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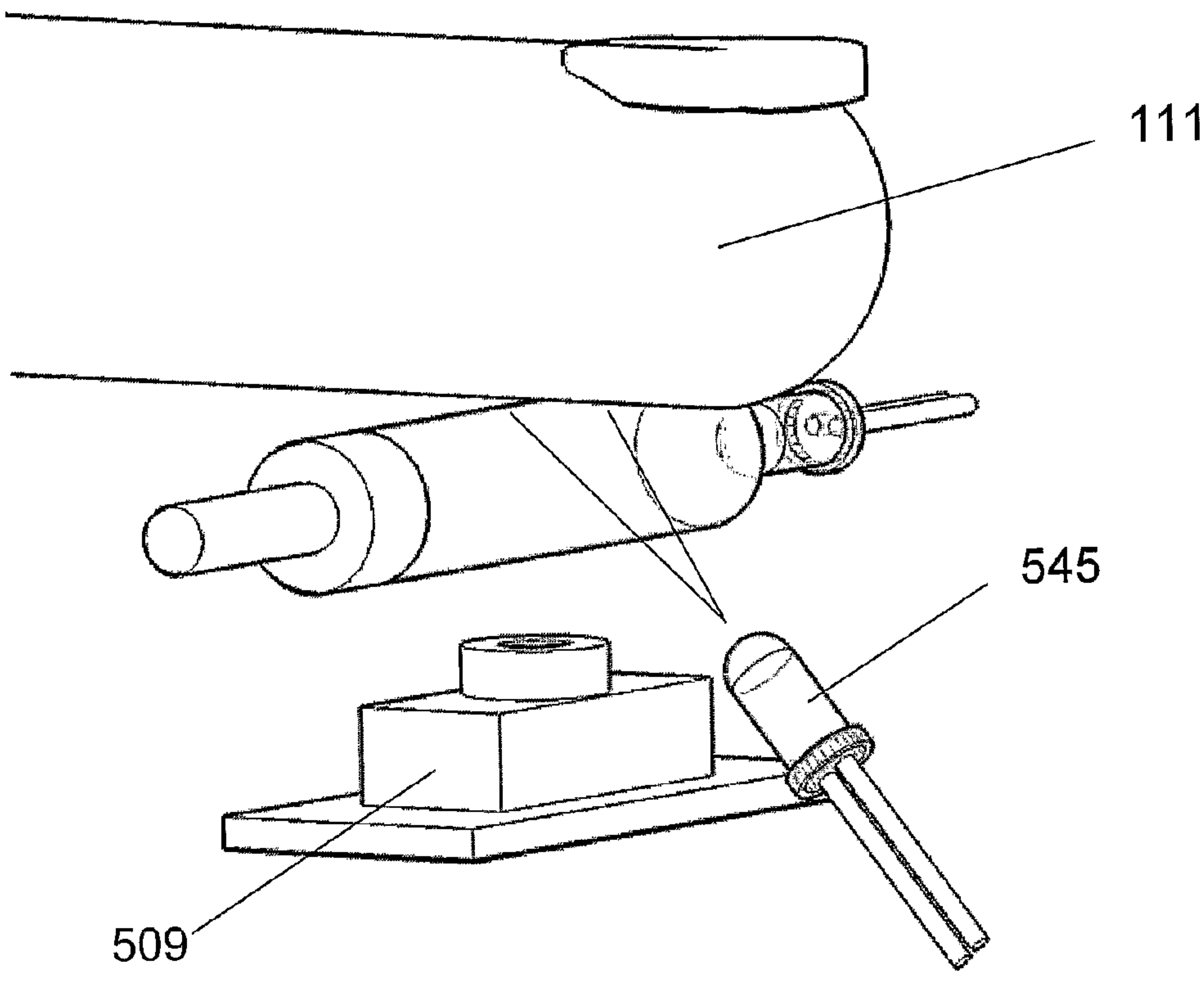

(57) Abrégé/Abstract:
A biometric measurement system has a platen, an illumination source, a light detector, and a controller. The controller is interfaced with the illumination source and the light detector. The controller has instructions to illuminate a purported skin site of an individual under distinct optical conditions during a single illumination session while the purported skin site is moved over the platen. The controller also has instructions to derive a multispectral image of the purported skin site from light received by the light detector after scattering from the purported skin site for multiple distinct optical conditions while the purported skin site is moved over the platen.

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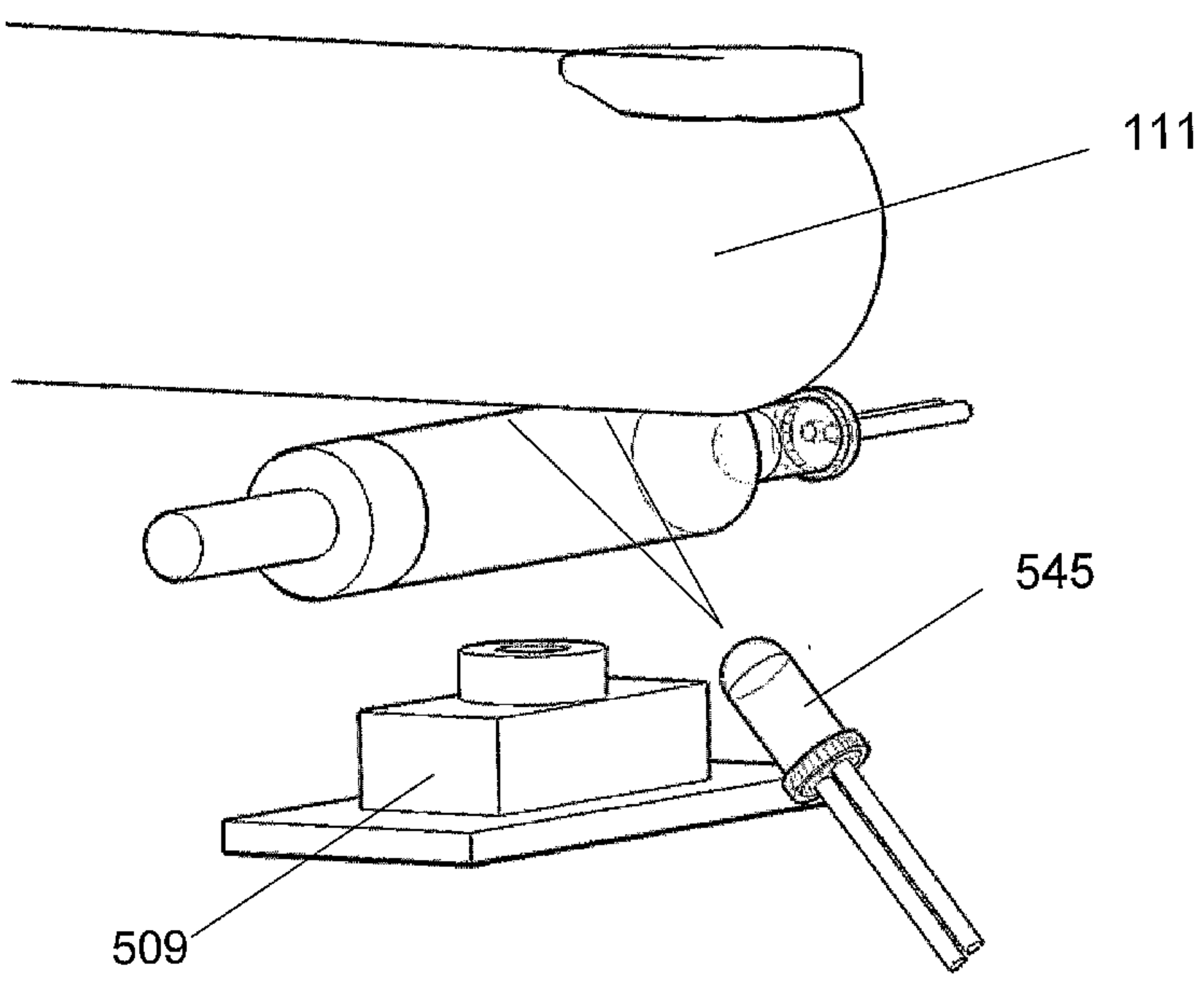
(54) Title: MULTISPECTRAL BIOMETRIC SENSORS



(57) Abstract: A biometric measurement system has a platen, an illumination source, a light detector, and a controller. The controller is interfaced with the illumination source and the light detector. The controller has instructions to illuminate a purported skin site of an individual under distinct optical conditions during a single illumination session while the purported skin site is moved over the platen. The controller also has instructions to derive a multispectral image of the purported skin site from light received by the light detector after scattering from the purported skin site for multiple distinct optical conditions while the purported skin site is moved over the platen.

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MULTISPECTRAL BIOMETRIC SENSORS

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application is a nonprovisional of, and claims the benefit of the filing date of, U.S. Pat. Appl. No. 60/675,776, entitled "MULTISPECTRAL BIOMETRIC SENSORS," filed April 27, 2005 by Robert K. Rowe, the entire disclosure of which is incorporated herein by reference for all purposes.

[0002] This application is also related to the following applications, each of which is incorporated herein by reference in its entirety for all purposes: U.S. Pat. Appl. No. 11/115,100, entitled "MULTISPECTRAL IMAGING BIOMETRICS," filed April 25, 2005 by Robert K. Rowe; U.S. Pat. Appl. No. 11/115,101, entitled "MULTISPECTRAL BIOMETRIC IMAGING," filed April 25, 2005 by Robert K. Rowe *et al.*; and U.S. Pat. Appl. No. 11/115,075, entitled "MULTISPECTRAL LIVENESS DETERMINATION," filed April 25, 2005 by Robert K. Rowe. Each of these three applications is a nonprovisional of each of the following provisional applications, the entire disclosures of which are also incorporated herein by reference for all purposes: U.S. Prov. Pat. Appl. No. 60/576,364, entitled "MULTISPECTRAL FINGER RECOGNITION," filed June 1, 2004 by Robert K. Rowe and Stephen P. Corcoran; U.S. Prov. Pat. Appl. No. 60/600,867, entitled "MULTISPECTRAL IMAGING BIOMETRIC," filed August 11, 2004 by Robert K. Rowe; U.S. Prov. Pat. Appl. No. 60/610,802, entitled "FINGERPRINT SPOOF DETECTION USING MULTISPECTRAL IMAGING," filed September 17, 2004 by Robert K. Rowe; U.S. Prov. Pat. Appl. No. 60/654,354, entitled "SYSTEMS AND METHODS FOR MULTISPECTRAL FINGERPRINT SENSING," filed February 18, 2005 by Robert K. Rowe; and U.S. Prov. Pat. Appl. No. 60/659,024, entitled "MULTISPECTRAL IMAGING OF THE FINGER FOR BIOMETRICS," filed March 4, 2005 by Robert K. Rowe *et al.*

[0003] This application is further related to commonly assigned U.S. Pat. Appl. No. 11/009,372, entitled "METHODS AND SYSTEMS FOR ESTIMATION OF PERSONAL CHARACTERISTICS FROM BIOMETRIC MEASUREMENTS," filed December 9, 2004 by Robert K. Rowe, the entire disclosure of which is incorporated herein by reference for all purposes.

[0004] The applications identified above are sometimes referred to herein collectively as "the related applications."

BACKGROUND OF THE INVENTION

[0005] This application relates to biometric sensors. More specifically, this application relates to biometric sensors that may be incorporated into portable electronic devices.

[0006] Typical fingerprint sensors use hardware and software that perform a single function or a limited range of functions (e.g. collect biometric data and also act as a pointing device on a cellular phone). In applications that require a biometric sensor as part of a portable electronic device (PED), such as a cellular telephone, PDA or laptop computer, the addition of a fingerprint reader may significantly increase the cost and complexity of the overall system. In many cases, semiconductor-based fingerprint sensors are selected for PED applications since they can be made small and with a relatively low cost. However, semiconductor readers are relatively fragile, requiring protection from electrostatic discharge, scratching and abrasion, water, and other such effects. Typically optical fingerprint technologies may be made more robust to these effects, but are often too large and too complex to be considered for incorporation into PED's or other applications requiring small and simple sensors.

[0007] There is accordingly a general need in the art for improved methods and systems that incorporate biometric sensors into PEDs.

BRIEF SUMMARY OF THE INVENTION

[0008] Embodiments of the invention provide a biometric measurement system. The biometric measurement system comprises a platen, an illumination source, a light detector, and a controller. The controller is interfaced with the illumination source and the light detector. The controller has instructions to illuminate a purported skin site of an individual under a plurality of distinct optical conditions during a single illumination session while the purported skin site is moved over the platen. The controller also has instructions to derive a multispectral image of the purported skin site from light received by the light detector after scattering from the purported skin site for each of multiple of the plurality of distinct optical conditions while the purported skin site is moved over the platen.

[0009] In different embodiments, the skin site may be in contact with the platen or may not be in contact with the platen.

[0010] In some embodiments, the instructions to derive the multispectral image may comprise instructions to generate a composite of a plurality of images derived for different portions of the purported skin site as the purported skin site is moved over the platen. For example, the platen may comprise a roller with which a position of the skin site relative to the light detector is moved.

[0011] The illumination source may comprise a first illumination source disposed to illuminate the platen under total internal reflectance conditions. Corresponding instructions to illuminate the purported skin site may thus comprise instructions to illuminate the platen with the first source such that the skin site is illuminated indirectly. The illumination source may sometimes further comprise a second source disposed to illuminate the skin site directly. Corresponding instructions to illuminate the skin site may thus further comprise instructions to illuminate the skin site directly with the second source.

[0012] In some embodiments, the imager may comprise a color imager, providing for multiple subimages, with each subimage corresponding to a different illumination wavelength or range of wavelengths. The wavelengths forming the multiple subimages may sometimes be derived from multiple monochromatic illumination sources or may sometimes be derived from one or more broadband illumination sources.

[0013] In some embodiments, the biometric measurement system may be integrated with a portable electronic device. In such instances, the controller may additionally include instructions to perform a nonbiometric function with an imaging system that comprises the light detector, such as might be performed with a comparable portable electronic device lacking the biometric measurement system. The illumination source may be a white-light source. In one embodiment, a lightpipe is adapted to guide light from the illumination source to the platen. In such an embodiment, the instructions to perform the nonbiometric function may comprise instructions to perform a nonbiometric function with both the illumination source and the imaging system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A further understanding of the nature and advantages of the present invention may be realized by reference to the remaining portions of the specification and the drawings wherein like reference labels are used through the several drawings to refer to similar components. In some instances, reference labels include a numerical portion followed by a latin-letter suffix; reference to only the numerical portion of reference labels is intended to refer collectively to all reference labels that have that numerical portion but different latin-letter suffices.

[0015] Figs. 1A, 1B, and 1C provide top, side and isometric views of an area sensor according to one embodiment of the invention;

[0016] Figs. 2A, 2B, and 2C provide top, side, and isometric views of a static swipe sensor according to another embodiment of the invention;

[0017] Fig. 3 provides an illustration of a static swipe sensor with a lightpipe according to an embodiment;

[0018] Figs. 4A, 4B, and 4C provide top, side, and isometric views of a roller swipe sensor according to a further embodiment of the invention; and

[0019] Fig. 5 provides an illustration of a roller swipe sensor that includes direct illumination in an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Many PED's today include a digital imaging capability. The uses of the digital camera range from taking pleasure photos for remembrances and/or sharing, to using a camera in a laptop for business video conferencing. The imagers used in PED's are typically color imagers having a silicon imaging array covered by a Red-Green-Blue color filter array arranged in a Bayer pattern. Camera resolution is usually 640x480 (VGA) or 1280x1024 (XGA), or better. Imaging is provided for by one or more lenses or other optical elements. In some cases, the optical system is of a variable focus design that enables a wide range of focal distances. In some cases, the optical systems are capable of performing macro photography.

[0021] Most PED's contain one or more light sources for various purposes. In many cases these light sources are light emitting diodes (LED's) in either monochromatic or broad band ("white-light") configurations. In some cases the light sources are used for purposes such as supplying lighting to keyboards, backlighting for screens, or supplying electronic flash for digital imaging.

[0022] Systems and methods of multispectral imaging (MSI) are disclosed by the inventors in the related applications as having favorable characteristics relative to other fingerprint imaging technologies. Multispectral imaging is characterized by the illumination of a site under a plurality of distinct optical conditions during a single illumination session. The illumination under distinct optical conditions is sometimes performed simultaneously and sometimes performed sequentially in different embodiments. Such use of multiple optical conditions provides additional information that can be used to improve the overall performance of the biometric sensor as well as to enhance the ability of the sensor to detect attempts to use an artificial or altered sample to defeat the system. In some cases, the multiple optical conditions provide additional information that can be used to estimate personal characteristics such as age, gender, and ethnicity. The multiple optical conditions may include multiple illumination wavelengths, multiple polarization conditions, and multiple illumination and/or imaging angles. In the latter case, angles that produce images substantially affected by total internal reflectance (TIR) effects provide different and complementary information from those angles that are substantially unaffected by TIR (i.e. "direct illumination").

[0023] As will be understood by those of skill in the art, TIR effects result from the presence or absence of a difference in the index of refraction between a sensor platen and the finger placed on it. When the angle of light at an interface is greater than the critical angle determined from Snell's law and an air-filled valley of the fingerprint is present at a particular location of the platen, TIR occurs in the platen because of the air-platen index difference. Alternatively, if skin of the proper index of refraction is in optical contact with the platen, the TIR at this location is "frustrated," allowing light to traverse the platen-skin interface. A map of the differences in TIR across the region where the finger is touching the platen forms the basis for a conventional optical fingerprint reading. A number of optical arrangements are used to detect this variation of the optical interface in both bright-field and dark-field optical arrangements.

[0024] For purposes of illustration, the following description sometimes makes reference to use of a "finger" in performing measurements. It will be appreciated, however, that such illustrations are not intended to be limiting. Alternative sites that may be used include all surfaces and all joints of the fingers and thumbs, the fingernails and nail beds, the palms, the backs of the hands, the wrists and forearms, the face, the eyes, the ears, and all other external surfaces of the body.

[0025] In some embodiments, a sensor provides a plurality of discrete wavelengths of light that penetrate the surface of the skin, and scatter within the skin and/or underlying tissue. As used herein, reference to "discrete wavelengths" is intended to refer to sets of wavelengths or wavelength bands that are treated as single binned units — for each binned unit, information is extracted only from the binned unit as a whole, and not from individual wavelength subsets of the binned unit. In some cases, the binned units may be discontinuous so that when a plurality of discrete wavelengths are provided, some wavelength between any pair of the wavelengths or wavelength bands is not provided, but this is not required. In some cases, the binned units may overlap so that when a discrete wavelength is provided, two or more units may respond in some relative proportion. In some instances, the wavelengths are within the ultraviolet – visible – near-infrared wavelength range.

[0026] A portion of the light scattered by the skin and/or underlying tissue exits the skin and is used to form an image of the structure of the tissue at or below the surface of the skin. In some embodiments, such an image may include a fingerprint image, where the term "fingerprint" is used broadly herein to refer to any representation of any skin site with dermatoglyphic features and/or other textural features.

[0027] Embodiments of the invention thus provide improved systems and methods for collecting a set of MSI data with a single imager and a small number of other components similar to those already incorporated into many PEDs. Furthermore, certain embodiments advantageously adapt the design of existing imaging systems in PEDs in such a way that the biometric functionality may be achieved while retaining the general imaging functionality.

[0028] Figs. 1A, 1B, and 1C illustrate one embodiment of the present invention. The sensor 101 is configured to collect biometric data by touching the finger 111 on the platen 105. Light sources 103 illuminate the platen 105 from one or more sides, providing TIR illumination. When no finger is touching the platen 105, a substantial portion of the light emitted from sources 103 will enter into the platen 105 and be transmitted through it via a series of TIR reflections. However, when the skin of the finger 111 (or other substance of appropriate refractive index) makes contact with the platen, the light in the platen may pass into the finger 111. A portion of this light is then scattered by the skin and directed through the platen 105 and toward the optical system 107, which images the finger 111 onto an imager 109. The light sources 103 may be monochromatic sources such as LED's, laser diodes, or quantum dot lasers, or they may be broadband sources such as white-light LED's and various incandescent sources such as quartz-tungsten-halogen and others as known in the art. Sources 103a, 103b may be of the same wavelength characteristics or different (e.g. substantially different wavelengths), and there may be more than the two sources depicted. There may be lenses, mirrors, or other optical elements (not shown) that direct light from the sources 103 into the platen 105.

[0029] The imaging system 107 may comprise one or more lenses, one or more mirrors, and/or other optical elements known in the art. The imager 109 may be an imaging array such as a silicon CCD or CMOS array. The imager may be a monochromatic imager or may be a color imager. Examples of implementations of color imager that may be used include a Bayer color filter array and a wavelength-splitting beam splitter combined with multiple monochromatic imagers, as known in the art. Another example of an implementation of a color imager that may be used is a junction-depth filtering apparatus such as produced by Foveon®, Inc. and described in U.S. Pat. No. 6,958,194, entitled "IMAGER WITH IMPROVED SENSITIVITY," by Peter J. Hopper *et al.*, the entire disclosure of which is incorporated herein by reference for all purposes. In addition, the sensor 101 may comprise short-pass optical filters, band-pass optical filters, long-pass optical filters, linear polarizers, elliptical polarizers, diffuse scattering media, and/or other optical elements (not shown).

[0030] In one embodiment of the present invention, sensor 101 comprises a color RGB imager 109 and a variable-focus optical system 107 or other mechanism to obtain a focused image of the finger 111. The light sources 103 may be white-light LED's or some configuration of monochromatic LED's with one or more wavelengths that lie substantially within the Red-Green-Blue passbands of the imager 109. The optical system 107 may comprise a mechanical focus system, a liquid lens, a MEMS optical element, a system that implements wavefront coding technology, and/or other types of optical systems known in the art. The variable focus of the optical system 107 may allow the imager to image various depths in the finger. Additionally, the variable focus may enable the imager to be used for conventional imaging at times that a finger 111 is not present on the platen 105. The optical system 107 may provide a mechanism to perform macro imaging as required for barcode reading, optical scanning, and other such functions. As well, the optical system 107 may provide a mechanism to photograph distant objects such as people, landscapes and other such objects. In some cases, the optical system 107 may image directly through the platen 105. In other cases, the platen 105 may be movable or detachable, enabling the imager 109 to be used for conventional imaging when the platen 105 is not in the optical path and used for biometric tasks when the platen 105 is present. In some cases, the platen 105 may include one or more curved surfaces such that they provide optical power to improve the ability of the optical system 107 to focus on the finger 111.

[0031] Figs. 2A, 2B, and 2C illustrate a second embodiment of the present invention. In this embodiment, the platen 205 is of a narrow rectangular format and light sources 103 provide for TIR illumination. Similarly (although not necessarily) the imager 209 may also be a linear array or a rectangular array consisting of a small number of rows of pixels. In some cases, the optical system may be integrated with the imager 209 as depicted in Figs. 2A – 2C, instead of being a separate part as depicted in Figs. 1A – 1C. In this configuration, the finger 111 may be "swiped" or rubbed over the top of the sensor in either direction indicated by arrow 213. Multiple images or frames may be collected during the swipe and the image of the full finger region may then be reconstructed or "stitched" from the individual frames in a manner known in the art. In cases where the illumination source 103 comprises a broadband source and the imager 209 comprises a color imager, images corresponding to multiple illumination wavelengths may be collected simultaneously in this manner. Such a plurality of images may be used advantageously for biometric tasks such as identity determination, liveness determination and spoof detection, estimation of personal characteristics, and the like.

[0032] A variation of the illumination configuration is given by Fig. 3. In this figure, a lightpipe 305 is used to channel light from a distant light source (not shown). As depicted, the lightpipe 305 may be formed as the actual platen surface or the platen and light pipe might comprise a plurality of different pieces. Further, multiple lightpipes may be used and a variety of shapes may be selected in order to be consistent with other design constraints. In some embodiments, the lightpipe 305 is designed to maintain TIR throughout its length so light is channeled from the source (not shown) . In other cases the lightpipe may be coated with a metallic film or other reflective material in certain portions to aid light transmission. In some cases, the coating may be a material that selectively reflects certain wavelengths better than others, providing a mechanism for filtering the light as it propagates through the lightpipe. The use of a lightpipe for illumination is applicable to a wide range of embodiments of the present invention including swipe and single-touch configurations.

[0033] Figs. 4A, 4B, and 4C illustrate a different embodiment of the present invention. In this configuration, the finger 111 is swiped over a rolling platen 405. The platen 405 is preferably an optically clear material such as plastic, glass or others of the sort through which light source 103 can provide TIR illumination. The rolling platen 405 is able to spin on axle 435 while the imager 409 views the finger 111 through an appropriate optical system (not shown). In a manner similar to Figs. 2A – 2C and Fig. 3, the imager 409 may collect multiple frames while the finger 111 is swiped and the resulting composite image may be reconstructed from these frames. Optionally, a position encoder 425, such as an optical encoder, may be attached to the rolling platen 405. In such a way, the position on the finger at which each frame is collected may be determined and used to better reconstruct the full image. As disclosed earlier, in cases where the imager 409 comprises a color imager and the illumination source 103 compresses a broadband source, multiple images of different wavelengths may be collected simultaneously and used for a variety of biometric tasks.

[0034] Fig. 5 shows a variant of Figs. 4A – 4C that includes a light source 545 with a different orientation such that light is able to directly illuminate the finger 111. The light source 545 may optionally include an optical polarizing element (not shown) such as a linear polarizer. In such cases, the imager 509 may also include a polarizing element such as a linear polarizer (not shown), which may be oriented substantially perpendicular to the illumination polarizer. The direct illumination provided by light source 545 can be achieved using a variety of methods, but importantly such light is substantially unaffected by TIR effects that may occur between the finger 111 and the platen 505. Similar direct illumination techniques may also be used in conjunction with the other swipe and touch sensor embodiments of the present invention. In the case of a swipe embodiment, the direct and TIR illumination may be time modulated in a way that one frame is captured with TIR illumination and a second frame is captured under direct illumination. This alternation may then be continued throughout the duration of the finger swipe and two different images (i.e. direct-illuminated and TIR-illuminated) may be reconstructed. Similar time-modulated methods may also be applied to embodiments that incorporate multiple illumination sources (direct or TIR) with distinct wavelengths, distinct polarizations, or other differences in optical characteristics.

[0035] Alternatively, in cases where the imager 509 comprises a color filter array, the direct illumination source 545 and the TIR illumination source 503 may be different wavelengths. In particular, the TIR wavelength may be chosen such that it substantially passes through one of the color filter passbands (for example, red) while being substantially blocked by the other filter passbands (for example, blue and green). Similarly, the direct illumination may be a different wavelength (for example, blue) which is passed and blocked by the respective color filters. In such a way, both illumination sources 545 and 503 may be turned on simultaneously. The resulting image (in raw format rather than color processed) may thus be easily separated to produce the distinct image types. This same approach is applicable to any number of different imaging conditions, using sufficient numbers of different color filters with sufficient color discrimination characteristics and correspondingly monochromatic illumination sources.

[0036] In another alternative, the embodiment if Fig. 5 may be configured such that the TIR and direct images are additive rather than separable. For example, in the case of a monochromatic imager 509, both the direct illumination source 545 and the TIR illumination source 503 may be turned on at the same time, resulting in an image due to both sources. Similarly, in the case of a color imager 509, both sources 545 and 503 may have the same wavelength or may both be broadband sources, resulting in a similar additive image.

[0037] In some cases, the direct illumination may be used without TIR illumination. In such cases, noncontact measurements may be performed by holding the finger, hand, or other body part at an appropriate distance from the imager such that it can be illuminated and imaged. In the case of noncontact imaging, the platen may be eliminated from the system. In some cases,, the direct illumination may be performed using a white-light LED such as is present on some PEDs to perform a flash function. The imager 509 may be a color imager, enabling the collection of multiple images corresponding to multiple wavelengths during a single illumination session.

[0038] In the case where the imager 509 comprises a color image, subsequent processing steps may be aided by separating the resulting color image into a series of subimages, each of which represents a substantially different illumination wavelength condition. For example, in the case that the color imager is of a Bayer configuration, four subimages may be extracted from raw RGB data corresponding to the red, blue, and two green channels. Each subimage is slightly offset from the others by an amount approximately equal to the pixel size, but all four subimages represent substantially the same object under the multiple illumination conditions. Such subimage generation is broadly applicable across all embodiments of the present invention that make use of a color imager.

[0039] In some case, embodiments of the invention may be combined with other types of fingerprint sensors. By way of illustration, the swipe configuration of the multispectral imager depicted in Figs. 2A – 2C may be located in close proximity to or integrated with a swipe sensor of a different modality, such as capacitive, RF, or thermal sensing technology. In this way, multiple modalities may be used to collect biometric data during each user action.

[0040] Thus, having described several embodiments, it will be recognized by those of skill in the art that various modifications, alternative constructions, and equivalents may be used without departing from the spirit of the invention. Accordingly, the above description should not be taken as limiting the scope of the invention, which is defined in the following claims.

WHAT IS CLAIMED IS:

1. A portable electronic device comprising:

a body;

a platen adapted for placement of a purported skin site by an individual and integrated within the body;

an illumination source;

an imaging system; and

a controller interfaced with the illumination source and the imaging system, the controller including:

instructions to illuminate the purported skin site under a plurality of distinct optical conditions during a single illumination session;

instructions to derive a multispectral image of the purported skin site from light received by the imaging system after scattering from the purported skin site for each of multiple of the plurality of distinct optical conditions;

instructions to perform a nonbiometric function with the imaging system.

2. The portable electronic device recited in claim 1 wherein the illumination source comprises a white-light source.

3. The portable electronic device recited in claim 1 wherein the instructions to derive the multispectral image of the purported skin site comprise instructions to derive a plurality of images of different portions of the skin site as the skin site is moved over the platen.

4. The portable electronic device recited in claim 3 wherein the instructions to derive the multispectral image further comprise instructions to generate a composite of the plurality of images of different portions of the skin site.

5. The portable electronic device recited in claim 3 wherein the platen comprises a roller with which a position of the skin site relative to the imaging system is moved.

6. The portable electronic device recited in claim 5 wherein the platen is optically clear.

7. The portable electronic device recited in claim 1 wherein the illumination source comprises a first source disposed to illuminate the platen under total internal reflectance conditions.

8. The portable electronic device recited in claim 7 wherein the instructions to illuminate the purported skin site comprise instructions to illuminate the platen with the first source such that the skin site is illuminated indirectly.

9. The portable electronic device recited in claim 8 wherein:

the illumination source further comprises a second source disposed to illuminate the skin site directly; and

the instructions to illuminate the purported skin site further comprise instructions to illuminate the skin site directly with the second source.

10. The portable electronic device recited in claim 7 further comprising a lightpipe adapted to guide light from the illumination source to the platen.

11. The portable electronic device recited in claim 1 wherein:

the imaging system comprises a color imager configured to provide a plurality of subimages, each subimage corresponding to a different illumination wavelength or range of illumination wavelengths; and

the multispectral image comprises the plurality of subimages.

12. The portable electronic device recited in claim 11 wherein the illumination source comprises a plurality of illumination sources at different wavelengths.

13. The portable electronic device recited in claim 1 wherein the instructions to perform the nonbiometric function comprise instructions to perform a nonbiometric function with both the illumination source and the imaging system.

14. A biometric measurement system comprising:

a platen;

an illumination source;

a light detector; and

a controller interfaced with the illumination source and the light detector, the controller including:

instructions to illuminate a purported skin site of an individual under a plurality of distinct optical conditions during a single illumination session while the purported skin site is moved over the platen; and

instructions to derive a multispectral image of the purported skin site from light received by the light detector after scattering from the purported skin site for each of multiple of the plurality of distinct optical conditions while the purported skin site is moved over the platen.

15. The biometric measurement system recited in claim 14 wherein the instructions to derive the multispectral image of the purported skin site comprise instructions to generate a composite of a plurality of images derived for different portions of the purported skin site as the purported skin site is moved over the platen.

16. The biometric measurement system recited in claim 14 wherein the platen comprises a roller with which a position of the skin site relative to the light detector is moved.

17. The biometric measurement system recited in claim 16 wherein the platen is optically clear.

18. The biometric system recited in claim 14 wherein:

the illumination source comprises a first source disposed to illuminate the platen under total internal reflectance conditions; and

the instructions to illuminate the purported skin site comprise instructions to illuminate the platen with the first source such that the skin site is illuminated indirectly.

19. The biometric measurement system recited in claim 18 wherein:

the illumination source further comprises a second source disposed to illuminate the skin site directly; and

the instructions to illuminate the purported skin site further comprise instructions to illuminate the skin site directly with the second source.

20. The biometric measurement system recited in claim 14 wherein:

the light detector comprises a color imager configured to provide a plurality of subimages, each subimage corresponding to a different illumination wavelength or range of illumination wavelengths; and the multispectral image comprises the plurality of subimages.

21. The biometric measurement system recited in claim 20 wherein the illumination source comprises a plurality of illumination sources at different wavelengths.

22. A method of performing a biometric measurement on an individual, the method comprising:

illuminating a purported skin site of the individual under a plurality of distinct optical conditions during a single illumination session while the purported skin site is moved over a platen; and

receiving light scattered from the purported skin site separately for each of multiple of the plurality of distinct optical conditions while the purported skin site is moved over the platen to derive a multispectral image of the purported skin site.

23. The method recited in claim 22 further comprising generating a composite of a plurality of images derived for different portions of the purported skin site as the purported skin site is moved over the platen to derive the multispectral image.

24. The method recited in claim 22 wherein the purported skin site is moved over the platen by rolling the purported skin site over a roller comprised by the platen.

25. The method recited in claim 22 wherein illuminating the purported skin site comprises illuminating the platen with a first source under total internal reflectance conditions to illuminate the skin site indirectly.

26. The method recited in claim 25 wherein illuminating the purported skin site further comprises illuminating the skin site directly with a second source.

27. The method recited in claim 22 wherein the purported skin site is in contact with the platen.

28. The method recited in claim 22 wherein the purported skin site is not in contact with the platen.

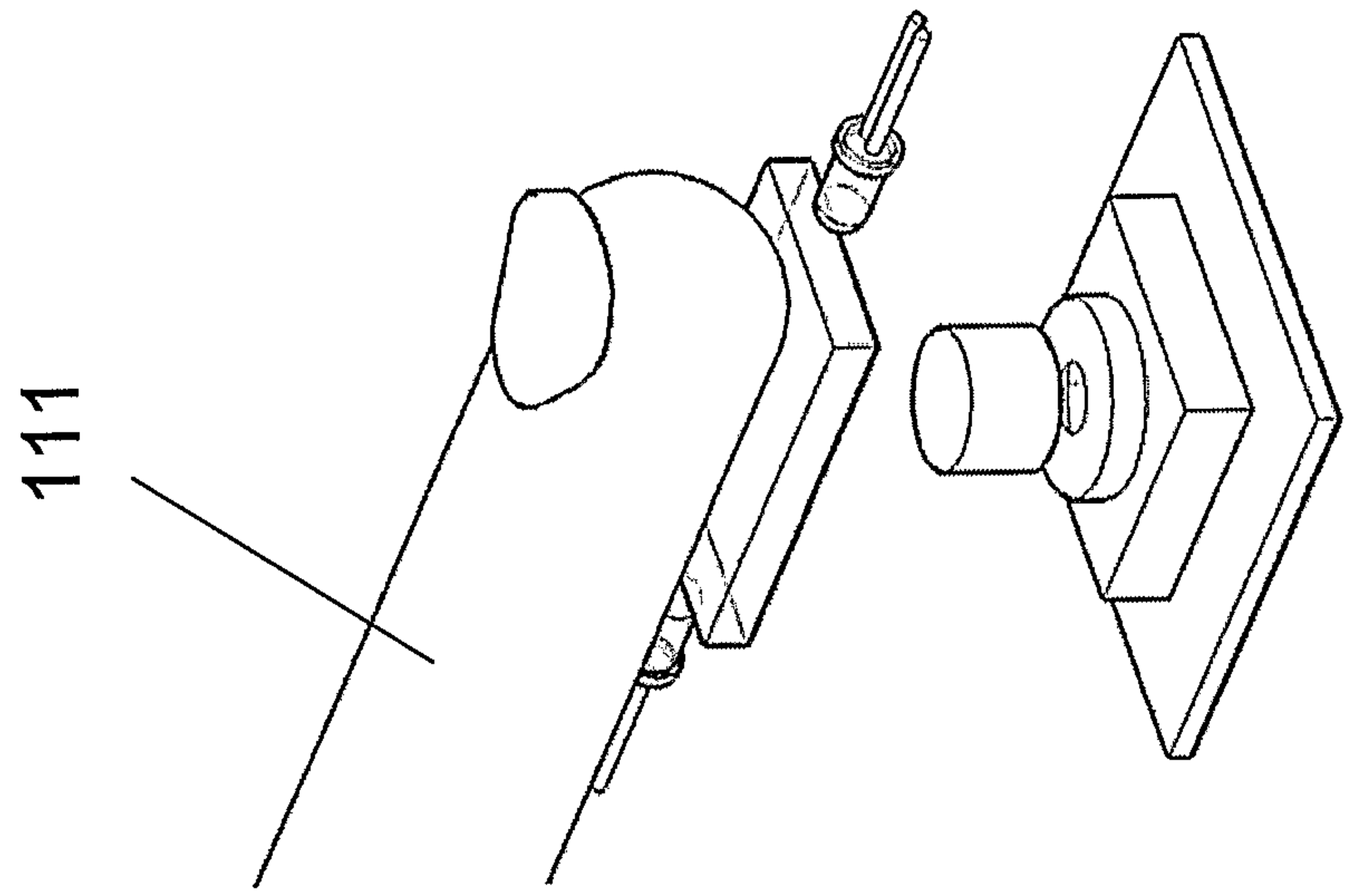


Fig. 1C

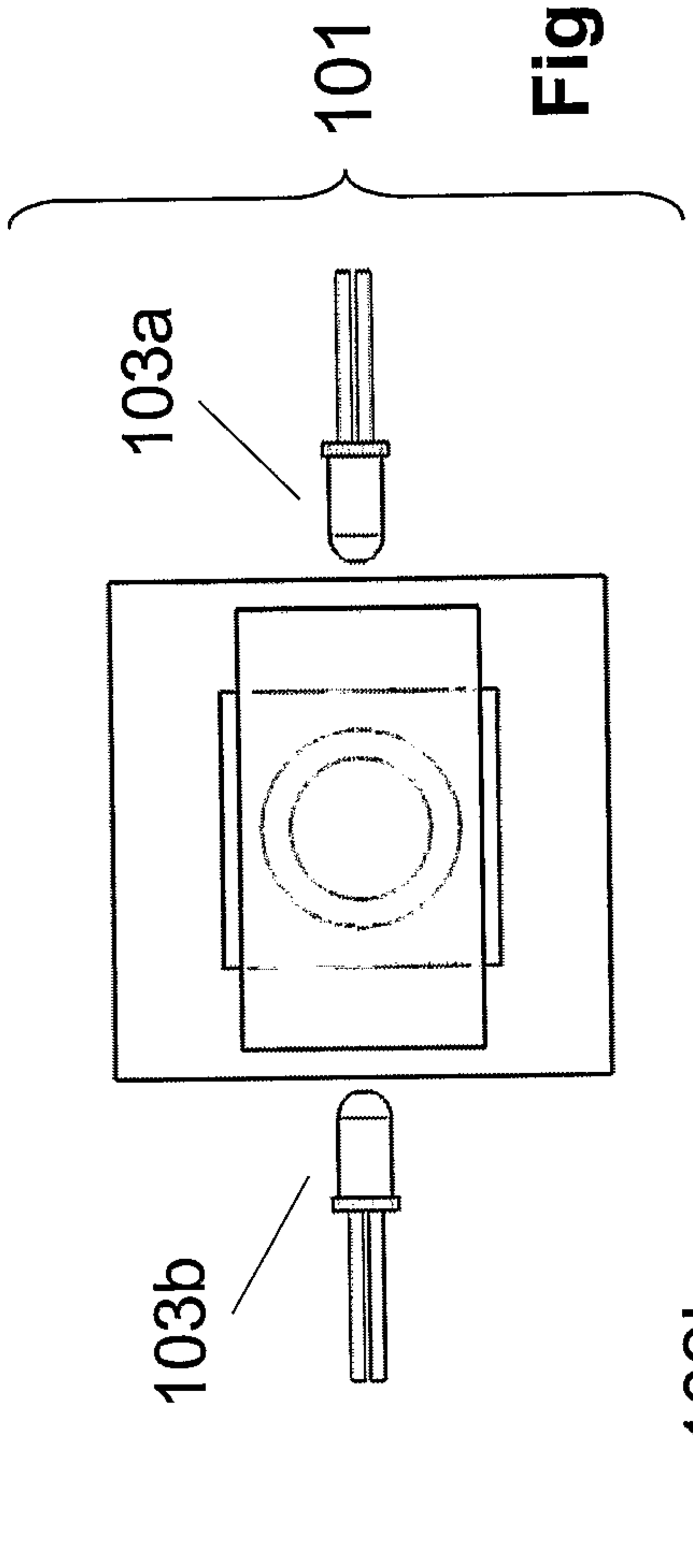


Fig. 1A

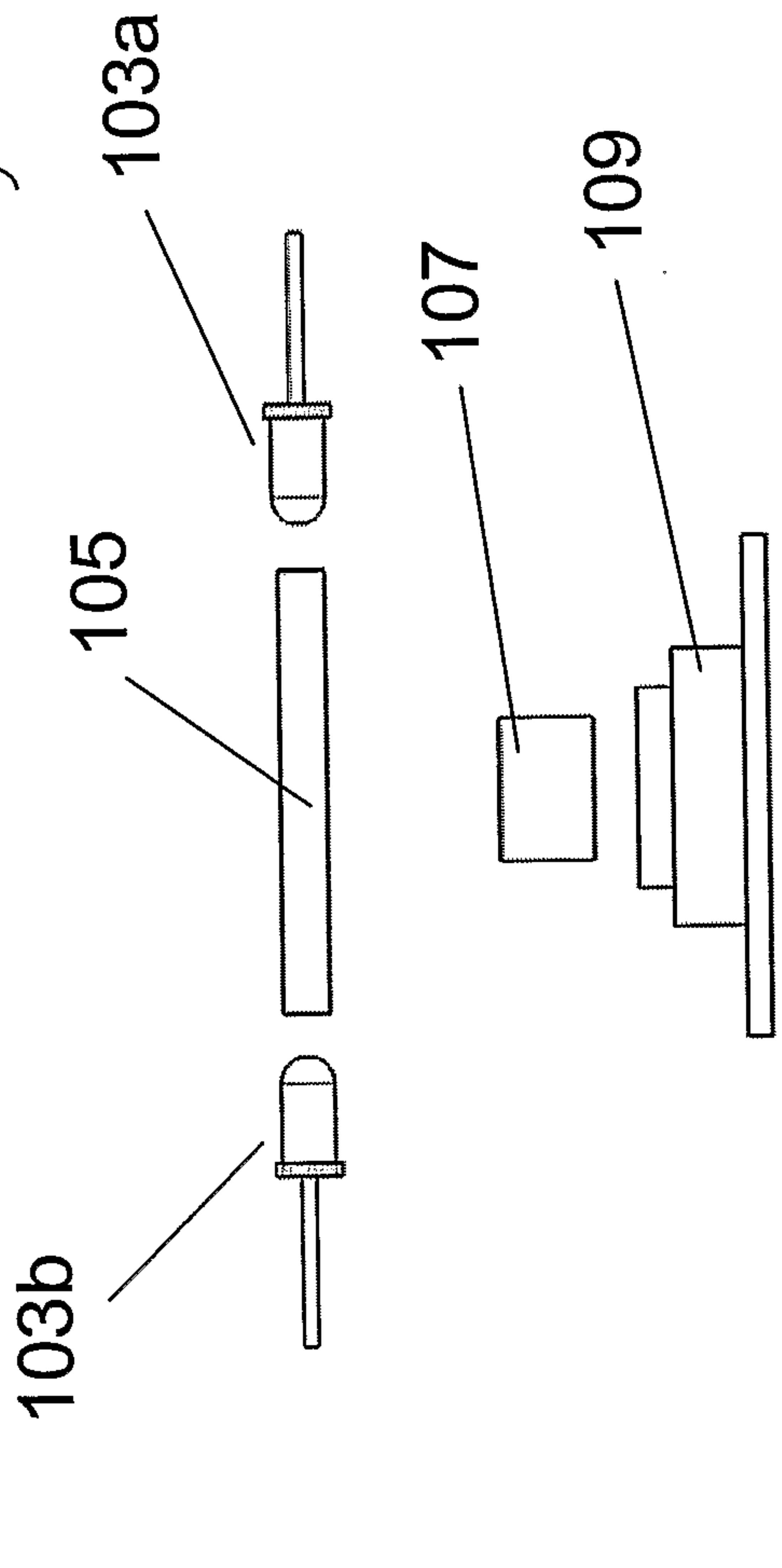


Fig. 1B

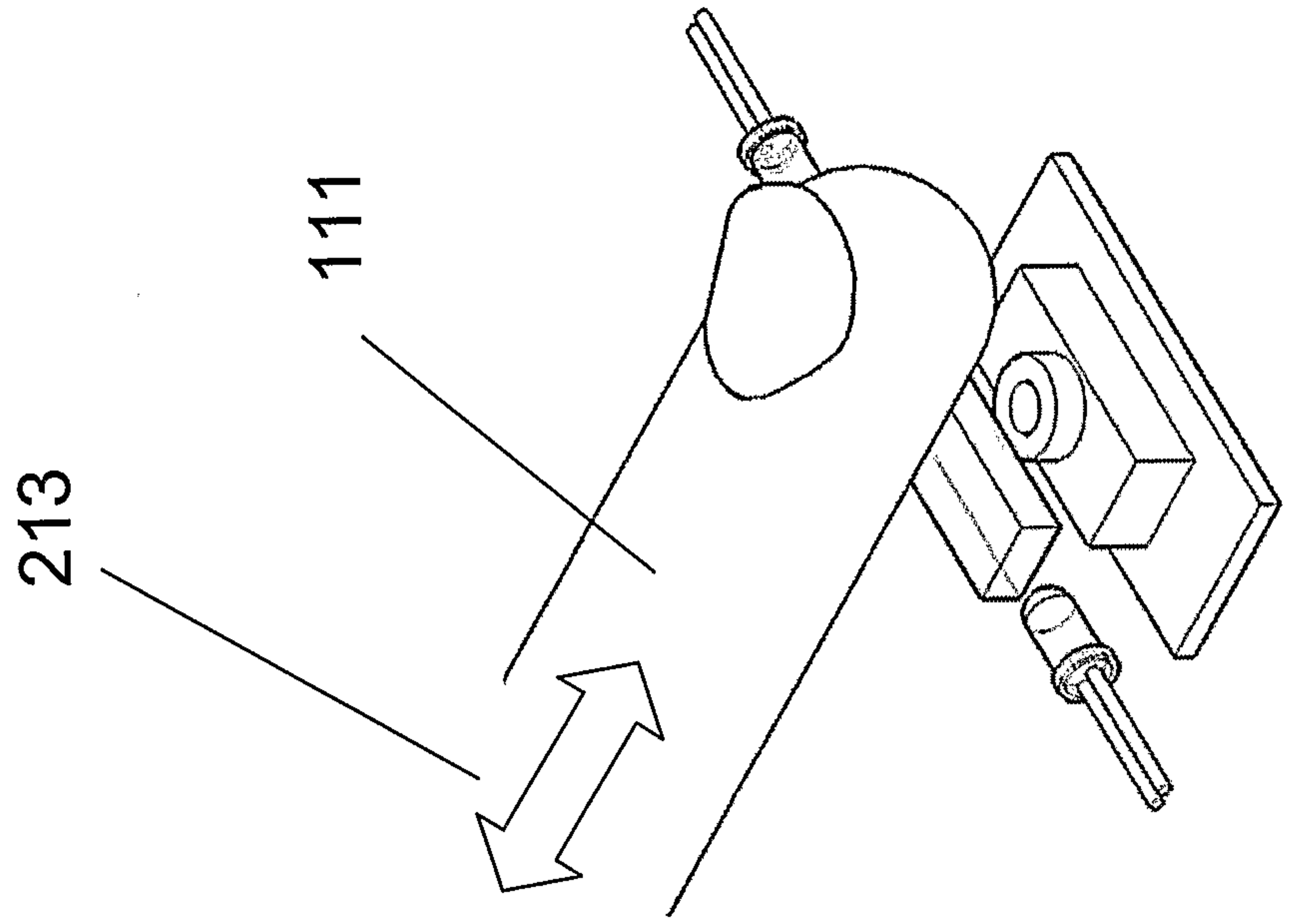
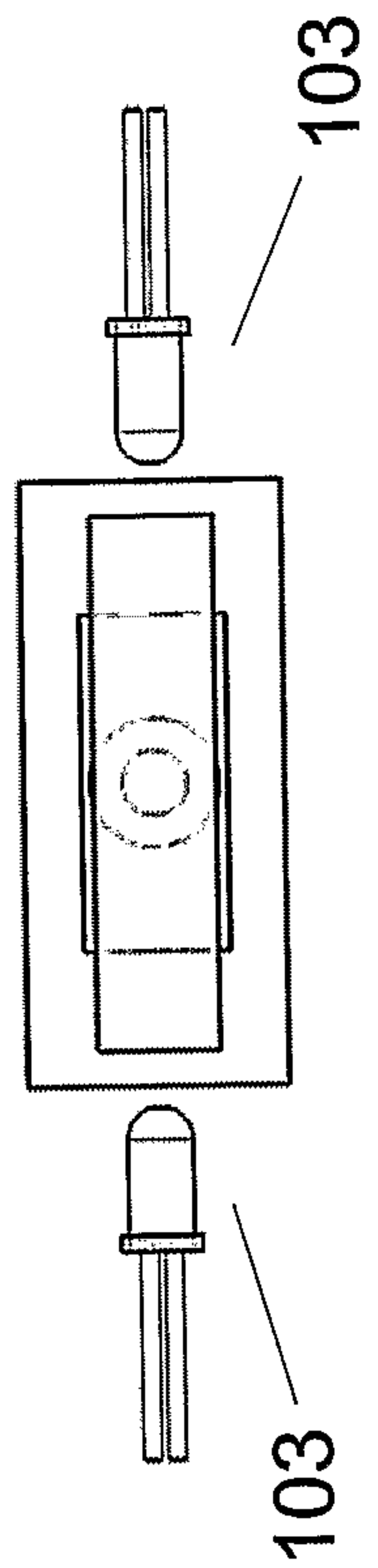


Fig. 2C

Fig. 2A



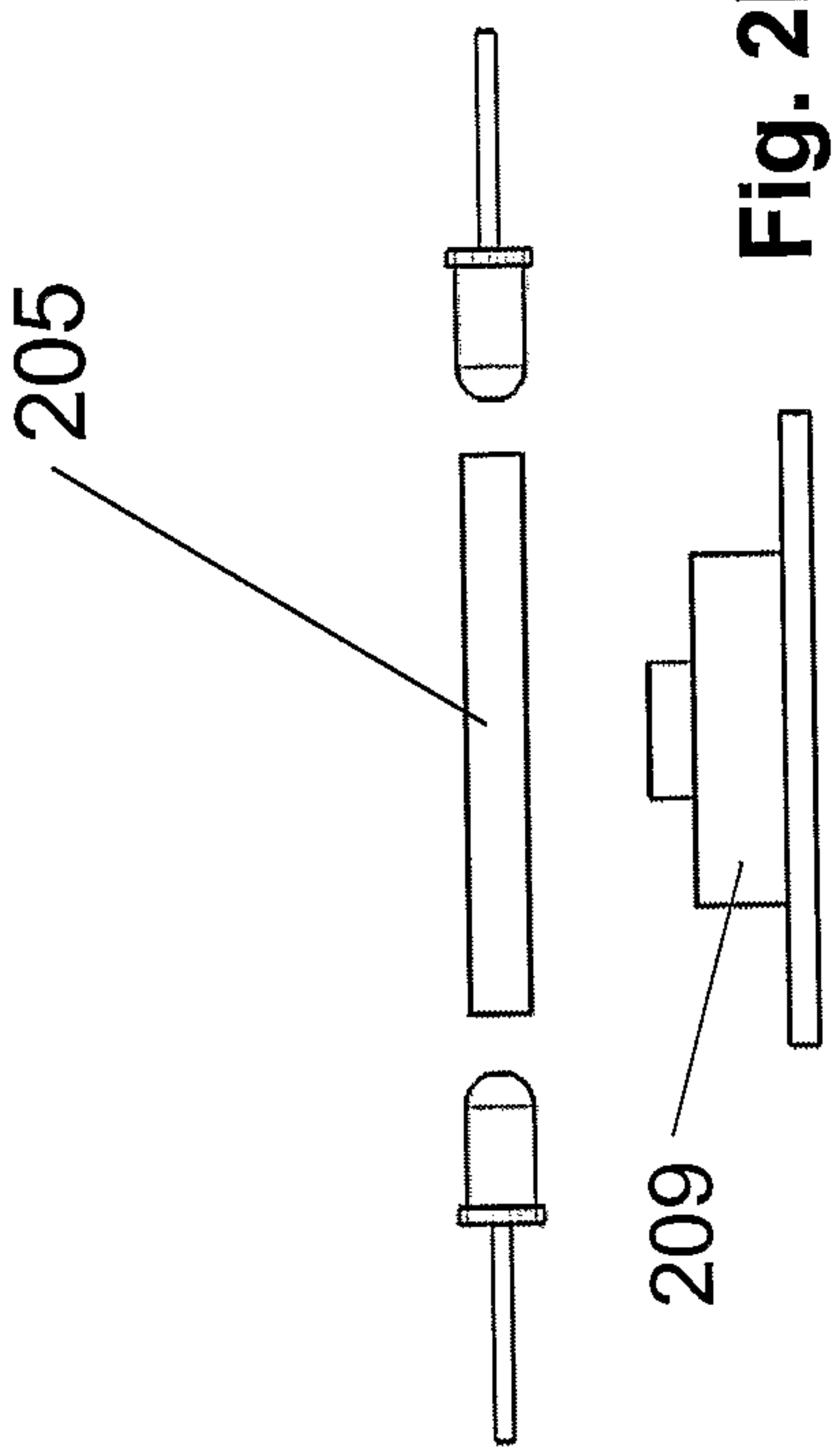


Fig. 2B

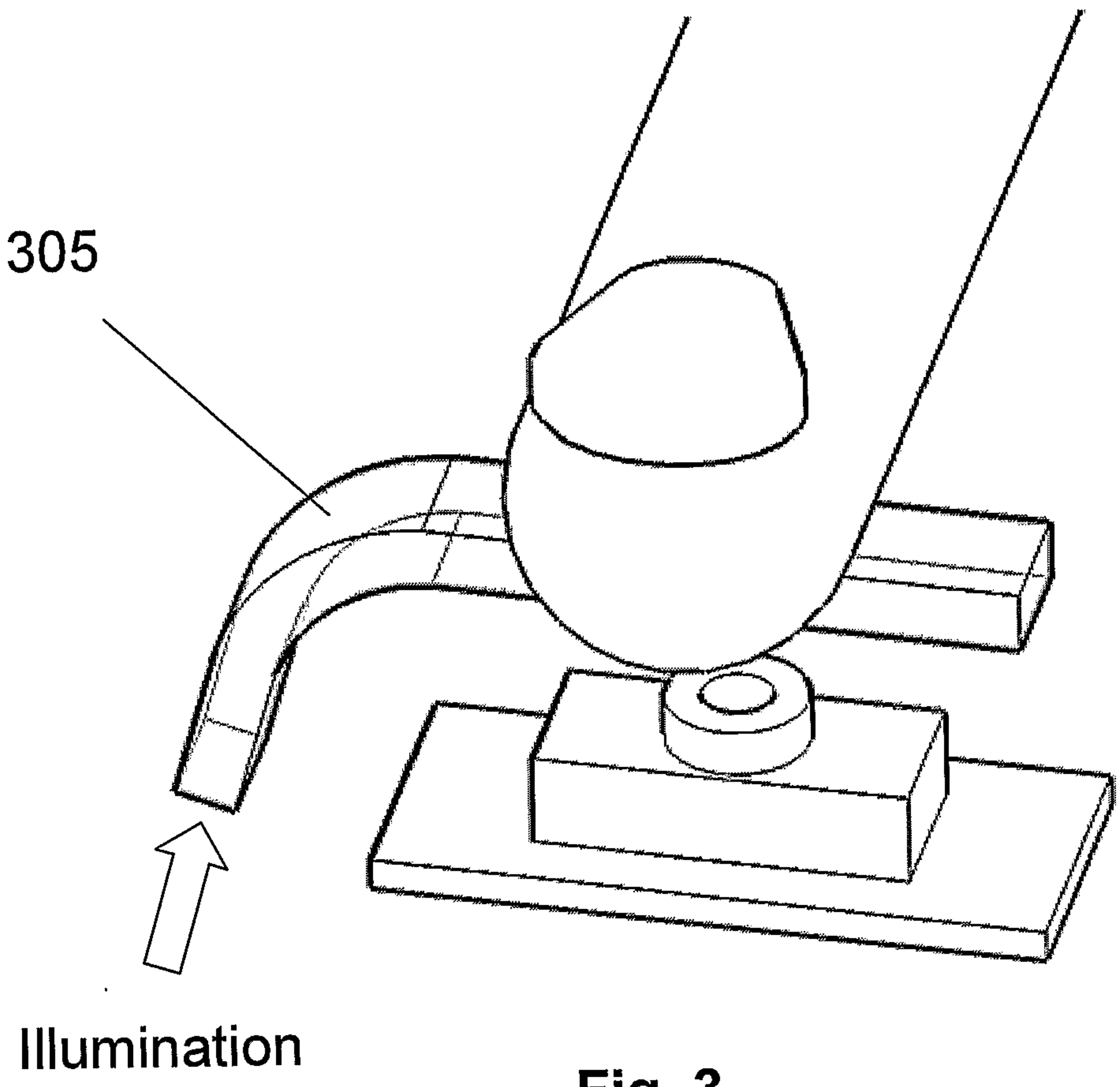


Fig. 3

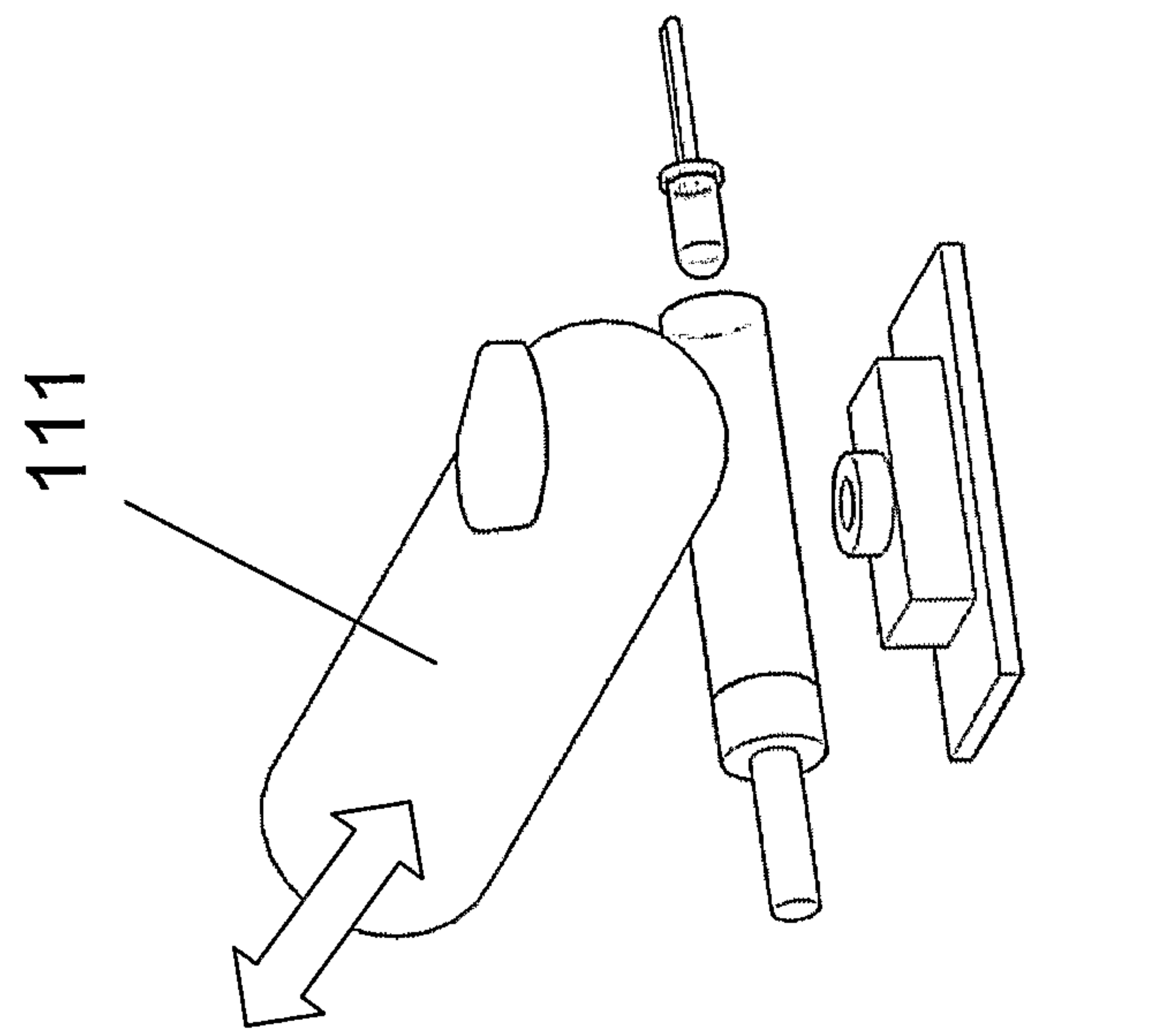


Fig. 4C

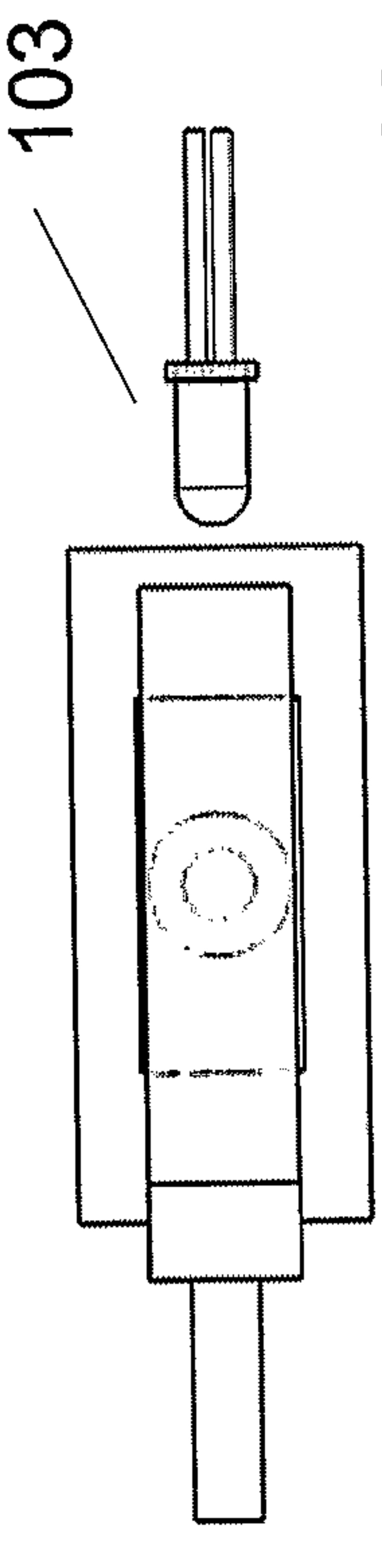


Fig. 4A

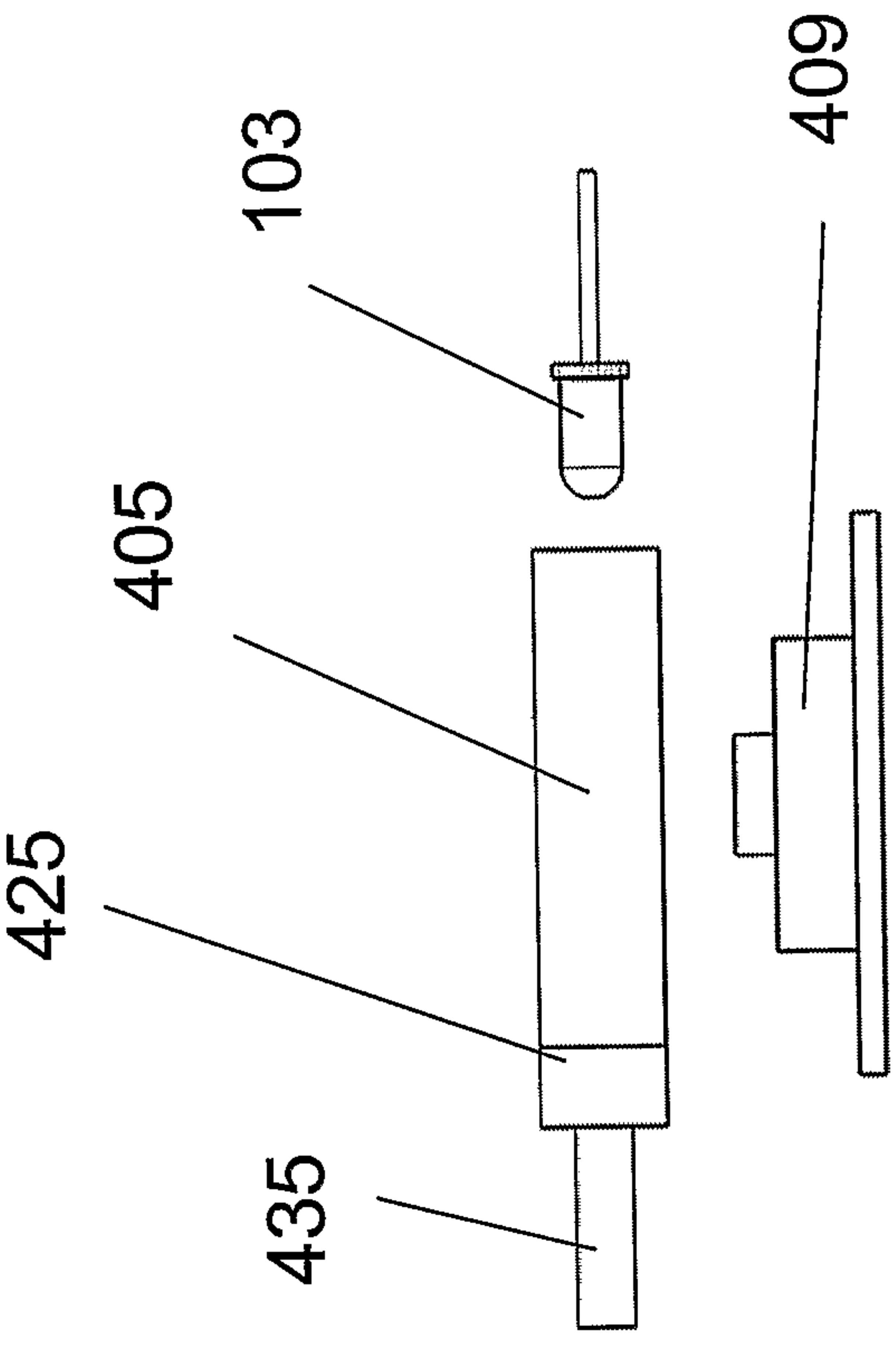


Fig. 4B

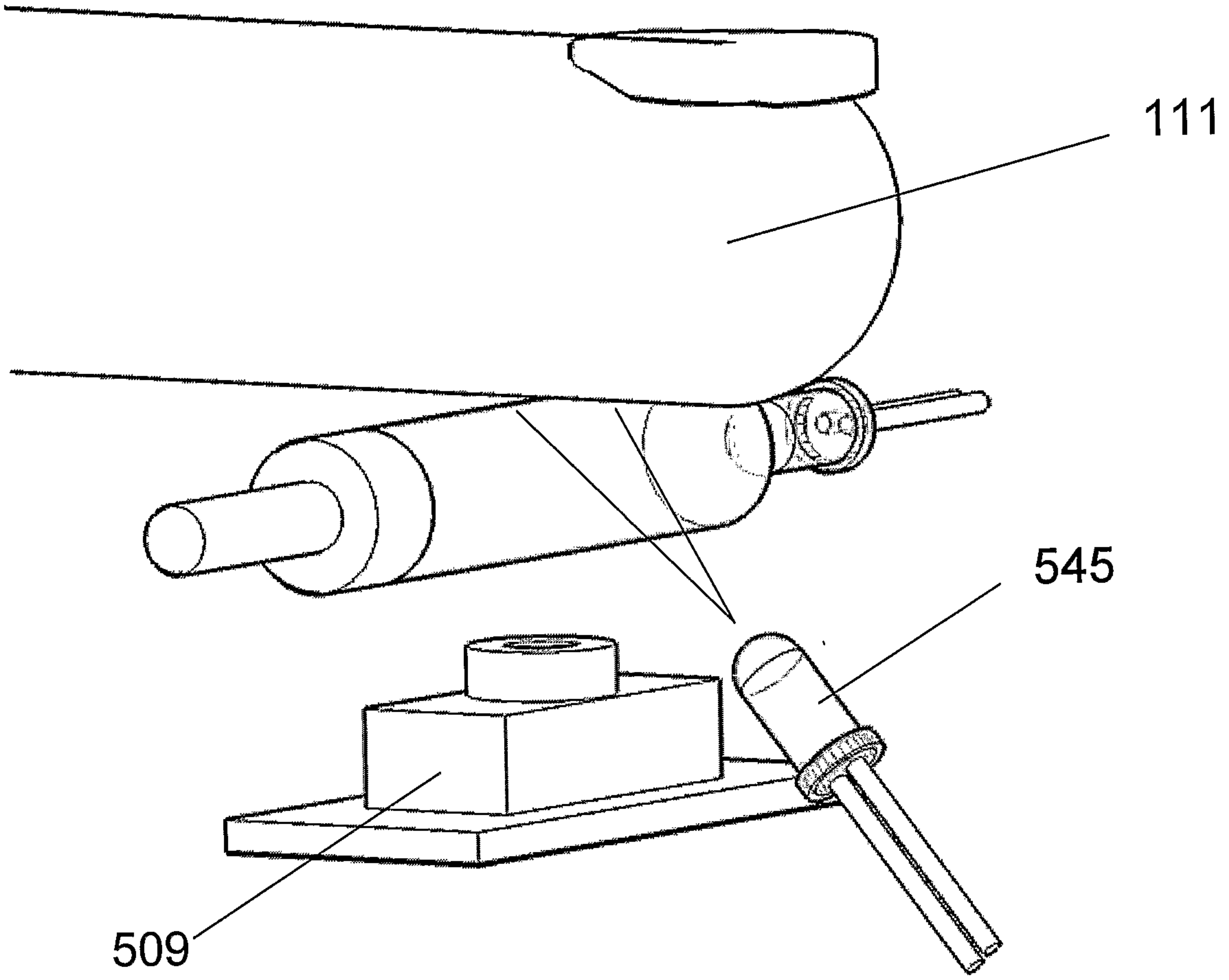
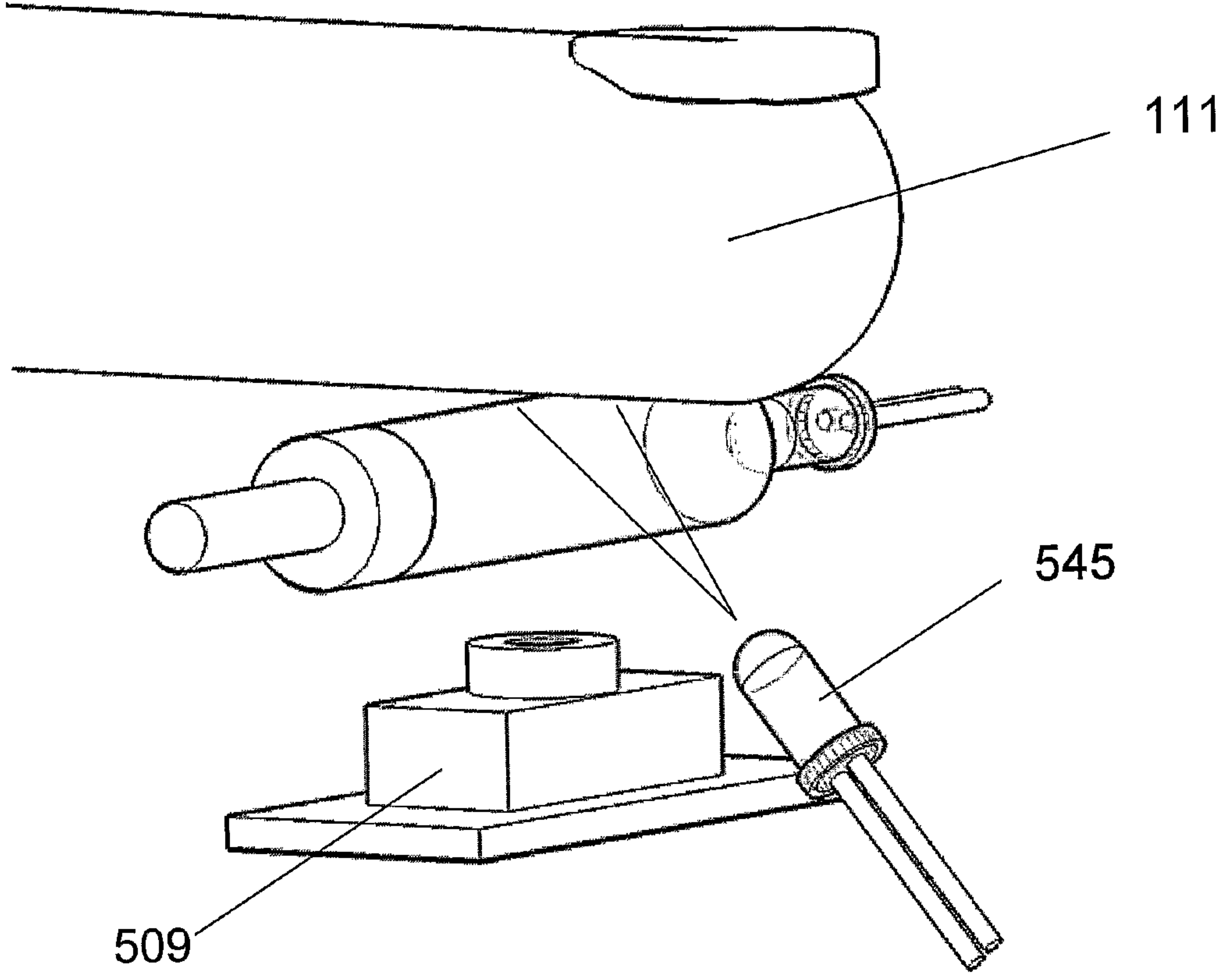


Fig. 5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