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(54) **HOLDING DEVICE FOR A BREATHING TUBE AND METHOD FOR READING OUT A CODING ON A SURFACE OF A BREATHING TUBE**

HALTEVORRICHTUNG FÜR EINEN BEATMUNGSSCHLAUCH UND VERFAHREN ZUM AUSLESEN EINER CODIERUNG AUF EINER OBERFLÄCHE EINES BEATMUNGSSCHLAUCHS

DISPOSITIF DE RETENUE POUR UN TUBE RESPIRATOIRE ET PROCÉDÉ POUR LIRE UN CODAGE SUR UNE SURFACE D'UN TUBE RESPIRATOIRE

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Description

[0001] The instant invention relates to a holding device for a breathing tube for use in lung function diagnostics according to the preamble of claim 1, to a lung function diagnostics device equipped with such a holding device according to the preamble of claim 11, and to a method for reading out a coding on the surface of a breathing tube according to the preamble of claim 12.

[0002] It is common in lung function diagnostics to use breathing tubes (also known as flow tubes) to measure the gas inhaled and/or exhaled by a patient. EP 3 017 760 A1 describes such a breathing tube. This European patent application also describes a comb-like indicator on the breathing tube serving as coding element. It is furthermore described in this European patent application to read out the comb-like structure by a light source and a corresponding detector.

[0003] It has been observed that the reliability of reading out such a comb-like structure or a comparable coding element on a surface of a breathing tube is often lower than desired.

[0004] WO 2016/172555 A1 describes an endotracheal tube apparatus comprising an endotracheal tube and a hub connection fitting, wherein the hub connection fitting includes a light emitting device. This apparatus comprises an elbow 173 that serves for guiding light towards and through a specific light guiding arranged in an inner space surrounded by a main body. This light is intended to illuminate a site of action at the end of the endotracheal tube.

[0005] US 2005/0267386 A1 discloses a device for expanding the connective fatty tissue and correcting inverted nipples and improving symmetry of the human breast by the application of gentle suction generated by oral inhalation.

[0006] WO 97/48338 A1 describes an air tube including a resistive element 22 which is located in a hollow space of a tubular portion 12. This resistive element 22 is adapted for providing a linear resistance versus pressure response, and is sized and adapted to cause a pressure difference or differential as air flows in the hollow space across this element.

[0007] EP 0 597 060 A1 describes an ultrasound spirometer having a pair of emitter/receiver cells 32, 36 arranged in a measurement section 16 obliquely to the axis of the measurement tube. A sterile easily interchangeable tube 14 is exactly fitted into the measurement tube and has measurement windows in the transition area to the measurement section, so that inserts 18 which are transparent to acoustic waves, but largely impervious to germs and other soils, may be inserted into respective openings.

[0008] US 2007/0261698 A1 describes a portable, lightweight, and small device which verifies intubation and monitors respiratory gas in a patient. The device comprises an electronic monitoring device portion and a disposable airway adapter, the disposable airway adapter having an integral display for indicating presence or levels of respiratory gas.

[0009] US 2010/0036272 A1 describes a system 300 for measuring a metabolic parameter. The system includes an integrated airway adapter 20, 100, 200 capable of monitoring any combination of respiratory flow, O_2 concentration, and concentrations of one or more of CO_2, N_2O, and an anesthetic agent in real time, breath by breath. Molecular oxygen concentration may be monitored by way of luminescence quenching techniques. Infrared absorption techniques may be used to monitor one or more of CO_2, N_2O, and anesthetic agents.

[0010] It is an object of the instant invention to provide a holding device for a breathing tube that is particularly appropriate to hold a breathing tube having a coding element like a comb-like coding structure on its outer surface, wherein the holding element serves for a higher reliability of reading out this coding element and enables manufacturing of a lung function diagnostics device that is more compactly designed than lung function diagnostics devices known from prior art. Furthermore, such a holding device shall be manufactured in a particularly simple manner.

[0011] This object is achieved by a holding device having the features of claim 1. Such a holding device serves to hold a breathing tube that is to be used in lung function diagnostics. Thereby, the holding device entirely consists of a material that is transparent for light having a wavelength in a first wavelength range but nontransparent for light having a wavelength in a second wavelength range (selectively transparent material). Thereby, the first wavelength range differs from the second wavelength range. Due to this selectively transparent material, light having a wavelength in the first wavelength range can be radiated through the holding device onto a breathing tube which is arranged within the holding device so that a coding structure on the surface of the breathing tube can be read out by the aid of the light. By such an arrangement, it is no longer necessary to provide a breakthrough in the holding device that can be passed by any light. Rather, the material of the holding device is chosen to be transparent for the first wavelength range at least in the region in which the light shall pass through the holding device to be able to read out a coding structure on a breathing tube inserted into the holding device. By such a design of the holding tube, the influence of stray light passing through the holding device towards a light detector is significantly decreased. This in turn increases the sensitivity and/or selectivity of a corresponding detecting device so that the overall readout process becomes much more reliable.

[0012] According to the presently claimed invention, the holding device comprises a fitting that serves for guiding, in its interior, light having a wavelength in the first wavelength range emitted from a light source on a circuit board towards and through a main body of the holding device onto a detecting device on the circuit board appropriate to detect light having a wavelength in the first

wavelength range. The light source and the detecting device face in the same direction. The holding device serves for guiding the light such that the light beam changes its direction within the fitting, wherein the fitting extends away from a lateral portion of the main body of the holding device, wherein the fitting has a free end arranged in a first plane that extends at an angle of 30° to 120° to a second plane in which the lateral portion of the main body extends.

[0013] The term "transparent" is to be understood such that a material is to be considered as transparent if at least 75 %, in particular at least 80 %, in particular at least 85 %, in particular at least 90 %, in particular at least 95 %, in particular at least 97 %, in particular at least 99 %, in particular 100 % of light radiated onto the material passes the material, i.e. if has a transparency of the before-mentioned percentages.

[0014] The term "nontransparent" is to be understood such that a material is to be considered as nontransparent if less than 25 %, in particular less than 20 %, in particular less than 15 %, in particular less than 10 %, in particular less than 5 %, in particular less than 3 %, in particular less than 2 %, in particular lesser than 1 %, in particular 0 % of light radiated onto the material passes the material.

[0015] The term "lung function diagnostics" refers to any kind of the analysis of breath gas (i.e., the analysis of gas inhaled or exhaled by a person) to determine the lung function of a patient, in particular all applications of spirometry, gas washout measurements, gas dilution measurements, or gas diffusion measurements. Typical parameters determined by lung function diagnostics are forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio (FEV1%), forced expiratory flow (FEF), forced inspiratory flow 25-75% or 25-50%, peak expiratory flow (PEF), tidal volume (TV), total lung capacity (TLC), diffusing capacity (DLCO), maximum voluntary ventilation (MW), functional residual capacity (FRC), and/or lung clearance index (LCI). The instantly described and/or claimed holding device is intended to hold breathing tubes to be used for determining any of these parameters in spirometry or to be used for any other kinds of lung function diagnostics without specific limitation.

[0016] As mentioned above, the holding device entirely consists of the selectively transparent material. This enables a particularly simple manufacturing of the holding device since it can then be manufactured in a single process step, e.g., by injection molding. Other appropriate manufacturing techniques can also be applied. Since the whole holding device is made from only a single material, no specific limitations regarding the manufacturing process are necessary.

[0017] In an embodiment, the first wavelength range comprises wavelengths of at least 600 nm (i.e. 600 nm and above), in particular at least 650 nm, in particular at least 700 nm, in particular at least 750 nm, in particular at least 800 nm, in particular at least 850 nm, in particular at least 900 nm, in particular at least 950 nm, in particular at least 1000 nm. An appropriate first wavelength range is a range of 600 nm to 1000 nm, in particular 650 nm to 950 nm, in particular 700 nm to 900 nm, in particular 750 nm to 850 nm, in particular 800 nm to 900 nm. In an embodiment, the first wavelength range comprises wavelengths of infrared light, i.e., the material is transparent for infrared light.

[0018] It is appropriate if the first wavelength range is comparatively narrow so as to allow only a transmission of specific, narrow-banded light. In an embodiment, the first wavelength range has a spectral width of not more than 200 nm, in particular not more than 150 nm, in particular not more than 100 nm, in particular not more than 75 nm, in particular not more than 50 nm, in particular not more than 30 nm. An appropriate spectral width for the first wavelength range is a spectral width of 30 nm to 200 nm, in particular 50 nm to 150 nm, in particular 75 nm to 100 nm.

[0019] In an embodiment, the second wavelength range comprises wavelengths of less than 600 nm (i.e., lower than 600 nm), in particular of less than 550 nm, in particular of less than 500 nm, in particular of less than 450 nm, in particular of less than 400 nm. An appropriate second wavelength range is a range of 300 nm to 600 nm, in particular 350 nm to 550 nm, in particular 400 nm to 500 nm.

[0020] It is appropriate if the second wavelength range is comparatively broad so as to filter a broad range of potentially disturbing stray light. In an embodiment, the second wavelength the range has a spectral width of at least 200 mm, in particular at least 250 nm, in particular at least 300 nm, in particular at least 350 nm, in particular at least 400 nm, in particular at least 450 nm, in particular at least 500 nm. An appropriate spectral width for the second wavelength range is a spectral width of 200 nm to 500 nm, in particular 250 nm to 450 nm, in particular 300 nm to 400 nm.

[0021] In an embodiment, the first wavelength the range comprises wavelengths above 700 nm, wherein the second wavelength range comprises wavelengths below 700 nm.

[0022] In an embodiment, the holding device has an inner main space. Thereby, a breathing tube can be inserted into this inner main space and can be removed from the inner main space after the measurement has been done. This makes it particularly simple to exchange breathing tubes after use, e.g. for hygienic reasons. One-piece breathing tubes (without exchangeable mouth piece) are directly contacted by a patient's mouth so that each breathing tube is regularly used for a single patient only.

[0023] In an embodiment, the holding device comprises a main body surrounding the inner main space. Furthermore, a first side body extending laterally from the main body on a first side and a second side body extending laterally from the main body on a second side are provided. Thereby, the first side is opposite to the second

side. The first side body surrounds a first inner side space and the second side body surrounds a second inner side space. The first inner side space serves for housing a first ultrasonic transceiver, and the second inner side space serves for housing a second ultrasonic transceiver. By such an arrangement of the holding device, ultrasonic measurements of gas flowing through a breathing tube inserted into the holding device can be performed in a particularly simple manner.

[0024] In an embodiment, the main body is made from a selectively transparent material. In another embodiment, both the main body and the first and second side bodies are made from the same selectively transparent material.

[0025] In an embodiment, the first plane extends in an angle of 40° to 110°, in particular 50° to 100°, in particular 60° to 90°, in particular 70° to 80° with respect to the second plane in which the lateral portion of the main body extends (from which lateral portion, in turn, the fitting extends). In an embodiment, the first plane is essentially perpendicular (i.e., in an angle of 80° to 100°, in particular 85° to 95°, in particular 88° to 92°, in particular 89° to 91° and very particular 90°) to the second plane.

[0026] The angle between the first plane and the second plane is chosen such that the free end of the fitting reaches, in the installed state of the holding device within a lung function diagnostics device, into the light emitting area (light cone) of a light source so that light emitted from that light source can be guided through the fitting towards and through the main body of the holding device. If a light source is chosen that only emits light in an upward direction, an essentially perpendicular arrangement between the first plane and the second plane is particularly appropriate to allow the fitting to guide light from the light source towards the main body of the holding device. If a light source is chosen which emits light in a broader angular range, a different angular arrangement between the first plane and the second plane can be chosen likewise.

[0027] Since the fitting connects two areas with each other that are located angularly, in particular essentially perpendicular, to each other, the fitting is able to also guide a light beam in its interior in an angled way. Since the light beam does not necessarily need to leave the fitting perpendicularly to the second plane, the overall angle, in which the light beam is guided within the fitting, does not necessarily need to correspond to the angle in which the first plane and the second plane are arranged to each other. Rather, the fitting is appropriate, in an embodiment, to guide a light beam in its interior in such a way that an angle between a line in an entry direction of the light beam and a line in an exit direction of the light beam guided within the fitting is in a range of from between 30° to 90°, in particular from 35° to 85°, in particular from 40° to 80°, in particular from 45° to 75°, in particular from 50° to 70°, in particular from 55° to 65°, in particular from 60° to 90°.

[0028] In an embodiment, the fitting has a curved surface. Such a curved surface is particularly appropriate to allow guiding a light beam in the interior of the fitting.

[0029] In an embodiment, the curved surface comprises at least two sections with different curvatures. Then, a light beam entering the fitting is reflected in the first section (having a first curvature) in a first angle towards the second section (having a second curvature) and is there reflected in a second angle. Thereby, the second angle can be the same as the first angle or can be different from the first angle. It is furthermore possible that a light beam is reflected more than twice within the fitting. It is in particular ensured that a light beam guided through the fitting is reflected in each section of the fitting having a curvature which deviates from the curvature of another section of the same fitting.

[0030] In an embodiment, the holding device comprises a lens that is integrally formed on the surface of the holding device. Such a lens is typically manufactured from the same material as the rest of the holding device, i.e. a selectively transparent material. Thus, it is not necessary to insert a lens made from another material into the holding device. Rather, the lens can be manufactured together with the main body of the holding device in a single manufacturing step. The lens serves for focusing light being guided through the lens towards the sensor (detecting device) arranged outside the holding device.

[0031] In an embodiment, the lens faces towards the first plane (i.e., the plane in which a light entry surface of the fitting is arranged).

[0032] In an embodiment, the selectively transparent material comprises at least one base material chosen from the group consisting of polycarbonates, acrylonitrile butadiene styrene, polystyrene, poly(methyl methacrylate), polyethylene terephthalate, polyethylene terephthalate glycol, copolymers of polystyrene and polyethylene terephthalate glycol, cellulose esters such as cellulose acetate butyrate, as well as blends and copolymers of these base materials. These materials exhibit a good overall light transparency, are insensitive to scratches and are stable enough so that the holding device can be produced with a small wall thickness but is still stable enough to securely house a breathing tube.

[0033] To achieve a selective light transparency of the material from which the holding device is made, the selectively transparent material additionally comprises a coloring agent having a filter effect for light having a specific wavelength. Then, the selectively transparent material is light nontransparent for light having a wavelength which is filtered by the coloring agent and is light transparent for light having a wavelength lying outside this range. Appropriate coloring agents are, e.g., the coloring agents disclosed in US 2015/0307688 A1, US 2016/0053081 A1, US 2017/0044375 A1, and EP 2 940 495 A1. Depending on the base material used, a further appropriate coloring agent is the coloring agent marketed by Clariant under the name "Polysynthren Black H". Further appropriate coloring agents are 1-hydroxy-4-(p-toluidino)-anthraquinon (CAS no. 81-48-1), 4-[(1,5-dihydro-

3-methyl-5-oxo-1-phenyl-4H-pyrazol-4-ylidene)methyl]-2,4-dihydro-5-methyl-2-phenyl-3H-pyrazol-3-one (CAS no. 4701-90-3), and mixtures thereof.

[0034] Appropriate concentrations of the coloring agent in the selectively transparent material are 1 to 20 percent by weight (% (w/w)), in particular 1.5 to 19 % (w/w), in particular 2 to 18 % (w/w), in particular 2.5 to 17 % (w/w), in particular 3 to 16 % (w/w), in particular 3.5 to 15 % (w/w), in particular 4 to 15 % (w/w), in particular 4.5 to 14 % (w/w), in particular 5 to 13 % (w/w), in particular 5.5 to 12 % (w/w), in particular 6 to 11 % (w/w), in particular 6.5 to 10 % (w/w), in particular 7 to 9 % (w/w), in particular 7.5 to 8.5 % (w/w).

[0035] In an aspect, the instant invention also relates to a lung function diagnostics device that is characterized by a holding device according to the preceding explanations.

[0036] The lung function diagnostics device additionally comprises a circuit board having a light source appropriate to emit light having a wavelength in a first wavelength range and the detecting device is appropriate to detect the light having a wavelength in the first wavelength range. Thereby, the light source and the detecting device face the same direction. Such an arrangement of light source and detecting device on one and the same circuit board can be manufactured in a particularly easy manner. To give an example, the light source can emit light in upward direction. The detecting device can detect light being radiated onto it from an upward direction. Such an arrangement only necessitates that the light is guided on a bow-like beam path. This can be achieved in a particularly simple manner if a fitting as described above is provided on a main body of the holding device. Then, the light can be emitted from the light source and can be guided through the fitting towards the main body of the holding device. Afterwards, it is radiated along a coding structure of a breathing tube inserted into the holding device and afterwards guided through the holding device and an optional lens towards the detecting device. Thus, the fitting which is present on the holding device of the lung function diagnostics device makes any angled arrangements of light source and detecting device superfluous. It allows for easy placement of the holding device of the lung function diagnostics device directly above the circuit board. It is not necessary that the circuit board comprises any specific arrangements for emitting light in a specific direction. Rather, light emitted such that a line extending along the light emission direction in the center of a light emitting cone is arranged essentially perpendicular to a plane in which the circuit board extends can well be used for operating the claimed lung function diagnostics device.

[0037] The light source can be an individual light source or a plurality (at least two) of light sources arranged next to each other, such as a light source array. Light emitting diodes (LEDs) are particularly appropriate light sources.

[0038] In an embodiment, the detecting device is a line detector comprising a plurality of individual detectors or an array of detectors so that irradiating a specific area can be detected well by the detecting device.

[0039] So far, holding devices for breathing tubes for lung function diagnostics have never been manufactured from selectively transparent materials according to the knowledge of the inventors. This can be easily explained by the fact that - according to the knowledge of the inventors - no one has ever considered using light having a specific wavelength for reading out a coding on a breathing tube to be inserted into the holding device and to minimize the influence of scattered light within lung function diagnostics devices. Therefore, in an aspect, the instant disclosure also relates to the novel use of a material that is transparent for light having a wavelength in a first wavelength range but nontransparent for light having a wavelength in a second wavelength range for manufacturing a holding device for a breathing tube for use in lung function diagnostics.

[0040] In an aspect, the instant invention also relates to a method for reading out a coding on the surface of a breathing tube for use in lung function diagnostics. This method comprises the following steps.

[0041] In a first step, a breathing tube is placed into the holding device. Thereby, the holding device entirely consists of a selectively transparent material, i.e., a material that is transparent for light having a wavelength in a first wavelength range but nontransparent for light having a wavelength in a second wavelength range. The holding device further comprises a fitting that serves for guiding, in its interior, light emitted from a light source towards and through a main body of the holding device such that the light beam changes its direction within the fitting. The fitting extends away from a lateral portion of the main body of the holding device, wherein the fitting has a free end arranged in a first plane that extends at an angle of 30° to 120° to a second plane in which the lateral portion of the main body extends.

[0042] Afterwards, light having a wavelength within the first wavelength range and being emitted by a light source on a circuit board appropriate to emit light having a wavelength in the first wavelength range is radiated through the holding device onto the breathing tube in a region in which a coding is arranged on the breathing tube.

[0043] Afterwards, the light that has passed the coding of the breathing tube is detected with a detecting device on the same circuit board appropriate to detect light having a wavelength in the first wavelength range, wherein the light source and the detecting device face in the same direction.

[0044] Thereby, the coding can be embodied by a comb-like structure on the surface of the breathing tube. Then, the light detected by the detecting device comprises a shadow pattern produced by the comb-like structure. Based on the specific shadow pattern detected by the detecting device, the coding is read out. Then, the position of the breathing tube within the holding device is determined on the basis of the position of the shadow

pattern. Alternatively or additionally, the breathing tube in question is identified (i.e., the type of breathing tube is identified) on the basis of the shadow pattern and therewith on the basis of the coding of the breathing tube.

[0045] In an embodiment, the light is emitted by the light source in a first direction and is then guided through the holding device so that it exits the holding device in a second direction. Thereby, an angle between the first line extending along the first direction and a second line extending along the second direction is in a range of from 0° to 60°, in particular from 5° to 55°, in particular from 10° to 50°, in particular from 15° to 45°, in particular from 20° to 40°, in particular from 25° to 35°, in particular from 30° to 55°. By such an angled guiding of the light through the holding device, it is possible to scan the coding structure of the breathing tube inserted into the holding device and to detect the light by the detecting device that is arranged in the same plane as the light source. To give an example, both the light source and the detecting device can be arranged on a planar circuit board.

[0046] In an embodiment, the light is emitted by the light source in a first direction towards the fitting extending away from a lateral portion of the main body of the holding device. Thereby, the light is reflected within the fitting at least once prior to entering the main body in a third direction. Thereby, an angle between a first line extending along the first direction and a third line extending along the third direction is in a range of from 30° to 90°, in particular from 35° to 85°, in particular from 40° to 80°, in particular from 45° to 75°, in particular from 50° to 70°, in particular from 55° to 65°, in particular from 60° to 90°. Such an angled guiding of a light beam through the fitting serves for a particularly appropriate coupling of the light beam into the main body of the holding device so that the light can pass through the main body of the holding device towards a coding region of a breathing tube inserted into the holding device. Thereby, it is not necessary to arrange the light source remote from the circuit board of the lung function diagnostics device in a specific angle with respect to the holding device. Rather, the light source is arranged on the same circuit board as the detecting device, thus making it particularly easy to manufacture a corresponding lung function diagnostics device and to carry out the precedingly described method.

[0047] All embodiments described with respect to the holding device, to the lung function diagnostics device, to the novel use of a selectively transparent material and to a method for reading out a coding on a surface of a breathing tube can be combined in any desired way and can be transferred from the holding device to the lung function diagnostics device, to the use of a selectively transparent material and to the method for reading out a coding on the surface of the breathing tube, and vice versa.

[0048] Further details and aspects of embodiments of the instant invention will be explained with respect to exemplary embodiments and accompanying Figures. In the Figures:

Figure 1A shows a perspective view on an embodiment of a breathing tube holder;

Figure 1B shows a top view onto the breathing tube holder of Figure 1A;

Figure 1C shows a front view of the breathing tube holder of Figure 1A;

Figure 1D shows a view of the right side of the breathing tube holder of Figure 1A;

Figure 1E shows a view of the left side of the breathing tube holder of Figure 1A;

Figure 1F shows a cross-sectional view of the breathing tube holder of Figure 1A along the line A-A indicated in Figure 1B;

Figure 2A shows a detailed view of an arrangement of a breathing tube holder and a circuit board located under the breathing tube holder;

Figure 2B shows a cross-sectional view through the arrangement of Figure 2A along the line A-A indicated in Figure 2A;

Figure 3 shows a view of the bottom of an embodiment of a breathing tube holder; and

Figure 4 shows a cross-sectional view of the breathing tube holder of Figure 3 with illustrated light beam guiding.

[0049] Figure 1A shows a perspective view of a breathing tube holder 1 as holding device for a breathing tube for use in lung function diagnostics. This breathing tube holder 1 comprises an inner breathing tube space 2 into which a breathing tube (not shown in Figure 1A) can be inserted for lung function diagnostics and can be removed after use. The inner breathing tube space 2 serves as an inner main space of the breathing tube holder 1. It is defined by a main body 3 of the breathing tube holder 1.

[0050] On a first side of the main body 3, a first ultrasonic transceiver housing 4 is arranged. On a second side, which is opposite to the first side, a second ultrasonic transceiver housing 5 is arranged. The first ultrasonic transceiver housing 4 can also be denoted as first side body. The second ultrasonic transceiver housing 5 can also be denoted as second side body. When the breathing tube holder 1 is in operation, one ultrasonic transceiver is inserted into the first ultrasonic transceiver housing 4 and a second ultrasonic transceiver is inserted into the second ultrasonic transceiver housing 5.

[0051] The breathing tube holder 1 further comprises a first flange 6 and a second flange 7 which serve for mounting the breathing tube holder 1 into a lung function

diagnostics device (not shown in the Figures).

[0052] A light guiding fitting 8 is integrally formed with the main body 3 of the breathing tube holder 1 on a first side 9 of the main body 3. Thereby, the light guiding fitting 8 extends away from this first side 9 in a curved manner. This light guiding fitting 8 serves for guiding infrared light through the breathing tube holder 1 onto a breathing tube that is inserted into the inner breathing tube space 2. This will be explained in the following in more detail.

[0053] Figure 1B shows a top view onto the breathing tube holder 1 of Figure 1A. Thereby, in this and all following Figures, the same elements will be referred to with the same numeral references. Regarding the details of Figures 1B to 1F, reference is made to the explanations given with respect to Figure 1A. In the following, only specific details that are not well visible in Figure 1A will be explained.

[0054] Figure 1C shows a front view of the breathing tube holder 1 of Figure 1A. Thereby, a supporting extension 10 arranged on a lower side of the breathing tube 1 can be seen. This supporting extension 10 serves for supporting the breathing tube 1 in its installed state.

[0055] Figure 1D shows a lateral view of the breathing tube holder 1 of Figure 1A from the right side as shown in Figure 1A.

[0056] Figure 1E shows a lateral view of the breathing tube holder 1 from the left side as shown in Figure 1A.

[0057] Figure 1F shows a cross-sectional view along the line A-A in Figure 1E of the breathing tube holder 1. Thereby, it can be seen that a first ultrasonic transceiver receiving space 40 is provided within the first ultrasonic transceiver housing 4. Likewise, a second ultrasonic transceiver receiving space 50 is provided within the second ultrasonic transceiver housing 5.

[0058] Figure 2A shows a detailed view of a breathing tube holder 1 (together with its already explained components) and a schematically illustrated circuit board 11. Thereby, two infrared light emitting diodes (LEDs) 12 are arranged on the circuit board 11. These infrared LEDs 12 emit light at a wavelength of 860 nm with a spectral width of 30 nm.

[0059] Figure 2B shows the arrangement of Figure 2A in a partial cross-sectional view along the line A-A indicated in Figure 2A. Thereby, Figure 2B illustrates in addition to one of the infrared LEDs 12 an infrared line detector 13 as detecting device arranged on the circuit board 11. The infrared LEDs 12 as well as the infrared detector 13 face in the same direction, namely upwards, as shown in Figure 2B.

[0060] A breathing tube 14 is inserted into the inner breathing tube space 2 of the breathing tube holder 1. This breathing tube 14 comprises a coding in form of a comb-like structure 15 that is arranged on an outer edge of the breathing tube 14. The breathing tube holder 1 of Figure 2B additionally comprises a lens 16 that is formed on a lower side of the main body of the breathing tube holder 1 as integral part of the breathing tube holder 1.

[0061] A free end 80 of the light guiding fitting 8 directly faces the infrared LEDs 12. Thereby, this free end 80 is arranged on a plane which is parallel to a plane, of which the circuit board 11 is a part (the circuit board 11 extends in the latter plane). In addition, the lens 16 faces towards the plane in which the free end 80 of the light guiding fitting 8 extends.

[0062] Figure 3 shows a view from the bottom side onto the breathing tube holder 1 of Figures 2A and 2B without breathing tube and without circuit board. In this view, the lens 16 arranged on the bottom of the main body of the breathing tube holder 1 as well as a flat free end 80 serving as light entrance plane of the light guiding fitting 8 are visualized in dark color for highlighting purposes. As will be explained in the following with respect to Figure 4, light enters into the breathing tube holder 1 via the free end 80 of the light fitting guiding 8 and exits the breathing tube holder 1 through the lens 16. Thus, both light entrance into the breathing tube holder 1 as well as light exit from the breathing tube holder 1 occurs on the same side of the breathing tube holder 1.

[0063] This is illustrated in more detail in Figure 4 showing a cross-sectional view of the breathing tube holder 1 illustrated in the preceding Figures in the area of the light guiding fitting 8. Thereby, also the circuit board 11 is schematically illustrated.

[0064] In operation, infrared light is emitted by two infrared LEDs 12 and enters the light guiding fitting 8 through its free end 80. The infrared light 17 is then reflected on an inner surface of the light guiding fitting 8 in a first section 81 of the light fitting guiding 8. The infrared light is then further guided through the light guiding fitting 8 towards an inner surface of a second section 82 of the light guiding fitting 8 and is once again reflected. Thereby, the curvature of the first section 81 is different from the curvature of the second section 82 of the light guiding fitting 8. The infrared light 17 is then guided through the first side 9 of the breathing tube holder 1 into the inner breathing tube space 2 of the breathing tube holder 1. There, the infrared light 17 hits a comb-like structure 15 of the breathing tube 14 that is inserted into the breathing tube holder 1. A part of the infrared light 17 is reflected upon exiting the first side 9 of the breathing tube holder 1 to the inner breathing tube space 2 of the breathing tube holder 1. This first reflected infrared light 18 is reflected back in the direction of the infrared LEDs 12 (i.e. it is reflected towards the infrared LEDs).

[0065] The infrared light beam 17 then passes the comb-like structure 15 on the exterior of the breathing tube 14 and enters again the breathing tube holder 1. It then passes the lens 16 and finally exits the breathing tube holder 1. Thereby, the infrared light 17 is focused onto the infrared detector 13 which is arranged on the circuit board 11. Upon finally exiting the breathing tube holder 1, a second part of the infrared light 17 is reflected back towards the inner breathing tube space 2 of the breathing tube holder 1. This second reflected infrared light 19 generally makes up a smaller part of the reflected infrared light than the first reflected infrared light 18.

[0066] Since the comb-like structure 15 generates a shadow pattern upon being irradiated with infrared light 17, a corresponding shadow pattern can be detected by detector 13. Thereby, it can be determined whether or not the breathing tube 14 is correctly inserted into the breathing tube holder 1, i.e., its position within the breathing tube holder 1 is detected. Furthermore, the type of breathing tube 14 can be detected by the shadow pattern. Such a lung function diagnostics device might reject a specific test if a breathing tube 14 is used that is not intended to be used for this test.

[0067] A line extending along the direction of emission of the infrared light 17 from the infrared LEDs 12 and a line extending along the direction of the infrared light 17 being focused from the lens 16 towards the detector 13 intersect each other at an angle of approximately 50°.

[0068] A line extending along the direction of emission of the infrared light 17 from the infrared LEDs 12 and a line extending in the direction of the infrared light 17 passing through the first side 9 of the breathing tube holder 1 intersect each other at an angle of approximately 65°.

[0069] These angles are to be understood only exemplarily since they strongly depend on the dimensions and the curvature of the light guiding fitting 8 and the optical properties of the lens 16. The infrared light 17 can also be guided through the breathing tube holder 1 under different angles without deviating from the scope of the instant invention. However, it turned out to be most convenient if the infrared LEDs 12 and the detector 13 face in the same direction and are arranged on the circuit board 11 in essentially the same plane. Thus, the instantly described breathing tube holder 1 makes it possible that no complicated arrangements of infrared LEDs and infrared detectors are necessary for emitting infrared light and properly detecting it after it has passed the coding region of a breathing tube like the comb-like structure 15 of breathing tube 14.

Claims

1. Holding device for a breathing tube for use in a lung function diagnostic application chosen from the group consisting of spirometry, gas washout measurements, gas dilution measurements, and gas diffusion measurements, wherein the holding device (1) entirely consists of a material that is transparent for light having a wavelength in a first wavelength range but nontransparent for light having a wavelength in a second wavelength range,
characterized in that
the holding device comprises a fitting (8) that serves for guiding, in its interior, light having a wavelength in the first wavelength range emitted from a light source (12) on a circuit board (11) towards and through a main body (3) of the holding device (1) onto a detecting device (13) on the circuit board (11) appropriate to detect light having a wavelength in the first wavelength range such that the light beam changes its direction within the fitting (8), wherein the light source (12) and the detecting device (13) face in the same direction, wherein the fitting (8) extends away from a lateral portion (9) of the main body (3) of the holding device (1), wherein the fitting (8) has a free end (80) arranged in a first plane that extends at an angle of 30° to 120° to a second plane in which the lateral portion (9) of the main body (3) extends.

2. Holding device according to claim 1, **characterized in that** the first wavelength range comprises wavelengths of at least 600 nm.

3. Holding device according to claim 1 or 2, **characterized in that** the first wavelength range has a spectral width of not more than 200 nm.

4. Holding device according to any of the preceding claims, **characterized in that** the second wavelength range comprises wavelengths of less than 600 nm.

5. Holding device according to any of the preceding claims, **characterized in that** the second wavelength range has a spectral width of at least 200 nm.

6. Holding device according to any of the preceding claims, **characterized in that** the holding device (1) comprises a main body (3) surrounding an inner main space (2) which serves for removably housing a breathing tube (14) for use in a lung function diagnostic application chosen from the group consisting of spirometry, gas washout measurements, gas dilution measurements, and gas diffusion measurements, a first side body (4) extending laterally from the main body (3) on a first side (9), and a second side body (5) extending laterally from the main body (3) on a second side being opposite to the first side (9), wherein the first side body (4) surrounds a first inner side space (40) and the second side body (5) surrounds a second inner side space (50), wherein the first inner side space (40) serves for housing a first ultrasonic transceiver and the second inner side space (50) serves for housing a second ultrasonic transceiver.

7. Holding device according to any of the preceding claims, **characterized in that** the fitting (8) has a curved surface.

8. Holding device according to claim 7, **characterized in that** the curved surface comprises at least two sections (81, 82) having different curvatures.

9. Holding device according to any of the preceding claims, **characterized in that** it comprises a lens

(16) being integrally formed as part of a surface of the holding device (1).

10. Holding device according to any of the preceding claims, **characterized in that** the material comprises at least one base material chosen from the group consisting of polycarbonates, acrylonitrile butadiene styrene, polystyrene, poly(methyl methacrylate), polyethylene terephthalate, polyethylene terephthalate glycol, copolymers of polystyrene and polyethylene terephthalate glycol, cellulose esters such as cellulose acetate butyrate, and copolymers of these base materials.

11. Lung function diagnostics device for a lung function diagnostic application chosen from the group consisting of spirometry, gas washout measurements, gas dilution measurements, and gas diffusion measurements **characterized by** a holding device (1) according to any of the preceding claims and in that the lung function diagnostics device comprises a circuit board (11) having a light source (12) appropriate to emit light having a wavelength in a first wavelength range and a detecting device (13) appropriate to detect light having a wavelength in the first wavelength range, wherein the light source (12) and the detecting device (13) face in the same direction.

12. Method for reading out a coding (15) on a surface of a breathing tube (14) for use in lung function diagnostics, comprising the following steps:

a) placing a breathing tube (14) into a holding device (1), wherein the holding device (1) entirely consists of a material that is transparent for light having a wavelength in a first wavelength range but nontransparent for light having a wavelength in a second wavelength range, the holding device (1) further comprising a fitting (8) that serves for guiding, in its interior, light emitted from a light source (12) towards and through a main body (3) of the holding device (1) such that the light beam changes its direction within the fitting (8), wherein the fitting (8) extends away from a lateral portion (9) of the main body (3) of the holding device (1), wherein the fitting (8) has a free end (80) arranged in a first plane that extends at an angle of 30° to 120° to a second plane in which the lateral portion (9) of the main body (3) extends,

b) irradiating light (17) having a wavelength in the first wavelength range and being emitted by a light source (12) on a circuit board (11) appropriate to emit light having a wavelength in the first wavelength range through the holding device (1) onto the breathing tube (14) in a region in which a coding (15) is arranged on the breathing tube (14),

c) detecting the light (17) that has passed the coding (15) of the breathing tube (14) with a detecting device (13) on the same circuit board (11) appropriate to detect light having a wavelength in the first wavelength range, wherein the light source (12) and the detecting device (13) face in the same direction.

Patentansprüche

1. Haltevorrichtung für ein Atemröhrchen zur Verwendung in einer diagnostischen Lungenfunktionsanwendung, die aus der aus Spirometrie, Gasauswaschmessungen, Gasverdünnungsmessungen und Gasdiffusionsmessungen bestehenden Gruppe ausgewählt ist, wobei die Haltevorrichtung (1) vollständig aus einem Material besteht, das für Licht mit einer Wellenlänge in einem ersten Wellenlängenbereich transparent ist, aber für Licht mit einer Wellenlänge in einem zweiten Wellenlängenbereich nicht transparent ist,
dadurch gekennzeichnet, dass
die Haltevorrichtung ein Anschlussteil (8) umfasst, das dazu dient, in seinem Inneren Licht mit einer Wellenlänge im ersten Wellenlängenbereich, das von einer Lichtquelle (12) auf einer Leiterplatte (11) ausgesendet wird, zu einem und durch einen Hauptkörper (3) der Haltevorrichtung (1) auf eine Detektionsvorrichtung (13) auf der Leiterplatte (11), die zum Nachweisen von Licht mit einer Wellenlänge im ersten Wellenlängenbereich geeignet ist, zu leiten, so dass der Lichtstrahl seine Richtung im Anschlussstück (8) ändert, wobei die Lichtquelle (12) und die Detektionsvorrichtung (13) in die gleiche Richtung zeigen, wobei sich das Anschlussstück (8) von einem seitlichen Abschnitt (9) des Hauptkörpers (3) der Haltevorrichtung (1) weg erstreckt, wobei das Anschlussstück (8) ein freies Ende (80) aufweist, das in einer ersten Ebene angeordnet ist, die sich in einem Winkel von 30° bis 120° zu einer zweiten Ebene erstreckt, in der sich der seitliche Abschnitt (9) des Hauptkörpers (3) erstreckt.

2. Haltevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Wellenlängenbereich Wellenlängen von mindestens 600 nm umfasst.

3. Haltevorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der erste Wellenlängenbereich eine Spektralbreite von höchstens 200 nm aufweist.

4. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der zweite Wellenlängenbereich Wellenlängen von weniger als 600 nm umfasst.

5. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der zweite Wellenlängenbereich eine Spektralbreite von mindestens 200 nm aufweist.

6. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Haltevorrichtung (1) einen Hauptkörper (3) umfasst, der einen inneren Hauptraum (2) umgibt, der zur entfernbaren Unterbringung eines Atemröhrchens (14) zur Verwendung in einer diagnostischen Lungenfunktionsanwendung dient, die aus der aus Spirometrie, Gasauswaschmessungen, Gasverdünnungsmessungen und Gasdiffusionsmessungen bestehenden Gruppe ausgewählt ist, wobei sich ein erster Seitenkörper (4) seitlich vom Hauptkörper (3) auf einer ersten Seite (9) erstreckt und sich ein zweiter Seitenkörper (5) seitlich vom Hauptkörper (3) auf einer zweiten, der ersten Seite (9) gegenüberliegenden Seite erstreckt, wobei der erste Seitenkörper (4) einen ersten inneren Seitenraum (40) umgibt und der zweite Seitenkörper (5) einen zweiten inneren Seitenraum (50) umgibt, wobei der erste innere Seitenraum (40) zur Aufnahme eines ersten Ultraschall-Sendeempfängers dient und der zweite innere Seitenraum (50) zur Aufnahme eines zweiten Ultraschall-Sendeempfängers dient.

7. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Anschlussstück (8) eine gebogene Oberfläche aufweist.

8. Haltevorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** die gebogene Oberfläche mindestens zwei Abschnitte (81, 82) mit verschiedenen Krümmungen umfasst.

9. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sie eine Linse (16) umfasst, die einstückig als Teil einer Oberfläche der Haltevorrichtung (1) ausgebildet ist.

10. Haltevorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Material mindestens ein Grundmaterial umfasst, das aus der aus Polycarbonaten, Acrylnitril-Butadien-Styrol, Polystyrol, Poly(methylmethacrylat), Polyethylenterephthalat, Polyethylenterephthalatglykol, Copolymeren von Polystyrol und Polyethylenterephthalatglykol, Celluloseestern, wie etwa Celluloseacetatbutyrat, und Copolymeren dieser Grundmaterialien bestehenden Gruppe ausgewählt ist.

11. Diagnostische Lungenfunktionsvorrichtung für eine diagnostische Lungenfunktionsanwendung, die aus der aus Spirometrie, Gasauswaschmessungen, Gasverdünnungsmessungen und Gasdiffusionsmessungen bestehenden Gruppe ausgewählt ist, **gekennzeichnet durch** eine Haltevorrichtung (1) nach einem der vorhergehenden Ansprüche und **dadurch, dass** die diagnostische Lungenfunktionsvorrichtung eine Leiterplatte (11) mit einer Lichtquelle (12), die zum Aussenden von Licht mit einer Wellenlänge in einem ersten Wellenlängenbereich geeignet ist, und eine Detektionsvorrichtung (13) umfasst, die zum Nachweisen von Licht mit einer Wellenlänge im ersten Wellenlängenbereich geeignet ist, wobei die Lichtquelle (12) und die Detektionsvorrichtung (13) in die gleiche Richtung zeigen.

12. Verfahren zum Auslesen einer Codierung (15) auf einer Oberfläche eines Atemröhrchens (14) zur Verwendung in der Lungenfunktionsdiagnostik, umfassend die folgenden Schritte:

a) Platzieren eines Atemröhrchens (14) in einer Haltevorrichtung (1), wobei die Haltevorrichtung (1) vollständig aus einem Material besteht, das für Licht mit einer Wellenlänge in einem ersten Wellenlängenbereich transparent ist, aber für Licht mit einer Wellenlänge in einem zweiten Wellenlängenbereich nicht transparent ist, wobei die Haltevorrichtung (1) ferner ein Anschlussteil (8) umfasst, das dazu dient, in seinem Inneren Licht, das von einer Lichtquelle (12) ausgesendet wird, zu einem und durch einen Hauptkörper (3) der Haltevorrichtung (1) zu leiten, so dass der Lichtstrahl seine Richtung im Anschlussstück (8) ändert, wobei sich das Anschlussstück (8) von einem seitlichen Abschnitt (9) des Hauptkörpers (3) der Haltevorrichtung (1) weg erstreckt, wobei das Anschlussstück (8) ein freies Ende (80) aufweist, das in einer ersten Ebene angeordnet ist, die sich in einem Winkel von 30° bis 120° zu einer zweiten Ebene erstreckt, in der sich der seitliche Abschnitt (9) des Hauptkörpers (3) erstreckt,
b) Ausstrahlen von Licht (17), das eine Wellenlänge im ersten Wellenlängenbereich aufweist und von einer Lichtquelle (12) auf einer Leiterplatte (11) ausgesendet wird, die zum Aussenden von Licht mit einer Wellenlänge im ersten Wellenlängenbereich geeignet ist, durch die Haltevorrichtung (1) auf das Atemröhrchen (14) in einem Bereich, in dem eine Codierung (15) auf dem Atemröhrchen (14) angeordnet ist,
c) Nachweisen des Lichts (17), das durch die Codierung (15) des Atemröhrchens (14) gedrungen ist, mit einer Detektionsvorrichtung (13) auf derselben Leiterplatte (11), die zum Nachweisen von Licht mit einer Wellenlängen im ersten Wellenlängenbereich geeignet ist, wobei die Lichtquelle (12) und die Detektionsvorrichtung (13) in die gleiche Richtung zeigen.

Revendications

1. Dispositif de support pour un tube respiratoire destiné à être utilisé dans une application diagnostique de la fonction pulmonaire choisie dans le groupe constitué par la spirométrie, des mesures de lavage de gaz, des mesures de dilution de gaz et des mesures de diffusion de gaz, dans lequel le dispositif de support (1) consistant entièrement en un matériau qui est transparent à une lumière ayant une longueur d'onde dans une première plage de longueur d'onde mais non transparent à une lumière ayant une longueur d'onde dans une deuxième plage de longueur d'onde,
caractérisé en ce que
le dispositif de support comprend un raccord (8) qui sert à guider, dans son intérieur, une lumière ayant une longueur d'onde dans la première plage de longueur d'onde émise depuis une source de lumière (12) sur une carte de circuit imprimé (11) vers et à travers un corps principal (3) du dispositif de support (1) sur un dispositif de détection (13) sur la carte de circuit imprimé (11) approprié pour détecter une lumière ayant une longueur d'onde dans la première plage de longueur d'onde de sorte que le faisceau lumineux change sa direction à l'intérieur de le raccord (8), dans lequel la source de lumière (12) et le dispositif de détection (13) sont orientés dans la même direction, dans lequel le raccord (8) s'étend à distance d'une partie latérale (9) du corps principal (3) du dispositif de support (1), dans lequel le raccord (8) possède une extrémité libre (80) agencée dans un premier plan qui s'étend selon un angle de 30° à 120° vers un deuxième plan dans lequel s'étend la partie latérale (9) du corps principal (3).

2. Dispositif de support selon la revendication 1, **caractérisé en ce que** la première plage de longueur d'onde comprend des longueurs d'onde d'au moins 600 nm.

3. Dispositif de support selon la revendication 1 ou 2, **caractérisé en ce que** la première plage de longueur d'onde a une largeur spectrale pas plus de 200 nm.

4. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la deuxième plage de longueur d'onde comprend des longueurs d'onde inférieures à 600 nm.

5. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la deuxième plage de longueur d'onde a une largeur spectrale d'au moins 200 nm.

6. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le dispositif de support (1) comprend un corps principal (3) entourant un espace principal interne (2) qui sert à loger de manière amovible un tube respiratoire (14) destiné à être utilisé dans une application diagnostique de la fonction pulmonaire choisie dans le groupe constitué par la spirométrie, des mesures de lavage de gaz, des mesures de dilution de gaz et des mesures de diffusion de gaz, un premier corps latéral (4) s'étendant latéralement depuis le corps principal (3) sur un premier côté (9), et un deuxième corps latéral (5) s'étendant latéralement depuis le corps principal (3) sur un deuxième côté étant opposé au premier côté (9), dans lequel le premier côté latéral (4) entoure un premier espace interne (40) et le deuxième côté latéral (5) entoure un deuxième espace interne (50), dans lequel le premier espace latéral interne (40) sert à loger un premier transducteur à ultrasons et le deuxième espace latéral interne (50) sert à loger un deuxième transducteur à ultrasons.

7. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le raccord (8) possède une surface courbée.

8. Dispositif de support selon la revendication 7, **caractérisé en ce que** la surface courbée comprend au moins deux sections (81, 82) ayant différentes courbures.

9. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend une lentille (16) faisant partie intégrante d'une surface du dispositif de support (1).

10. Dispositif de support selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le matériau comprend au moins un matériau de base choisi dans le groupe constitué par les polycarbonates, l'acrylonitrile butadiène styrène, le polystyrène, le poly(méthacrylate de méthyle), le polyéthylène téréphtalate, le polyéthylène téréphtalate glycol, des copolymères de polystyrène et de polyéthylène téréphtalate glycol, des esters cellulosiques tels que l'acétate butyrate de cellulose, et des copolymères de ces matériaux de base.

11. Dispositif de diagnostic de la fonction pulmonaire pour une application diagnostique de la fonction pulmonaire choisie dans le groupe constitué par la spirométrie, des mesures de lavage de gaz, des mesures de dilution de gaz et des mesures de diffusion de gaz **caractérisé par** un dispositif de support (1) selon l'une quelconque des revendications précédentes et en ce que le dispositif de diagnostic de la fonction pulmonaire comprend une carte de circuit imprimé (11) possédant une source de lumière (12) appropriée pour émettre une lumière ayant une lon-

gueur d'onde dans une première plage de longueur d'onde et un dispositif de détection (13) approprié pour détecter une lumière ayant une longueur d'onde dans la première plage de longueur d'onde, dans lequel la source de lumière (12) et le dispositif de détection (13) sont orientés dans la même direction.

12. Procédé permettant de lire un codage (15) sur une surface d'un tube respiratoire (14) destiné à être utilisé dans des diagnostics de la fonction pulmonaire, comprenant les étapes suivantes consistant à :

a) placer un tube respiratoire (14) dans un dispositif de support (1), le dispositif de support (1) consistant entièrement en un matériau qui est transparent à une lumière ayant une longueur d'onde dans une première plage de longueur d'onde mais non transparent à une lumière ayant une longueur d'onde dans une deuxième plage de longueur d'onde, le dispositif de support (1) comprenant en outre un raccord (8) qui sert à guider, dans son intérieur, une lumière émise depuis une source de lumière (12) vers et à travers un corps principal (3) du dispositif de support (1) de sorte que le faisceau lumineux change sa direction à l'intérieur de le raccord (8), dans lequel le raccord (8) s'étend à distance d'une partie latérale (9) du corps principal (3) du dispositif de support (1), dans lequel le raccord (8) possède une extrémité libre (80) agencée dans un premier plan qui s'étend selon un angle de 30° à 120° vers un deuxième plan dans lequel s'étend la partie latérale (9) du corps principal (3),

b) irradier de la lumière (17) ayant une longueur d'onde dans la première plage de longueur d'onde et étant émise par une source de lumière (12) sur une carte de circuit imprimé (11) appropriée pour émettre une lumière ayant une longueur d'onde dans la première plage de longueur d'onde à travers le dispositif de support (1) sur le tube respiratoire (14) dans une région dans laquelle un codage (15) est disposé sur le tube respiratoire (14),

c) détecter la lumière (17) qui est passée le codage (15) du tube respiratoire (14) avec un dispositif de détection (13) sur la même carte de circuit imprimé (11) approprié pour détecter une lumière ayant une longueur d'onde dans la première plage de longueur d'onde, dans lequel la source de lumière (12) et le dispositif de détection (13) sont orientés dans la même direction.

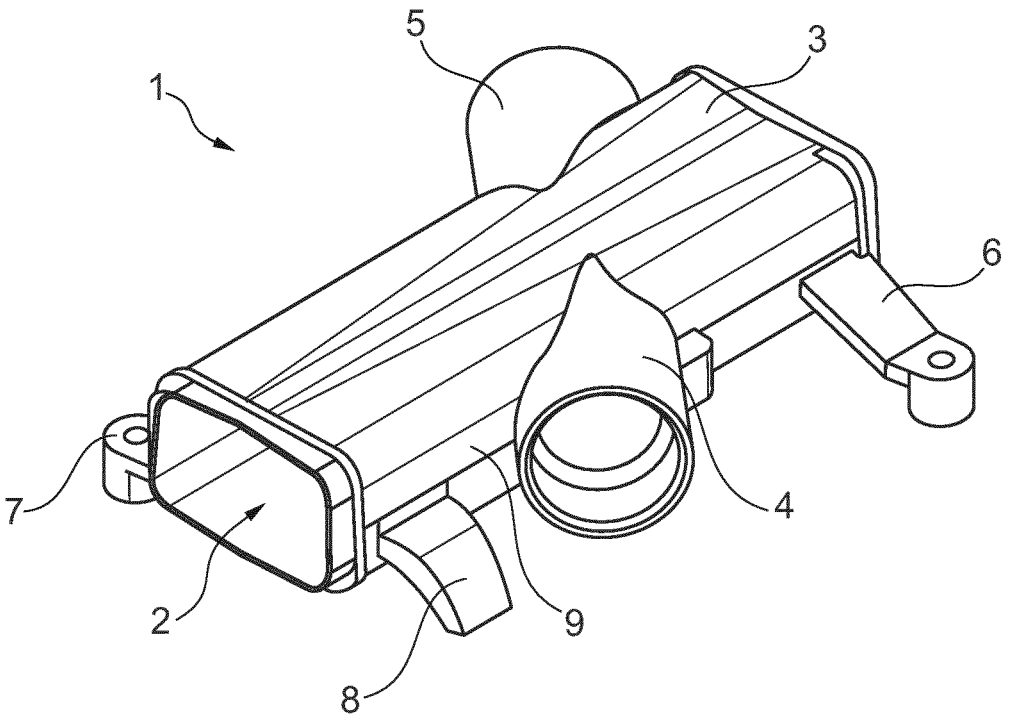

FIG 1A

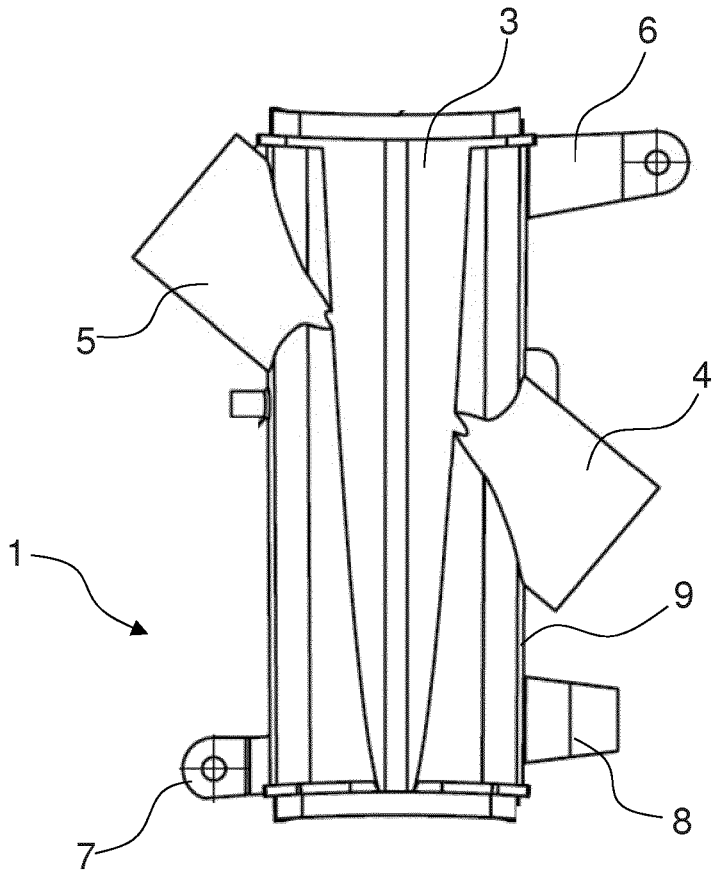

FIG 1B

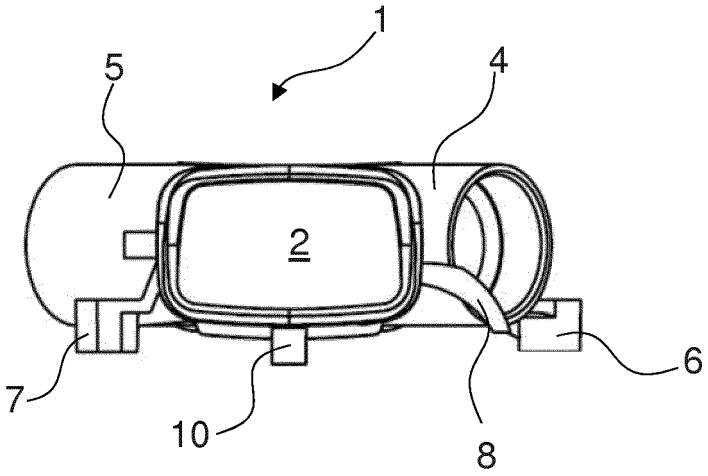

FIG 1C

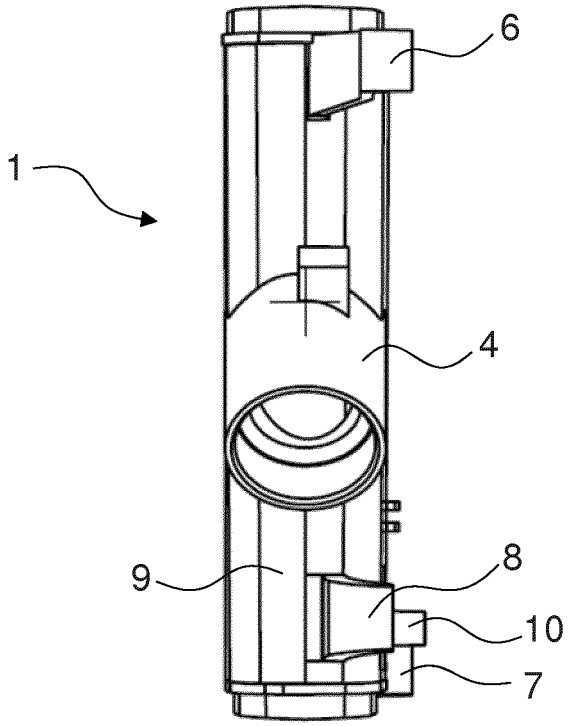

FIG 1D

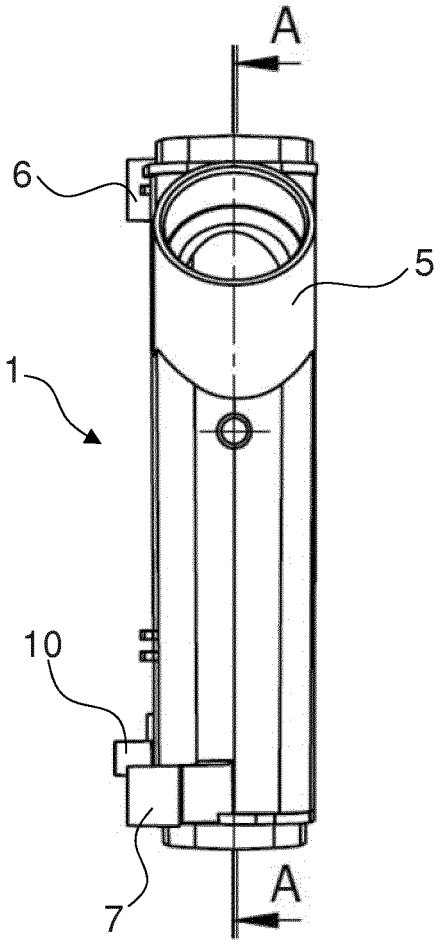

FIG 1E

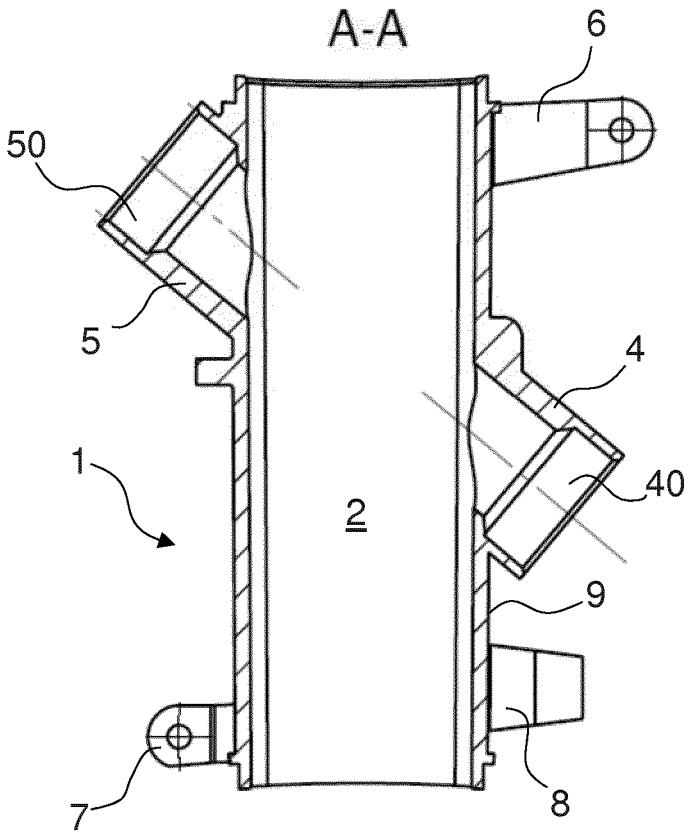

FIG 1F

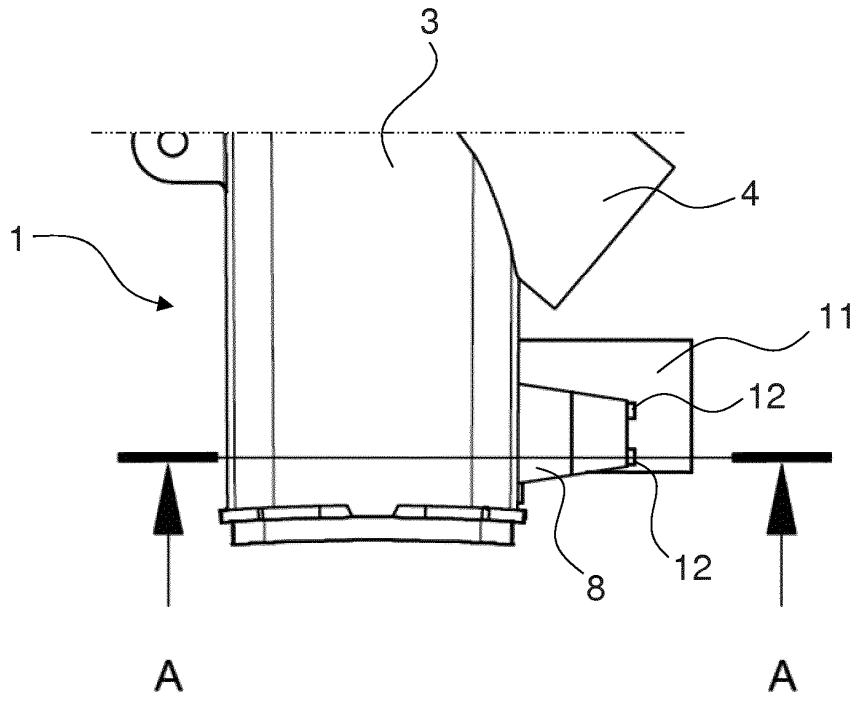

FIG 2A

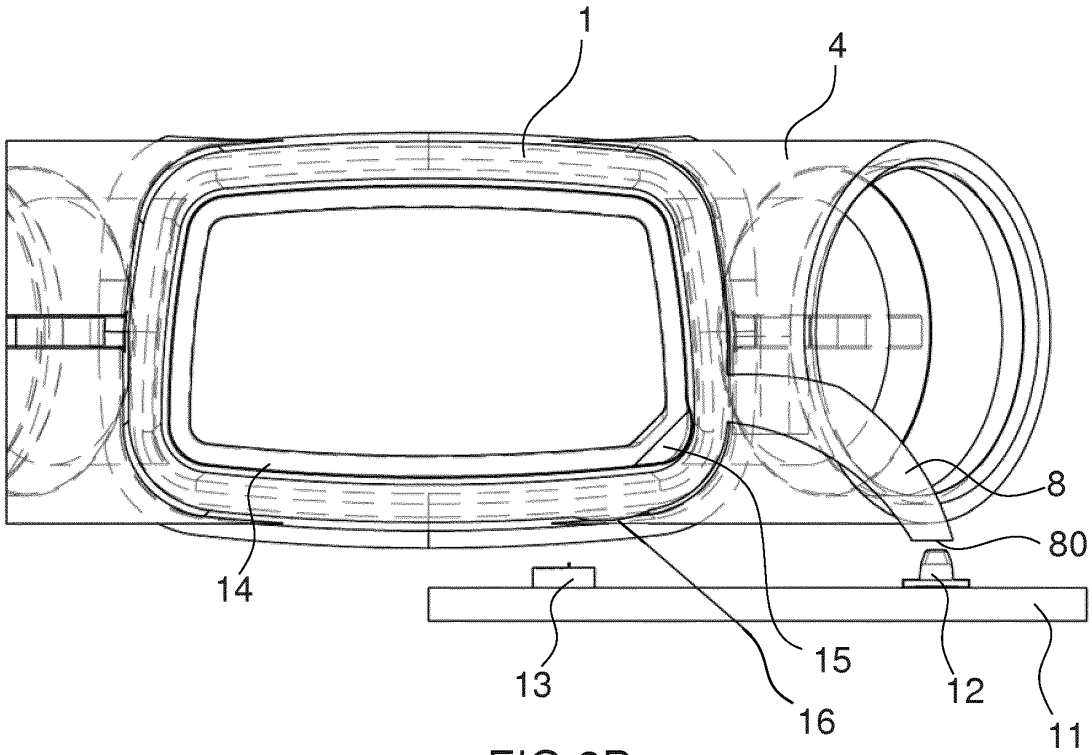

FIG 2B

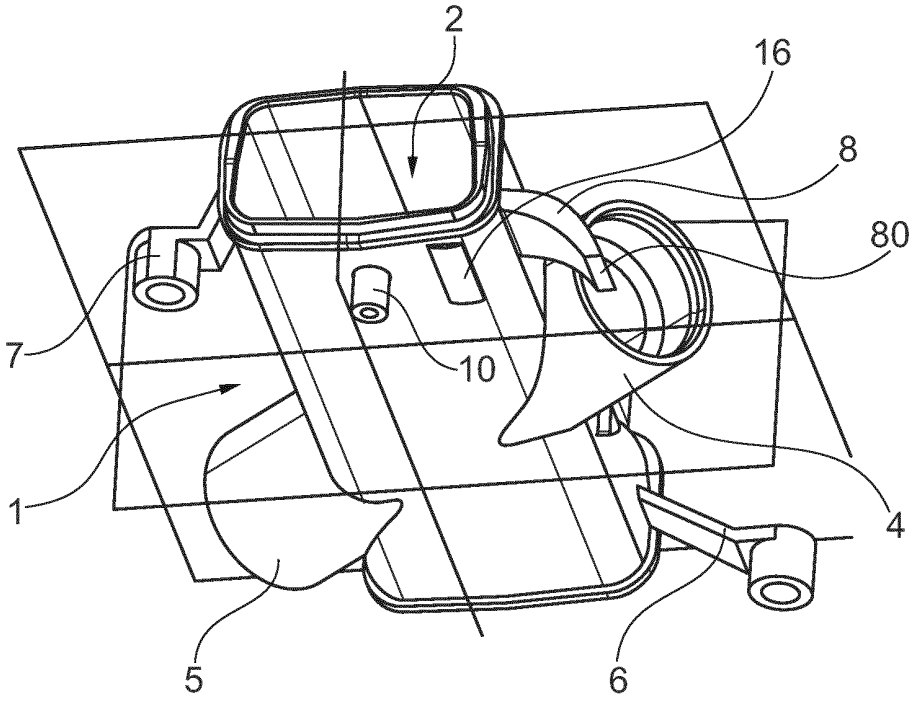

FIG 3

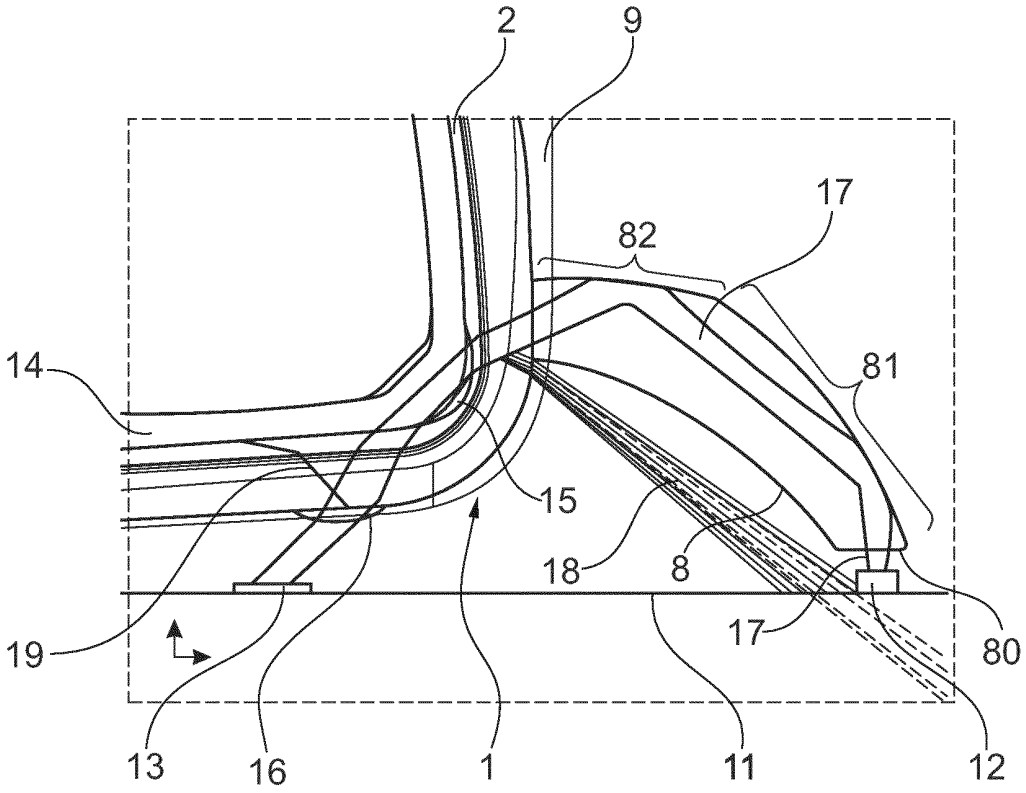

FIG 4

REFERENCES CITED IN THE DESCRIPTION

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- *CHEMICAL ABSTRACTS,* 4701-90-3 **[0033]**

专利名称(译)	通风软管的装置和在通风软管的表面上读取编码的方法		
公开(公告)号	EP3403578B1	公开(公告)日	2020-03-25
申请号	EP2017171303	申请日	2017-05-16
[标]申请(专利权)人(译)	NDD MEDIZINTECHN		
申请(专利权)人(译)	NDD MEDIZINTECHNIK AG		
当前申请(专利权)人(译)	NDD MEDIZINTECHNIK AG		
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发明人	BUESS, CHRISTIAN KLEINHAPPL, ERICH		
IPC分类号	A61B5/08 A61B5/00 A61B8/00		
CPC分类号	A61B5/08 A61B5/082 A61B5/087 A61B90/98 A61B5/0059 A61B5/097 A61B2090/0811 A61L29/041 A61L29/043 A61L29/06 G01B11/14		
其他公开文献	EP3403578A1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种用于肺功能诊断的呼吸管的保持装置。 其特征在于，保持装置（1）包括对于具有第一波长范围内的波长的光是透明的但是对于具有第二波长范围内的波长的光是不透明的材料。 在其他方面，本发明涉及一种包括这种保持装置（1）的肺功能诊断装置，涉及一种选择性透明材料在制造这种保持装置（1）中的新颖用途，并且涉及一种读取编码的方法。 （15）在呼吸管（14）的表面上，用于肺功能诊断。

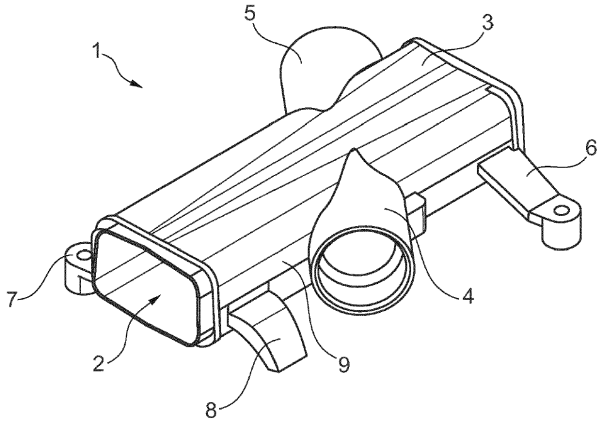

FIG 1A