pass through the diffuser 28 for a second time where it will be diffused.

[00150] Each of the curved reflective surfaces 412a-d of the first group of curved reflective surfaces 412 may each have a profile that is described by the following formula:

$$\frac{x^2 + y^2}{a^2} + \frac{z^2}{c^2} = 1$$

where $\vec{z}$ is a vector that points from the position of the respective light source 9a-d towards the perimeter 5c of the glass window 5 and crosses the single common axis 2a. And where $\vec{x}$ is vector that is perpendicular to the single common axis 2a and to $\vec{z}$ and where $\vec{y}$ is a vector that is perpendicular to $\vec{z}$ and to $\vec{x}$. $\vec{x}$, $\vec{y}$ and $\vec{z}$ are measured from a reference point that is situated along the $\vec{x}$-direction halfway between the perimeter 5c of the glass window 5 and the position of the respective light source 9a-d. The value of a is equal to the distance along the $\vec{x}$- or $\vec{y}$-direction between the reference point and a point of the respective reflective surface 412a-d and wherein c is larger than a, preferably c is more than 1.5 times larger than a but smaller than 5 times a. c is preferably chosen larger than the distance along the $\vec{x}$-direction between the respective light source 9a-d and the perimeter 5c of the glass window 5.

[00151] Figure 10 is a plan view illustrating the positioning of the configuration and positioning of reflective surfaces 412a-d of the first group 412 of curved reflective surfaces in the microscope module 100. The reflective surfaces 412a-d are arranged symmetrically with respect to the single common axis 2a. Each of the reflective surfaces 412a-d is arranged to receive light from a respective light source 9a-d in the first group 9 of light sources 9a-d and to direct received light away from the microscope module 100. It will be understood that any number of reflective surfaces 412a-d may be provided; in one embodiment three reflective surfaces are provided (each of which defines a part-ellipsoidal volume); the three reflective surfaces may be arranged symmetrically around the common axis 2a e.g.

120° spacing between each reflective surface. In another embodiment the reflective surfaces 412a-d of the first group of reflective surfaces 412 are arranged asymmetrical with respect to the single common axis 2a, such that no two light sources 9a-d are oriented directly opposite one another and hence light travelling from the perimeter 5c of the first glass window 5, through the first glass window 5, and through the single common axis 2a towards the opposite edge of the first glass window 5, can be reflected at the opposite edge of by the reflective material that is provided at the perimeter 5c of the first glass window 5. The reflected light will be sent back through the first glass window 5 for a second time where is may be diffused by the diffuser. It should be understood that the respective portions of the perimeter 5c of the first glass window 5 which is adjacent to the reflective surfaces 412a-d are without reflective material so as to allow the light to be received from the reflective surfaces 412a-d into the first glass window 5.

[00152] Each reflective surface 412a-d is profiled so that it has a first (f1) and a second (f2) focal point, and wherein the first (f1) focal point of each of the reflective surfaces 412a-d is located at the perimeter 5c of the glass window 5. The second (f2) focal point is located the position of the light source 9a-d belonging to the first group 9 of light sources 9a-d.

[00153] The configuration and positioning of the curved reflective surfaces 16a-d of the second group 16, and the configuration and positioning of the second group 17 of light sources 17a-d, is the same as shown in Figure 2 for the microscope assembly 1.

[00154] In the embodiments of the microscope modules 1,100 described above the microscope modules 1,100 are provided with both a first group 9 of light sources 9a-d and a second group 17 of light sources 17a-d, and with both a first group 12,412 of curved reflective surfaces 12a-d,412a-d and a second group 16 of curved reflective surfaces 16a-d. Importantly it should be understood that having two groups of light sources and two groups of curved reflective surfaces is not essential to the present invention: In another embodiment the microscope module comprises only one single group of light sources and only one single group of curved reflective surfaces is provided in the microscope module; for example the microscope module may comprise exclusively the first group 9 of light sources 9a-d and the first group 12,412 of curved reflective surfaces 12a-d,412a-d only (i.e. no second group 17 of light sources 17a-d, and no second group 16 of curved reflective surfaces 16a-d is provided); or in another exemplary embodiment the microscope module may comprise exclusively the second group 17 of light sources 17a-d, and the second group 16 of curved reflective surfaces 16a-d (i.e. no first group 9 of light sources 9a-d and the first group 12,412 of curved reflective surfaces 12a-d is provided).

[00155] Figure 6 provides a perspective view of a slide holder 13 according to a further aspect of the present invention. The slide holder 13 comprises a platform 13a having a groove 34 defined therein. The groove 34 is dimensioned so that it can receive a slide. Figure 6 illustrates a standard slide 22 which has been positioned into the groove 34. In an embodiment the shape and dimensions of the perimeter of the platform 13a are equal to the shape and dimensions of the elastic layer 8' of the attachment means 8 in the microscope module 1,100; this allows the slide holder 13 to be attached to the elastic layer 8' when the microscope module 1,100 (and slide holder 13) is not in use. Advantageously attaching the slide holder 13 to the elastic layer 8' prevents dirt and particles from collecting on the elastic layer 8'. Thus there is provided an assembly according to a further aspect of the present invention which comprises a microscope module 1,100 and slide holder 13 which is mounted on the attachment means 8 of the microscope module 1,100 so that the slide holder 13 is attached to the attachment means 8.

[00156] Referring again to Figure 6, it can be seen that the platform further comprises a trench 23 defined therein. A surface 24 which defines a base of the trench 23 comprises reflective material. The trench 23 has a depth which is deeper than the depth of the groove 34. The trench 23 may have a depth between 0.1 mm-2cm, but preferably has a depth of between 0.5mm-5mm; the groove 34 has a depth between 0.5mm-5mm, but preferably has a depth of between 0.8mm - 1.2mm. Thus a surface 35 which defines a base of the groove 34 and the reflective surface 24 which defines a base of the trench 23 are parallel but lie of different planes.

[00157] In one embodiment no trench is provided in the groove 34; in this embodiment the groove 34 is preferably '+' shaped, consisting of a first and second grooves which are orthogonal to one another. The first and second grooves have equal depths. Preferably a base surface of one of the first or second groove comprises reflective material.

[00158] In the Example shown in Figure 6 the groove 34 comprises a first groove subsection 34a and a second groove subsection 34b wherein the trench 23 is interposed between the first groove subsection 34a and the second groove subsection 34b and wherein the depth of the first groove subsection 34a and the second groove subsection 34b is equal. The first groove subsection 34a, second groove subsection 34b and trench 23 cumulatively extend the full length of the platform 13a.

[00159] The first groove subsection 34a and the second groove subsection 34b each have a depth between 0.5mm-5mm. The first groove subsection 34a has a width between 25mm-30mm and a length between 1mm-75mm. The second groove subsection 34b has a width between 25mm-30mm and a length between 1mm-75mm.

[00160] As illustrated in Figure 7 the dimensions of the trench 23 are smaller than the dimensions of the standard slide 22 such that an airgap 123 is provided between the slide 22 and reflective surface 24 of the trench 23 when a slide 22 is positioned in the groove 34. In this example the trench 23 has a width between 25mm-50mm and a length between 5mm-50mm so that the reflective surface extends beyond the field of view of the lenses 2. The dimensions of the trench 23 are smaller than the dimensions of the standard slide 22. The standard slide 22 has a length of 70mm - 80mm and a width of 20mm-30mm. Preferably, the trench 23 is wider than the standard slide 22.

[00161] In another embodiment there is provided a slide holder 130 as shown in Figure 13. The slide holder 130 has at least two grooves 340 defined in the platform 130a, each of the two groove 340 can have at least one trench 230 formed therein. In Figure 13 it is illustrated that in one embodiment the slide holder 130 comprises a first groove 341 and a second groove 342, each groove being composed of a respective first groove subsection 341a,342b and a respective second groove subsection 341 a,342b. The slide holder 130 can also comprise two trenches but in the present example a trench 231 is formed only within the first groove 341 a onlyl while the second groove has no trench. Instead the second groove is '+' shaped formed by two orthogonal groove subsections, wherein the second groove subsection is provided with reflective material 242 at its base surface. The trench 231 that is formed within the first groove 341 also comprises reflective material 241 at its base surface. The reflective material 241 at the base of the trench 231 has different reflective properties to the reflective material 232 at the base of the second groove subsection 341 b of the second groove 341 .

[00162] In the example illustrated in Figure 13 the trench 231 formed in between the first groove 341 a and the second groove 341 b comprises a reflective surface 241 having diffuse reflection properties, meaning that reflection of light at the reflective surface of the trench majorly occurs in a non-specular manner. The reflective surface provided at the base of the other trench 232 is white colored (e.g. comprises white paint) and/or comprises a metal with a surface roughness of greater than 500nm and preferably larger than 1000nm.

[00163] The trench has a depth which is deeper than the depth of the first groove 341 . The trench 231 may have a depth between 0.1 mm-2cm, but preferably has a depth of between 1mm-10mm; the first groove 341 has a depth between 0.5mm-5mm, but preferably has a depth of between 0.8mm - 1.2mm. Thus a surface 351 which defines a base of the first groove 341 and the reflective surface 241 which defines a base of the trench 231 are parallel but lie of different planes.

[00164] In the example illustrated in Figure 13 the first groove subsection 342a and the second groove subsection 342b of the second groove 342 are arranged perpendicular to each other in a '+' shaped arrangement, and wherein the second groove subsection 342b comprises a reflective surface 242 with a surface roughness of less than 10nm, so that it can reflect light a specular manner.

[00165] The first groove subsection 342a and the second groove subsection 342b have an equal depth of between 0.8mm-1 .2mm. In this example the depth of the first and second groove subsections is 1mm. The first groove subsection 342a is formed from one end of the slide holder 130 to the other end of the slide holder 130 and has a width between 20-30mm, wherein in the present example is is formed with 26mm. The second groove subsection 342b is formed perpendicular and across the first groove subsection 342a. The second groove subsection 342b has a width and a length between 10mm-50mm, wherein in the present example the width is 30mm. The second groove subsection 342b does preferably not expand to the edge of the slide holder 130.

[00166] It will be understood that the slide holder 130 could be used with either of the microscope modules 1,100 above, or with an embodiment of microscope module which comprises only one single group of light sources and only one single group of curved reflective surfaces, in order to perform analysis of a specimen.

[00167] Figure 8 provides a cross-sectional view of an assembly 70 according to a further aspect of the present invention. Figure 9 provides a perspective view of the assembly 70 shown in Fig. 8.

[00168] Referring to Figures 8 and 9 the assembly 70 comprises a mobile device 14 in the form of a smart phone 14 having an integrated camera 15 comprising at least an photographic sensor 15a and a lens 15b; a microscope module 1,100 as shown in Fig. 1; and slide holder 13 of Fig. 5 which supports a slide 22 having a sample 20 thereon.

[00169] In the assembly 70 the microscope module 1,100 is arranged to abut the mobile device 14 and is positioned such that the lenses 2 of the microscope module 1,100 overlay the lens 15a of the camera 15 of the mobile device 14.

[00170] The slide holder 13 is arranged in the assembly 70 such that the single common axis 2a intersects the reflective surface 24 which defines a base of the trench 23. Such positioning ensures that the reflective surface 24 defining the base of the trench 23 is within the field of view lenses 2. In the most preferred embodiment the reflective surface 24 defining the base of the trench 23 should overlay (simultaneously) all of the light sources 9a-d,1 7a-d of in the microscope module 1,100. During use, the reflective surfaces 12a-d,16a-d will assist directing light in a controlled manner to the sample and eventually into the lenses 2 when performing bright field analysis or away from the lenses when performing dark field analysis.

[00171] A slide 22 which supports a sample 20 on a surface thereof, is positioned within the groove 34 of the slide holder 13 so that the sample 20 overlays the reflective surface 24 defining the base of the trench 23; an airgap 123 is defined between the slide 22 and a reflective surface 24 defining the base of the trench 23. In this example the reflective surface 24 is formed with a mirror-finish (e.g. the reflective surface 24 comprises metal (e.g. Aluminum) with a surface roughness smaller than 10nm), such that light rays impinging on the reflective surface are reflected in a specular manner.

[00172] The distance (di) between each of the light sources in 9a-d the first group 9 and the single common axis 2a may be less than "**tan** (**CRA**$_{max}$+α_{NA})·(**i**+**2**(/2i+/22)) + tan(sin(CRA$_{max}$+α_{NA})·«-1)-2^ + *r*" but be larger than the radius of the glass window 5, wherein CRA_{max} is the maximum critical ray angle of the lenses 2; α_{NA} is equal to arcsin(NA), where NA is the numerical aperture of the lenses 2; t is the distance along the single common axis 2a between each light source 9a-d and a surface of the first glass window 5; h_1 is the distance between a surface of the first glass window 5 and the focal point of the lenses 2; h_2 is the thickness of the airgap 123; g is the thickness of the slide 22; and wherein the first glass window 5 is circular and r is the radius of the first glass window 5.

[00173] The distance (di) between each of the light sources in 17a-d the second group 17 and the single common axis 2a may be larger than "$\tan(CRA_{max}+a_{NA})\cdot(t+2(h_1+h_2)) + \tan(\sin(CRA_{max}+\alpha_{NA})\cdot$«$-1)\cdot 2g + r$", wherein CRA_{max} is the maximum critical ray angle of the lenses 2; α_{NA} is equal to **arcsin(NA),** where **NA** is the numerical aperture of the lenses 2; t is the distance along the single common axis 2a between each light source 17a-d and a surface of the first glass window 5; h_1 is the distance between a surface of the first glass window 5 and the focal point of the one or more lenses; h_2 is the thickness of the airgap 123; g is the thickness of the slide 22; and wherein the first glass window 5 is circular and r is the radius of the first glass window 5.

[00174] The microscope module 1 and the slide holder 13 can be used with a mobile device 14 to implement a method according to a further aspect of the present invention: During use the user will attach the microscope module 1 to a mobile device 14 having an integrated camera 15 with an photographic sensor 15a and a lens 15b, such that the one or more lenses 2 of the microscope module 1 overlay the lens 15b of the camera 15 of the mobile device 14; they will insert a slide 22 having a sample 20 thereon, into the groove 34 of the slide holder 13, and arrange the slide 22 so that the sample 20 overlays the reflective surface 24 which defines a base of the trench 23, wherein there is an airgap 123 between the reflective surface 24 which defines a base of the trench 23 and the slide 22. The assembly 70 of microscope module 1 and mobile device 14 are then placed onto the slide holder 13 such that the single common axis 2a intersects with the centre of the reflective surface 24 of the trench 23 of the slide holder 13. Once these steps are completed the user will have formed the assembly 70 illustrated in Figures 8 and 9. In one embodiment the slide holder 13 will be attached to the attachment means 8 of the microscope module 1, and the method will comprise the steps of detaching the slide holder 13 from the attachment means 8 before attaching the microscope module 1 to the mobile device 14.

[00175] After the assembly 70 has been formed the user can operate one of the one or more light sources 9a-d,17a-d,33a-d of the microscope module 1. Light is received at the lenses 2 of the microscope module 1; and the received light is passed to the lens of the camera 15b of the mobile device 14 and by the lens of the camera 15b of the mobile device 14 it is focused onto the photographic sensor 15a of the mobile device 14. The light is then processed in the mobile device 14 to generate an image; and the image is displayed on a screen of the mobile device 14.

[00176] The user may operate the assembly 70 to perform bright field analysis by, operating a first group 9 of light sources 9a-d to emit light. Because the light sources 9a-d and the curved reflective surfaces 12a-d belonging to the first group 12, are located closer to the lenses 2 than the second group 17 of light sources light sources 17a-d and second group of curved reflective surfaces 16a-d, the light originating from the light sources 9a-d can follow a steeper path than light originating from the light sources 17a-d; this ensures that greater amount of light is received into the lenses 2; thus the light sources 9a-d are most suited to perform bright field analysis.

[00177] Fig. 11a shows the light path when performing bright field analysis with the assembly of Fig. 8 that incorporates a microscope module 1 of Figure 1.

[00178] Some of the light which is emitted by each of the respective light sources 9a-d will be reflected by the curved reflective surfaces 12a-d belonging to the first group 12. The light will then be reflected by the respective curved reflective surfaces 12a-d to the reflective surface 24 which defines a base of the trench 23 of the slide holder 13. The light will be reflected by the reflective surface 24 of the trench 23, will pass through the sample 20 which is on the slide 22, and will be received by said lenses 2 of the microscope module 1. The light may be reflected back and forth between the reflective element 27 of the microscope module and the reflective surface 24 of the trench 23, and on at least some occasions passing through the sample 20. Because the plurality of light sources 9a-d of the first group 9 of light sources 9a-d are positioned at the second focal point (f2) of a curved reflective surface 12a-d; and because each curved reflective surface 12a-d is profiled such that its first focal point (f1) lies on the single common axis 2a, portions of the emitted light will eventually be received by said lenses 2 of the microscope module 1 after it passes through the sample 20 which is on the slide 22.

[00179] The light which is received by the lenses 2 will be passed to the lens 15b of the camera 15 of the mobile device 14. The light is then processed in the mobile device 14 by the photographic sensor 15a to generate an image (e.g the processing of the light may include focusing the light onto the photographic sensor 15a of the mobile device 14); and the image is displayed on a screen of the mobile device 14.

[00180] The user may alternatively operate the assembly 70 to perform dark field analysis. Fig. 11b shows the light path when performing dark field analysis with the assembly of Fig. 8.

[00181] Because the second group of light sources 17 and the second group of curved reflective surfaces 16 are further away from the lenses 2 than the light sources 9a-d and the respective curved reflective surfaces 12a-d,412a-d belonging to the first group 12,412, the light originating from the light sources 17a-d can follow a shallower path than light originating from the light sources 9a-d; this ensures that greater amount of light is deflected away from the lenses 2 (i.e. a great amount of light is not received into the lenses 2); thus light sources 17a-d are most suited to be used to perform dark field analysis.

[00182] To perform dark field analysis the user operates the second group of light sources light sources 17 to emit light. Some of the light which is emitted by respective light sources 17a-d will be reflected by respective curved reflective surfaces 16a-d belonging to the second group 16. The curved reflective surfaces 16a-d will deflect the majority of light which is emitted by the respective light sources 17a-d so that the majority of emitted light is not received into the lenses 2 (e.g. the curved reflective surfaces 16a-d will deflect the majority of light along a path which passes over the lenses 2 but not into the lenses 2) but that the light passes through the area of the focal plane of the lenses 2 such that a sample 20 can be illuminated. Some emitted light will be received at the lenses 2 of the microscope module 1 through scattering from the sample 20; the light which is received at the lenses 2 is then passed to the lens 15b of the camera 15 of the mobile device 14. The light is then processed in the mobile device 14 to generate an image (e.g. processing of the light may include focusing the light onto a photographic sensor 15a of the mobile device 14); and the image is displayed on a screen of the mobile device 14. The position of the focal points cause the light to be deflected away from the lenses 2 for dark field analysis; because the distance between the second group of light sources 17 and the common axis 2a is larger than the distance between the first group of light sources 9 and the common axis 2a, the light which is incident towards the lenses 2 at such a shallow angle that it is not received into the lenses 2.

[00183] It should be remembered that the curved reflective surfaces 16a-d in the second group of curved reflective surfaces 16 are each positioned further away from the single common axis 2a as each of the curved reflective surfaces 12a-d belonging to the first group 12. In other words the curved reflective surfaces 12a-d in the first group 12 are positioned closer to the single common axis 2a than the curved reflective surfaces 16a-d in the second group 16; it is this positioning which ensures that the light which is deflected by the curved reflective surfaces 12a-d in the first group 12, pass through the sample 20 at an angle such that it is received into the lenses 2 of the microscope module 1 thus allowing bright field analysis of the sample 20, and ensures that majority of the light which is deflected by the curved reflective surfaces 16a-d in the second group 16 passes through the sample 20 at an angle such that is it directed away from the lenses 2 (i.e. is not received into the lenses 2 thus allowing for dark field analysis of the sample 20.

[00184] Using the microscope module 100 shown in Fig. 4 in place of the microscope module 1 in the assembly 70, provide an assembly according to a further embodiment of the present invention. If the microscope module 100 shown in Figure 4 is used in the assembly 70 in place of the microscope module 1, then the assembly would operate differently when performing bright field analysis. Fig. 12 shows the light path when the assembly 70 has the microscope module 100 of Fig. 4, when performing bright field analysis:

[00185] After the assembly 70 has been formed using the microscope module 100 in place of the microscope module 1, the user may operate the first group 9 of light sources 9a-d to emit light. Some of the light which is emitted by each of the respective light sources 9a-d will be reflected by the curved reflective surfaces 412a-d belonging to the first group 412. Since the each curved reflective surfaces 412a-d is profiled such that its first focal point (f1) lies on the perimeter 5c of the first glass window 5 the light which is reflected by the curved reflective surfaces 412a-d will be received into the first glass window 5 at the perimeter 5c of the first glass window 5. Some of the received light will be captured in the glass window 5 by total internal reflection; Upon reaching the diffuser 28 part of the light which has been captured in the first glass window 5 is re-emitted from the glass window 5 at the diffuser 28; if the diffuser 28 is formed as an area with higher roughness, light will be uniformly emitted in all directions; because the inner radius of the diffuser 28 is larger than the aperture 27a, the majority of light will not be directly collected by the lenses 2. Light guided in the direction of the microscope module 100 will be reflected at the reflective element 27 and be guided away from the microscope adapter, towards the sample. The light will be reflected by the reflective surface 24 of the trench 23, will pass through the sample 20 which is on the slide 22, and will be received by said lenses 2 of the microscope module 1. The light which is received by the lenses 2 will be passed to the lens 15b of the camera 15 of the mobile device 14. The light is then processed in the mobile device 14 on the photographic sensor 15a in order to generate an image (e.g. the processing may involve focusing the light onto a photographic sensor 15a of the mobile device 14); and the image is displayed on a screen of the mobile device.

[00186] It should be understood that in each of the above mentioned assemblies the first and second groups of light sources 9,1 7 may be operated simultaneously; this allows both dark field analysis and bright field analysis to be performed simultaneously. In some samples 20 certain species are best visible under dark field analysis and other species are best visible under bright field analysis; by operating the first 9 and second groups 17 of light sources simultaneously both those species which are best visible under dark field analysis and those which are best visible under bright field analysis will be visible.

[00187] It is possible to perform bright-field and dark-field analysis using an embodiment of the microscope module 1,100 which comprises only one single group of light sources 9,17. For example, using a microscope module 1,100 which comprises only the second group of light sources 17 (i.e. no first group of light sources 9). Such a microscope module can be used with a slide holder 130 according to Fig. 13 in order to perform bright-field and dark-field analysis. First, the microscope module is attached to a mobile device 14 such that the lenses 2 are aligned with a lens 15b of the mobile device 14 to form an assembly 70. A slide 22 on which the sample 20 to be tested is supported, is positioned in the second groove 342 so that the sample is above the reflective base of the trench 232. The assembly is then positioned so that reflective base of the trench 232 is within the field of view of the lenses 2 as illustrated in Fig. 11b. Dark field analysis of the sample 20 can then be performed by operating the light sources 17 in the microscope module and capturing an image using the camera 15 of the mobile device 14.

[00188] In a variation of the embodiment dark-field analysis can also be performed with a slide holder 130 that is without a reflective material at the base surface of at least one of its trenches 231,232. In this variation the base of the trench is instead coloured in black. When placing the field of view of the lenses 2 above the black-coloured trench, the black colour will absorb most of the stray light.

[00189] In Figure 14 illustrated performing bright field analysis; First, the microscope module 1,100 is attached to a mobile device 14 such that the lenses 2 are aligned with a lens 15b of the mobile device 14 to form an assembly 70. A slide 22 on which the sample 20 to be tested is supported, is positioned in the first groove 341 so that the sample is above the reflective base of the trench 231 . The assembly 70 is then positioned so that reflective base 241 of the trench 231 is within the field of view of the lenses 2 as illustrated in Figure 14. Importantly the reflective based 241 comprises material which reflects light diffusively (i.e. has diffuse reflection properties) - this supports bright-field illumination due to random redistribution of the angles of light rays that are reflected from the reflective surface 241 of the trench 231 . Therefore, it is possible to perform bright-field analysis even if only the second group of light sources 17 is formed on the microscope module. Bright field analysis of the sample 20 can then be performed by operating the light sources in the microscope module and capturing an image using the camera 15 of the mobile device 14. It should be understood that the bright field analysis illustrated in Figure 14 can also be perform using an embodiment of the microscope module which comprises only one single group of light sources and only one single group of curved reflective surfaces.

[00190] In a further variation each of the above mentioned assemblies, the microscope module 1,100 can be used to perform fluorescent microscopy. As mentioned each of the microscope modules 1,100 comprises UV light source 33a-d. In order to perform fluorescent microscopy the UV light sources 33a-d are operated so that they each emit UV light. Some of the emitted UV light will be reflected by respective curved reflective surfaces 16a-d belonging to the second group 16. The curved reflective surfaces 16a-d will deflect the majority of the UV light so that it passes into the sample 20 and is directed away from the lenses 2 (e.g. into the sample and then along a path which passes over the lenses 2 but not into the lenses 2). Some of the UV light which passes into the sample 20 will be scattered by particles in the same; and some of the scattered UV light will be deflected in a direction towards the lenses 2. The UV filter layer 6 will block the scattered UV light from entering the lens 15b of the camera 15 of the mobile device 14. Some of the UV light which passes into the sample 20 will undergo a stokes shift caused by some fluorescent particles or fluorophores that are contained in the sample 20; due to the Stokes shift the UV light will be changed to light with a longer wavelength (here referred to as "fluorescent light"). Some of the fluorescent light will directed towards the lenses 2. The UV filter layer 6 is configured to block UV light exclusively, accordingly the fluorescent light will pass through the UV filter layer 6 and will be received by the lens 15b of the camera 15 of the mobile device 14.

[00191] The fluorescent light which is received by the lenses 2 will be passed to the lens 15b of the camera 15 of the mobile device 14. The fluorescent light is then processed on the photographic sensor 15a in the mobile device 14 to generate an image (in one embodiment the fluorescent light is focused by the lens 15b of the camera of the mobile device 14 onto the photographic sensor 15a of the mobile device 14); and the image is displayed on a screen of the mobile device 14.

[00192] It should be understood that in each of the above mentioned assemblies the UV light source 33a-d may be operated simultaneously with the first and/or second groups of light sources 9,17. This allows fluorescent microscopy and dark field analysis, or fluorescent microscopy and bright field analysis to be performed simultaneously, or fluorescent microscopy and dark field analysis and bright field analysis to be performed simultaneously.

[00193] The assemblies 70 containing at least two groups of light sources 9,17 may each further comprise a means for individually controlling the intensity of the light which is emitted by each of the first group of light sources 9 and/or second group of light sources 17 and/or the UV light source 33a-d. This allows the user to control the weight of the type of analysis which is performed. For example, the user may adjust the emission intensity of the first group of light sources 9, second group of light sources 17 and the UV light source 33a-d such that the resulting image would show a composition of the sample 20 information obtained with different illumination methods (i.e. those information of the sample 20 that are achieved through dark field analysis lighting, those information of the sample 20 which are achieved through bright field analysis lighting, and those information of the sample 20 that are achieved through florescent microscopy) with the same resolution. If on the other hand the first group of light sources 9, second group of light sources 17 and the UV light source 33a-d are all operated simultaneously, but the first group of light sources 9 were operated to emit light at several times the intensity of the light emitted by each of the second group of light sources 17 and the UV light sources 33a-d, then more weight is given to the bright field analysis; this means that the resulting image would comprise comparably more information of the sample that is achieved through bright field analysis lighting than information of the sample that is achieved through either dark field analysis lighting or through fluorescent analysis lighting.

[00194] While the above-mentioned example shows the use of the microscope modules 1,100 to analyse a sample which is provided on the slide holder 13,1 30, it will be understood that the use of the slide holder 13,1 30, is not essential to the present invention. The microscope modules 1,100 may be used without the slide holder 13,1 30 to implement a method according to a further embodiment of the present invention:

[00195] The user will attach microscope module 1,100 to a mobile device 14 having an integrated camera 15 with a lens 15b, such that the lenses 2 of the microscope module 1,100 overlay the lens 15b of the camera 15 of the mobile device 14. Preferably the microscope module 100 shown in Figure 4 is used when the sample 20 is opaque (for example when the sample 20 is an opaque surface of an object). In this embodiment the microscope module 1,100 is positioned above the sample which is to be inspected. Dark field analysis and/or bright field analysis and/or fluorescent microscopy of the sample may be performed in the same manner as described above, using the sample 20 (instead of the slide holder 13) to deflect the light; during bright field analysis the sample 20 deflects the light into the lenses 2 of the microscope module 1,100 and when performing dark field analysis the sample deflects the light away from lenses 2 of the microscope module 1,100.

[00196] Various modifications and variations to the described embodiments of the invention will be apparent to those skilled in the art without departing from the scope of the invention as defined in the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiment.

Claims

1. A microscope module, suitable for mechanically cooperating with a mobile device having a camera, the microscope module comprising, one or more lenses wherein the one or more lenses are arranged so that a center of each of the one or more lenses lie on a single common axis, a plurality of light sources arranged symmetrically with respect to the single common axis.

2. A microscope module according to claim 1 wherein the microscope module comprises,

a first group of light sources arranged symmetrically with respect to the single common axis and a first group of curved reflective surfaces, each curved reflective surfaces of the first group being arranged to receive light from a respective light source in the first group of light sources and to direct received light away from the microscope module; and

a second group of light sources arranged symmetrically with respect to the single common axis and a first group of curved reflective surfaces, each curved reflective surfaces being arranged to receive light from a respective light source in the second group of light sources and to direct received light away from the microscope module; and

wherein the distance between each of the light sources in the first group and the single common axis is less than the distance between each of the light sources in the second group and the single common axis.

3. A microscope module according to any one of the preceding claims,

wherein the module further comprises a plurality of curved reflective surfaces, each of which has a first and second focal point, and wherein a respective light source is located at the second focal points.

4. A microscope module according to claim 3 wherein the first focal point of each curved reflective surface is located on the single common axis.

5. A microscope module according to claim 3 wherein the microscope module further comprises a first glass window which is arranged along the single common axis so as to overlays the one or more lenses, and

wherein the first focal point of each of the curved reflective surfaces is located at the perimeter of the first glass window, so that the glass window can receive light reflected by the curved reflective surfaces and internally reflect light received.

6. A microscope module according to claim 5 wherein the perimeter of the first glass window further comprises reflective material, and wherein the positions on the perimeter where the respective first focal points of the respective curved reflective surfaces are located are absent of reflective material, so that light can be received into the first glass window through at these positions.

7. A microscope module according to any one of claims 5 or 6 wherein the microscope module further comprises a diffuser which is arranged to diffuse light which has been internally reflected in the first glass window light so that at least part of the internally reflected light is directed away from the microscope module.

8. A microscope module according to claim 7 wherein the diffuser is defined by an area of first glass window which comprises a surface roughness which is larger than the surface roughness of another area of the first glass window.

9. A microscope module according to any one of claims 5 - 8 wherein the microscope module further comprises a reflective element which is arranged to overlay the first glass window, wherein the reflective element has an aperture defined therein through which light can pass, and wherein the reflective element is arranged so that the centre of the aperture lies on the single common axis.

10. A microscope module according to any one of the preceding claims further comprising a UV filter layer which is impermeable to UV light, which is positioned on the single common axis, and wherein the plurality of light sources comprise one or more UV light sources.

11. A microscope module according to any one of the preceding claims, further comprises a casing, and wherein the casing comprises a first surface and second surface, wherein the first and second surfaces lie on different planes and there is a step between the first and second surfaces; wherein the plane on which the second surface lies intersects a focal point of the one or more lenses.

12. A microscope module according to any one of the preceding claims, further comprising an attachment means which allows the microscope module to be removably attached to a surface of the mobile device, wherein the attachment means comprises an elastic layer which is mounted on a non-elastic layer, and wherein the elastic layer further comprises a plurality of projections, and wherein channels are defined between the plurality of projections, and wherein the elastic layer further comprises an adhesive material which enables the microscope module to be removably attach to the surface of a mobile device when the elastic layer is positioned to abut said surface.

13. A slide holder, which is suitable for cooperating with the microscope module according to any one of the preceding claims, the slide holder comprising a platform which has,

at least one groove defined therein which can receive a slide, and

at least one trench defined therein, the at least one trench having a depth which is deeper than the depth of the groove, and wherein a surface which defines a base of the trench comprises reflective material.

14. An assembly comprising,

a microscope module according to any one of claims 1-12; and

a mobile device having an integrated camera with a lens; and wherein the microscope module is arranged to abut the mobile device and is positioned such that the one or more lenses of the microscope module overlay the lens of the camera of the mobile device.

15. A method of analyzing a specimen using the assembly according to claim 14 and the slide holder according to claim 13, the method comprising the steps of,

attaching to microscope module to a mobile device having an integrated camera with a lens, such that the one or more lenses of the microscope module overlay the lens of the camera of the mobile device;

inserting a slide having a sample thereon, into the groove of the slide holder, and arranging the slide so that the sample overlays the reflective surface which defines a base of the trench, wherein there is an airgap between the reflective surface which defines a base of the trench and the slide;

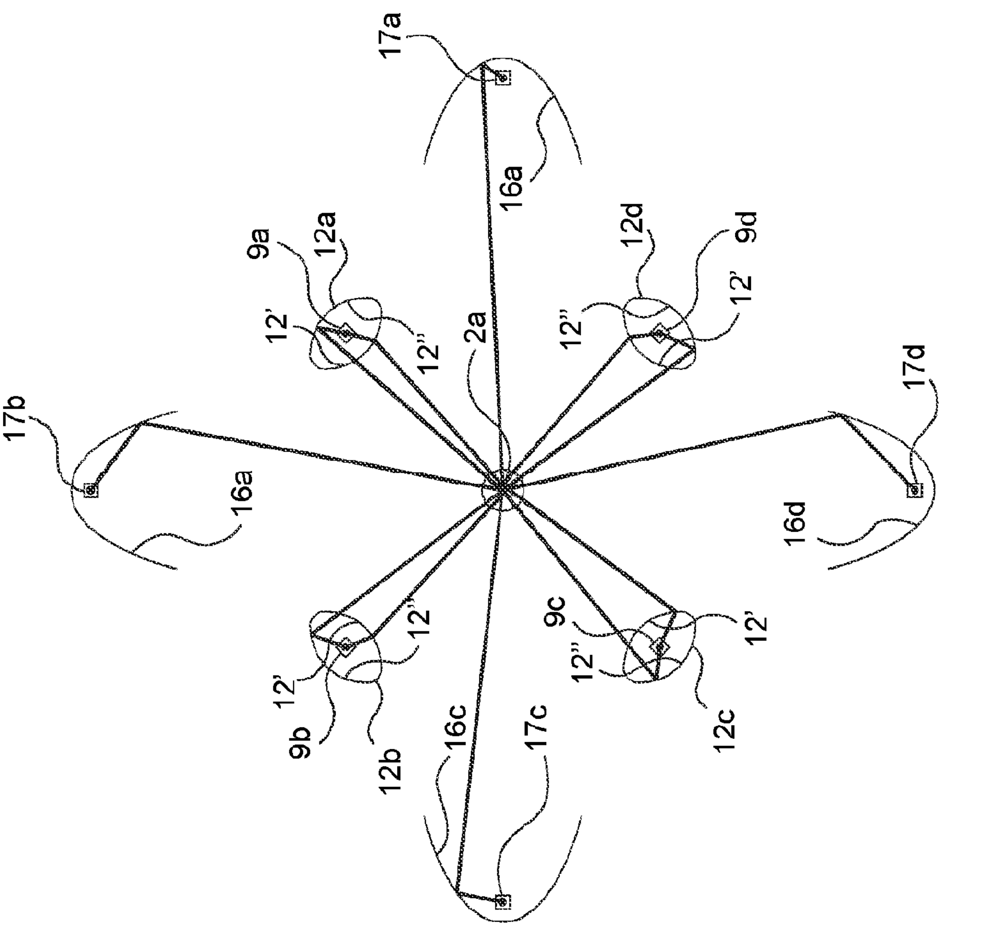
operating one of the one or more light sources of the microscope module;

receiving light at the one or more lenses of the microscope module;

passing the light received at the one or more lenses to the lens of the camera of the mobile device;

processing the light in the mobile device to generate an image of the specimen; and

displaying the image on a screen of the mobile device.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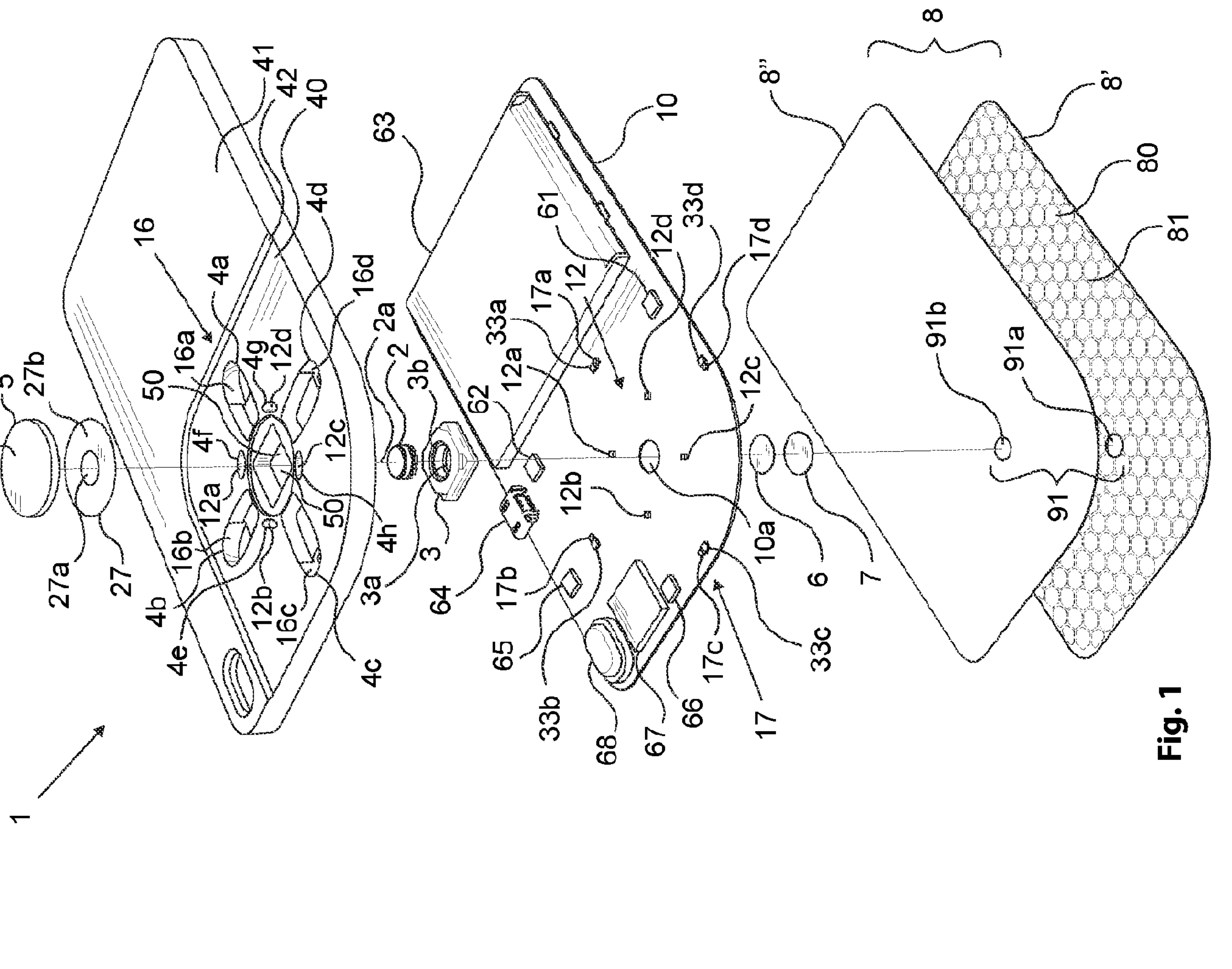
17c
9c
12c

Fig. 2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40
42
41
16b
4b
4e
12b
16c
4c
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3b
3
3a
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12a
33a
17a
12
61
63
10
12d
33d
17d
12b
12c
10a
17b
65
33b
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17c
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33c
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7
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8'
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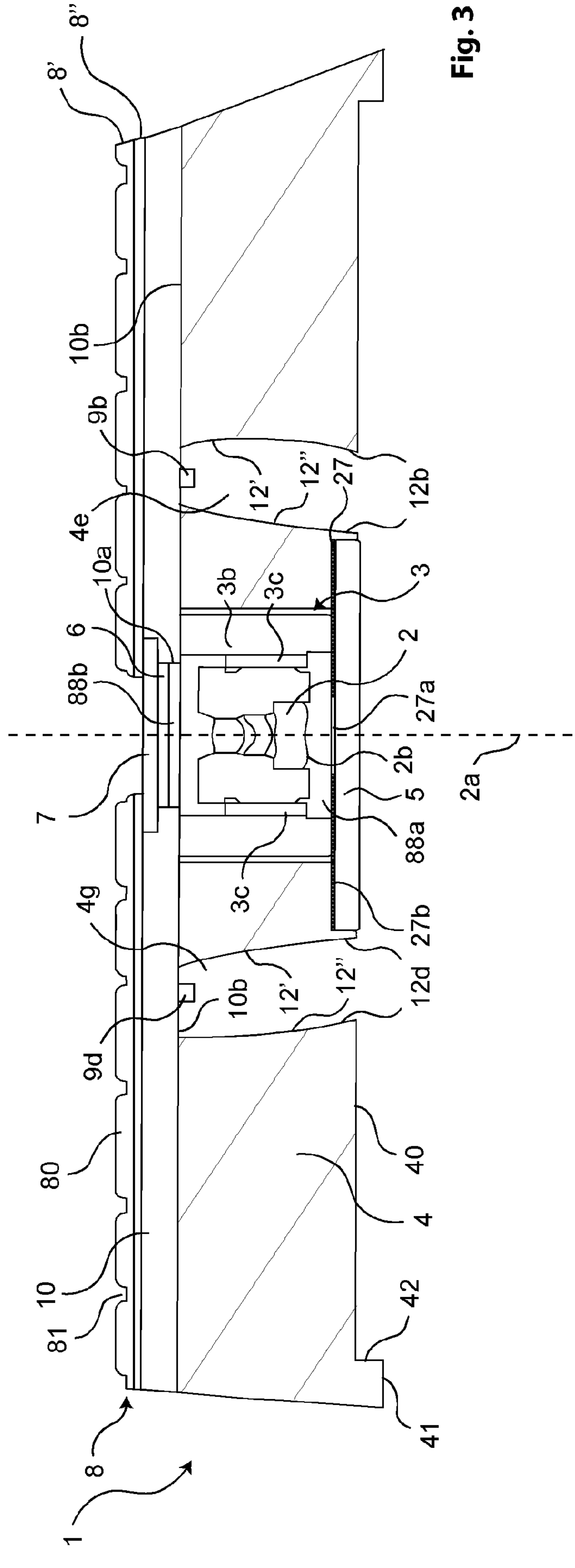
91a
91

Fig. 1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2b
7
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88a
3c
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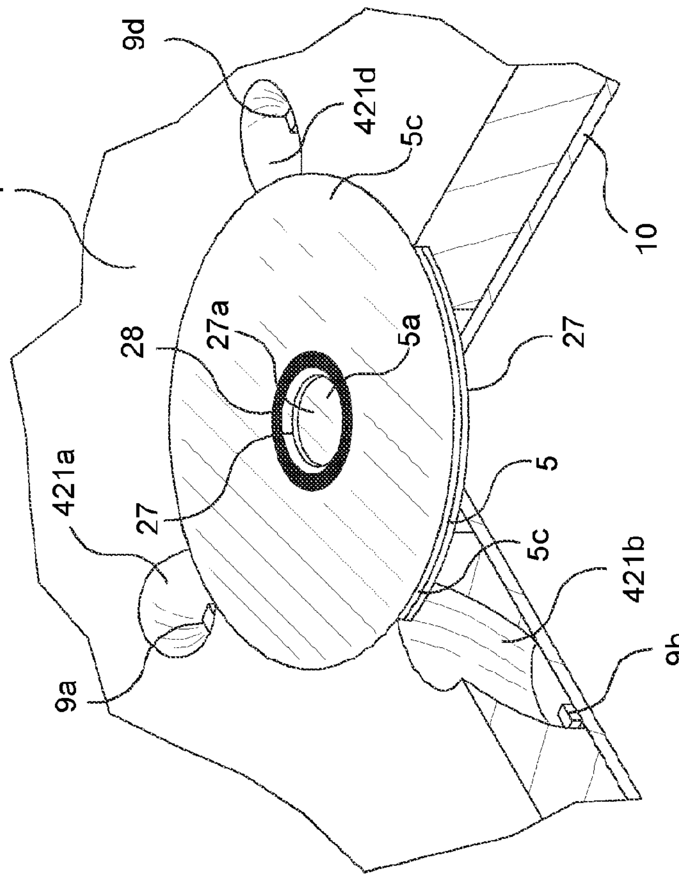
Fig. 3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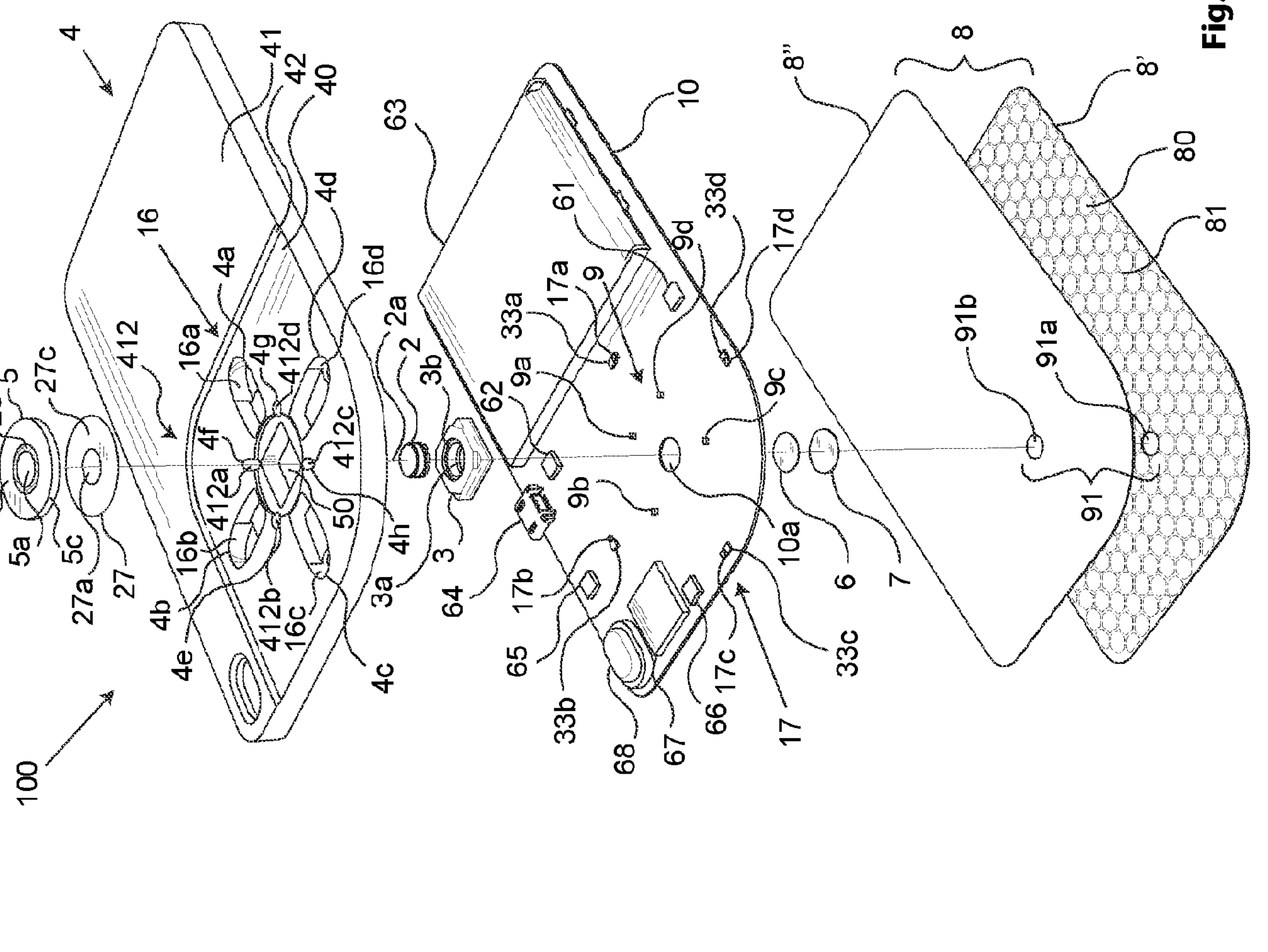
9b

Fig. 5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16b
412b
4b
4e
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3a
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9a
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9d
33a
17a
9
33d
17d
64
9b
65
17b
33b
68
67
66
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91

Fig. 4

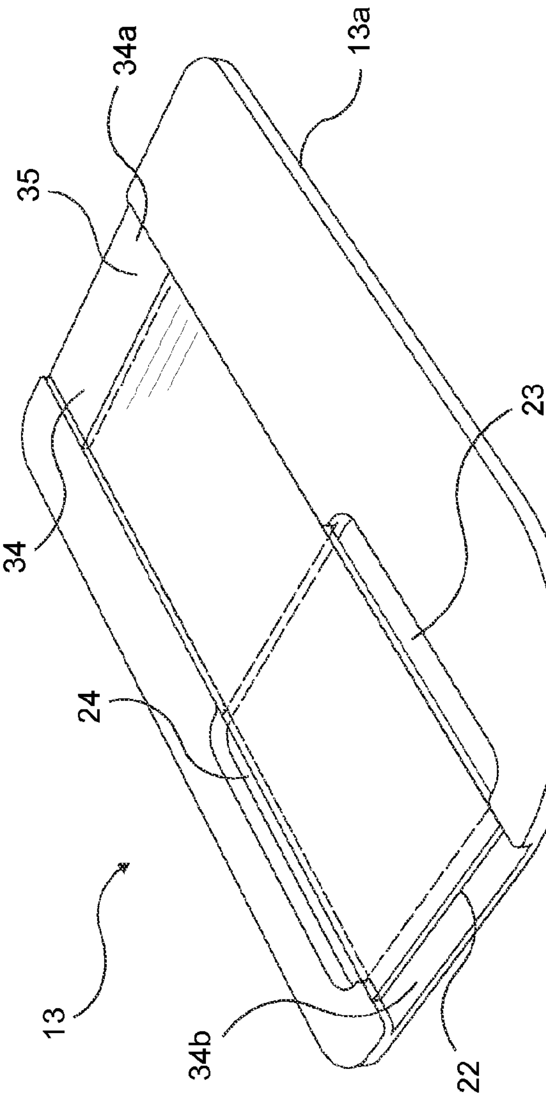


Fig. 6

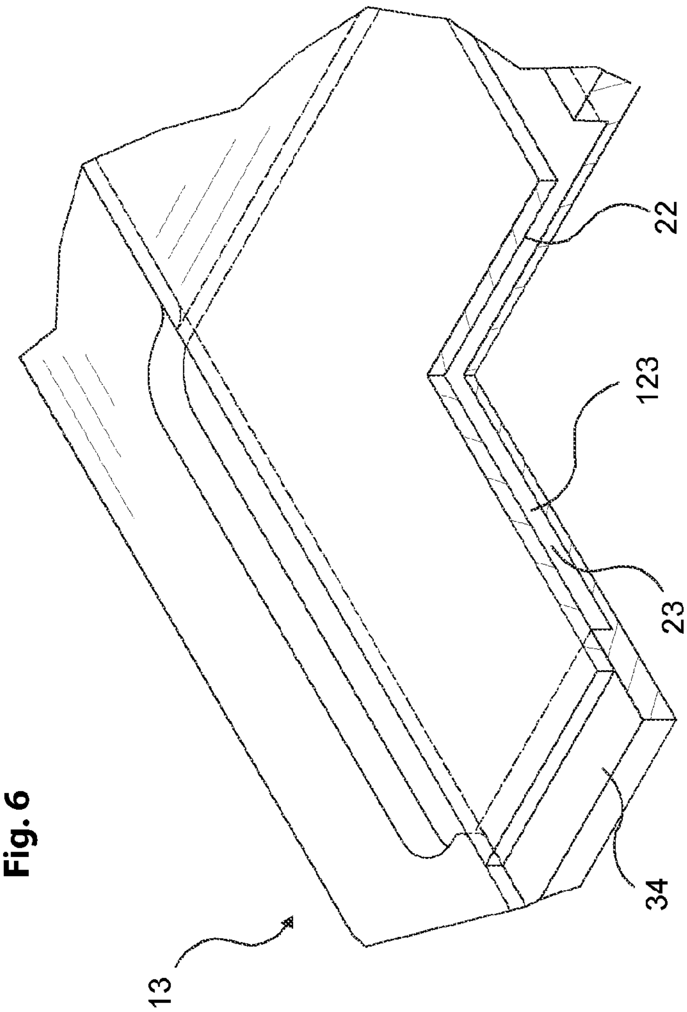


Fig. 7

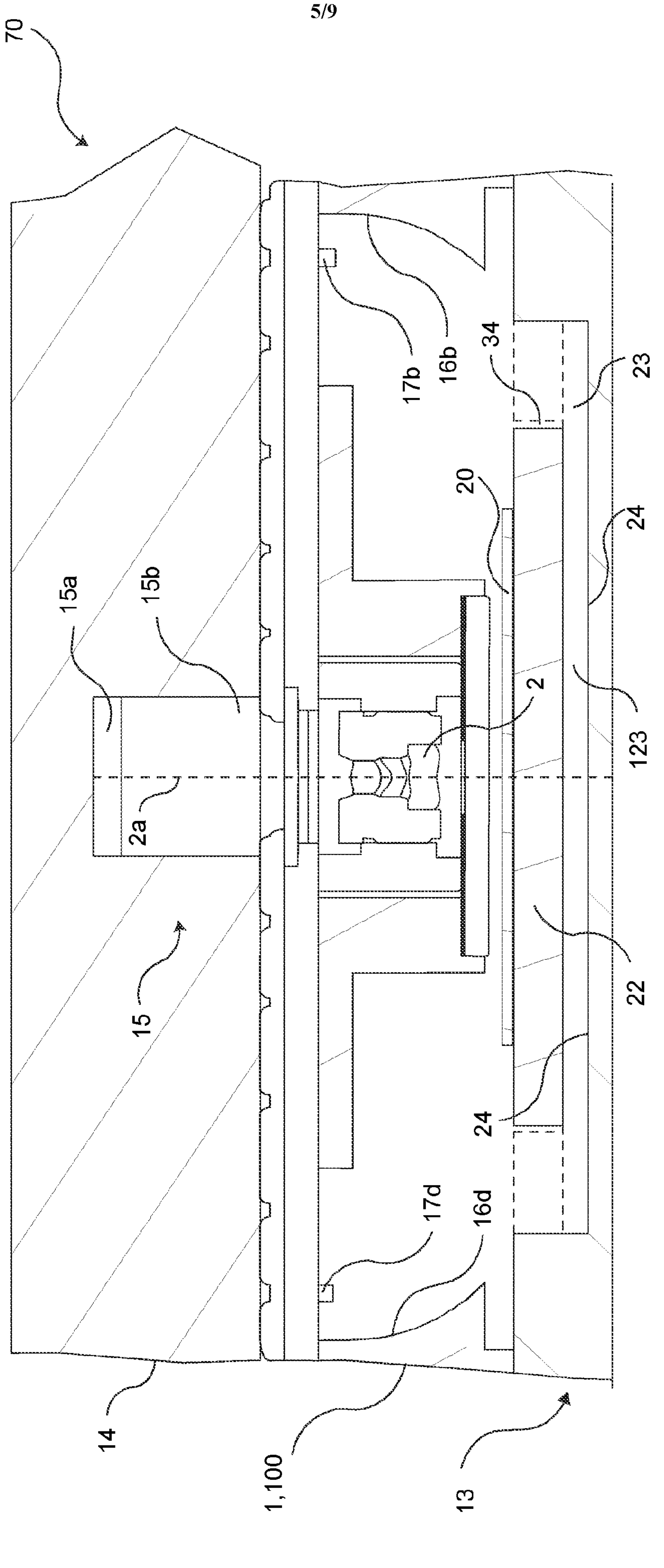


Fig. 8

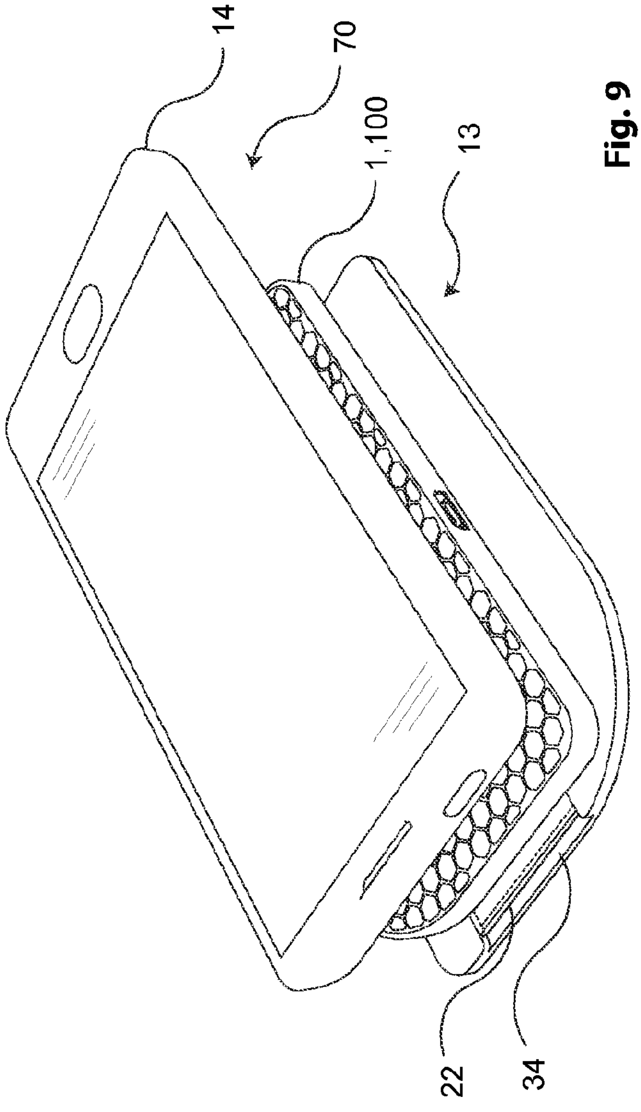
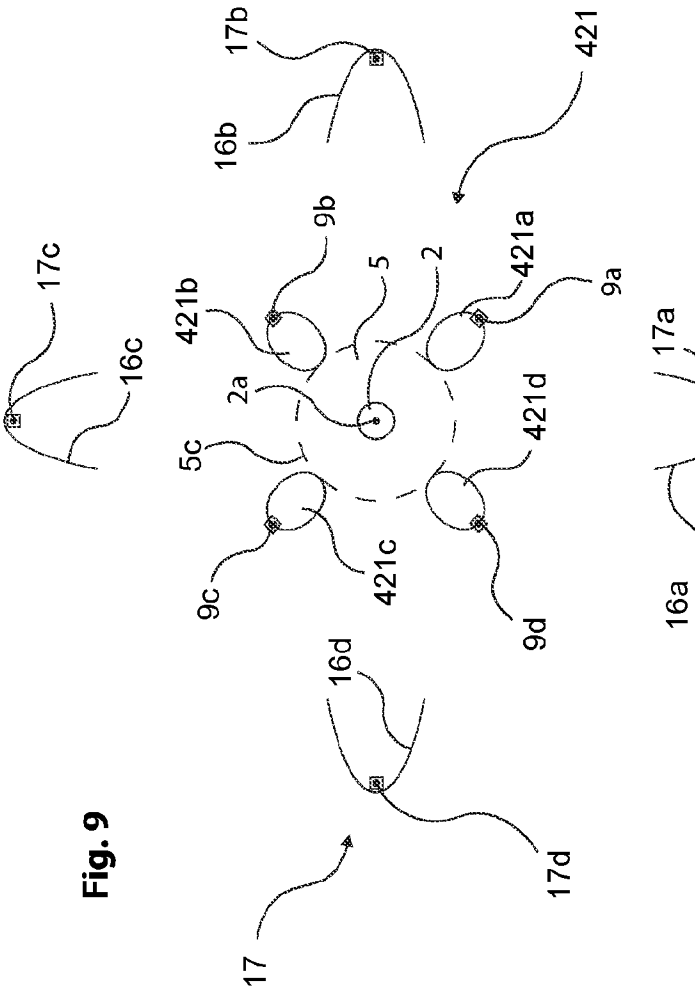

14
70
1,100
13
22
34

Fig. 9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16d
17d
17

Fig. 10

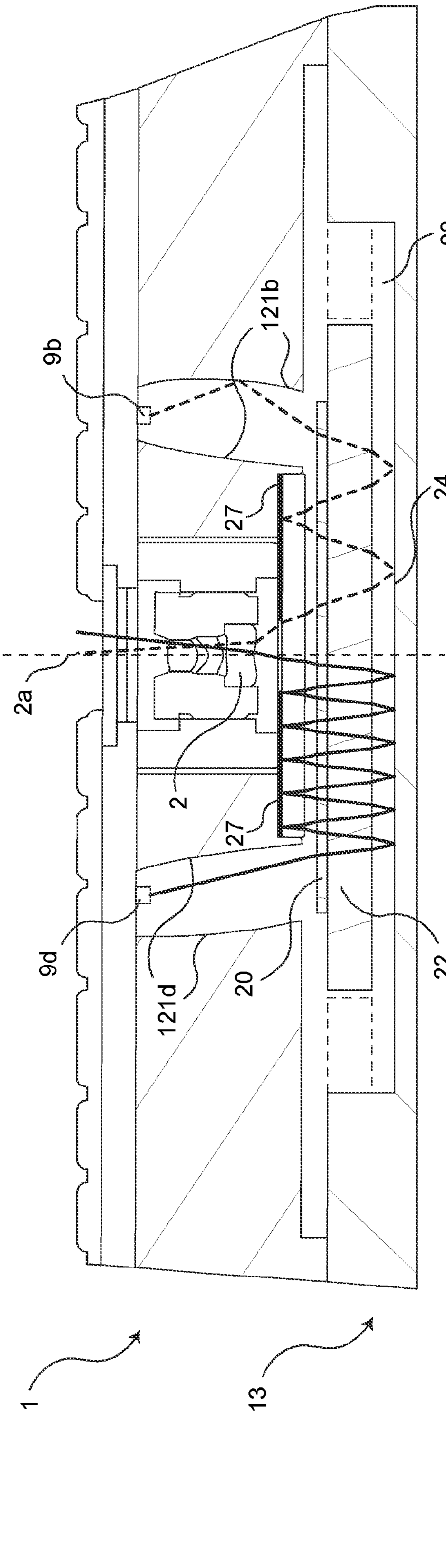


Fig. 11a

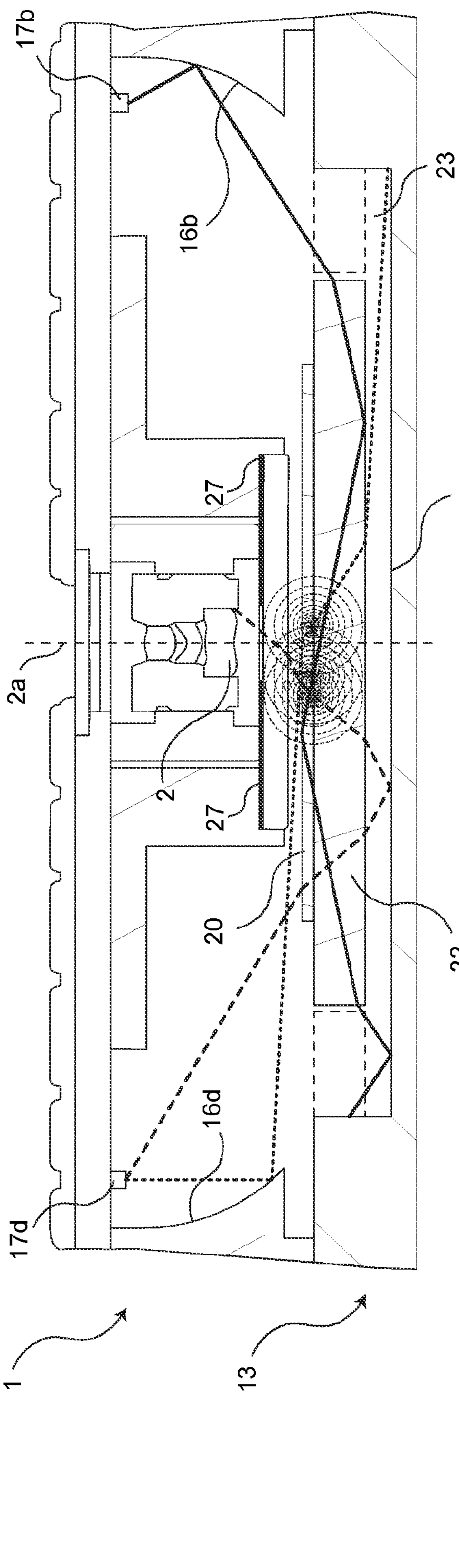


Fig. 11b

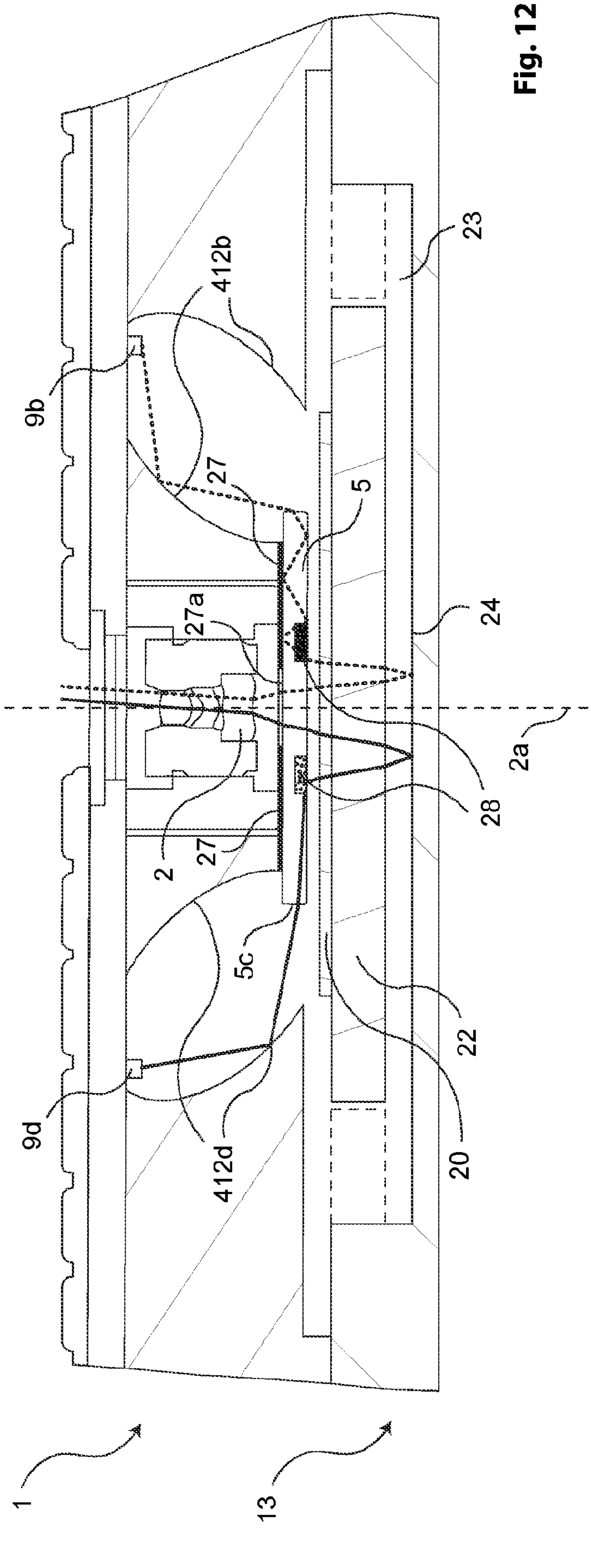
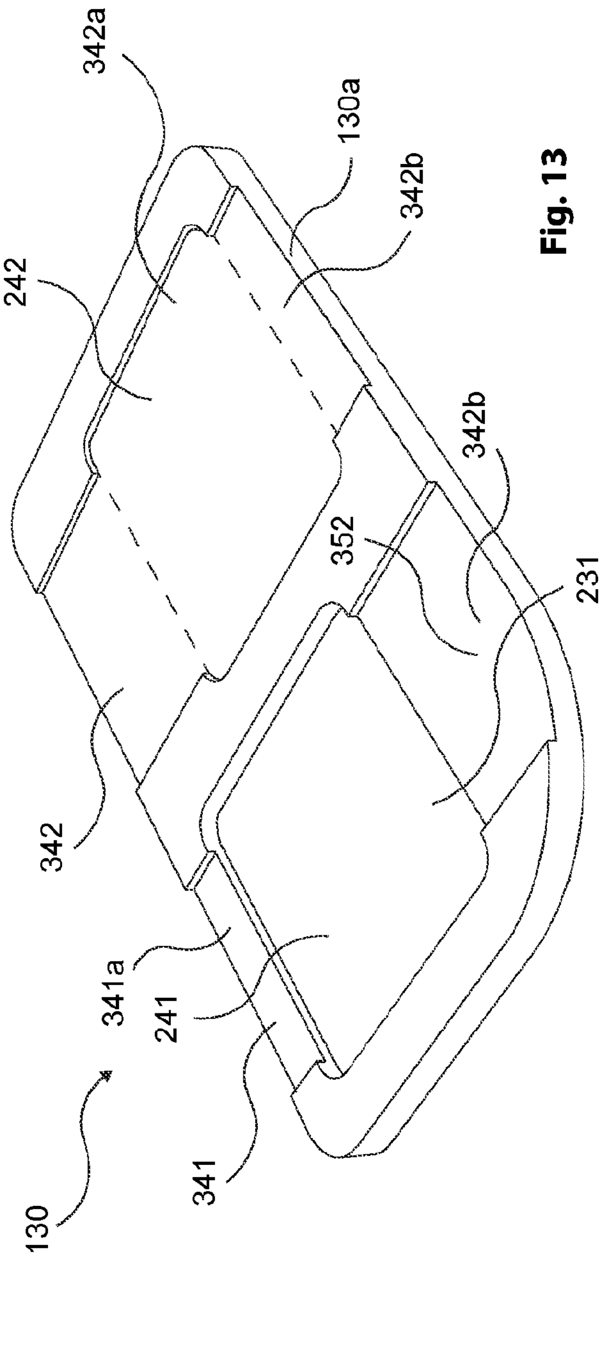


Fig. 12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231
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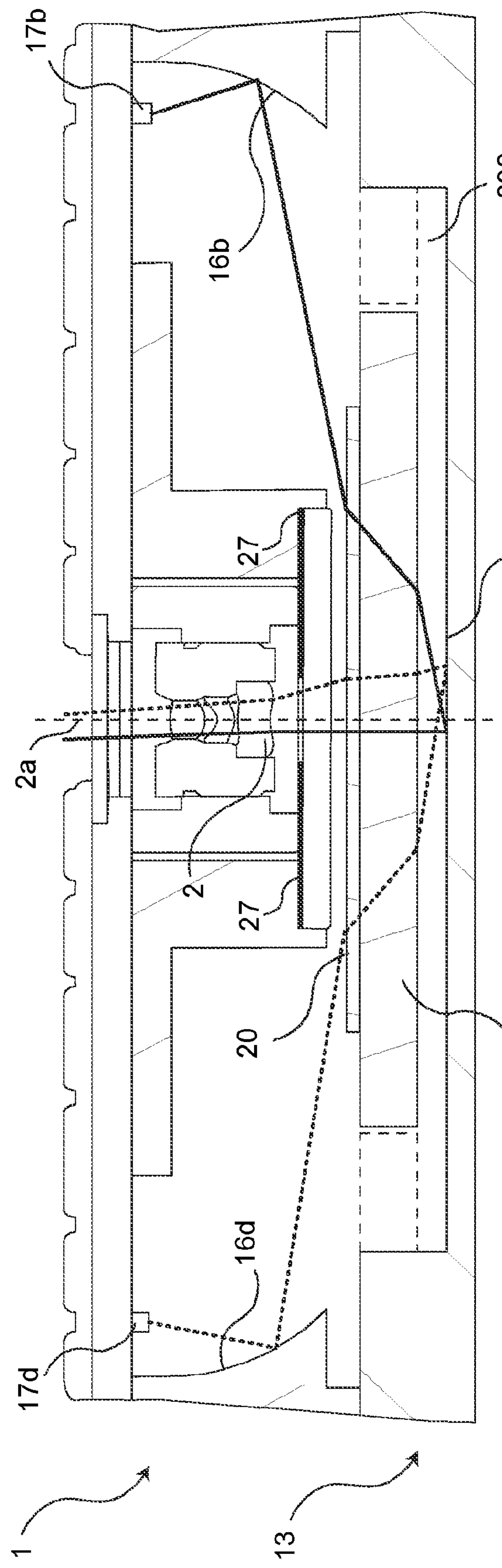
130a
342b

Fig. 13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13

Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/056081

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B21/08 G02B21/12 G02B21/36
ADD. G02B21/34

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/181947 A1 (YANG CHIH-YI [TW]) 28 July 2011 (2011-07-28) paragraph [0012] - paragraph [0019]; figures 1-2 -----	1,14
X	US 2015/286043 A1 (DOE NICHOLAS [US]) 8 October 2015 (2015-10-08) paragraph [0047] - paragraph [0048]; figure 3B paragraph [0045]; figure 3A -----	1,14
X	EP 1 363 153 A1 (MITUTOYO CORP [JP]) 19 November 2003 (2003-11-19)	1
A	paragraph [0043] - paragraph [0060]; figures 1-3 paragraph [0071] - paragraph [0090]; figure 5 -----	2
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 December 2016	06/02/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	A. Jacobs

1

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/073935 A1 (BEN-EZER ZEHAVA [IL]) 25 March 2010 (2010-03-25) paragraph [0026] - paragraph [0122]; figures 1A-8A, 1B-3B, 8B, 1C-2C -----	2
A	DE 100 30 772 A1 (COBRA ELECTRONIC GMBH [DE]) 31 October 2001 (2001-10-31) paragraph [0032] - paragraph [0037]; figures 1-3 -----	2
A	US 2013/170024 A1 (TEPLITZ KYLA [US] ET AL) 4 July 2013 (2013-07-04) paragraph [0041]; figure 14A -----	1,2

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/056081

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos. :

1, 2, 14

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 14

Microscope module comprising a first group of light sources arranged symmetrically with respect to a single common axis and a first group of curved reflective surfaces, each curved reflective surfaces of the first group being arranged to receive light from a respective light source in a first group of light sources and to direct received light away from the microscope module; and a second group of light sources arranged symmetrically with respect to the single common axis and a first [sic] group of curved reflective surfaces, each curved reflective surfaces being arranged to receive light from a respective light source in the second group of light sources and to direct received light away from the microscope module; and wherein the distance between each of the light sources in the first group and the single common axis is less than the distance between each of the light sources in the second group and the single common axis.

---

2. claims: 3-9

Microscope module comprising a plurality of curved reflective surfaces, each of which has a first and second focal point, and wherein a respective light source is located at the second focal points.

---

3. claim: 10

Microscope module comprising a UV filter layer which is impermeable to UV light, which is positioned on a single common axis, and wherein a plurality of light sources comprise one or more UV light sources.

---

4. claim: 11

Microscope module comprising a casing, and wherein the casing comprises a first surface and second surface, wherein the first and second surfaces lie on different planes and there is a step between the first and second surfaces; wherein the plane on which the second surface lies intersects a focal point of one or more lenses.

---

5. claim: 12

Microscope module comprising an attachment means which allows the microscope module to be removably attached to a surface of the mobile device, wherein the attachment means

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

comprises an elastic layer which is mounted on a non-elastic layer, and wherein the elastic layer further comprises a plurality of projections, and wherein channels are defined between the plurality of projections, and wherein the elastic layer further comprises an adhesive material which enables the microscope module to be removably attached to the surface of a mobile device when the elastic layer is positioned to abut said surface.

---

6. claims: 13, 15

Slide holder, which is suitable for cooperating with the microscope module according to any one of the preceding claims, the slide holder comprising a platform which has at least one groove defined therein which can receive a slide, and at least one trench defined therein, the at least one trench having a depth which is deeper than the depth of the groove, and wherein a surface which defines a base of the trench comprises reflective material.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2016/056081

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011181947 A1	28-07-2011	TW M385006 U	21-07-2010
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