EN

EUROPEAN QUALIFYING EXAMINATION 2025

PAPER C

Part 1

This paper contents :

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17 March 2025

Cool & Heath
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Dear Mrs Cool,

We would like to file an opposition on behalf of our company, Fever S.E., against European patent EP 3 858 221 B1 (Annex 1). For technical reasons, we have not been able to retrieve all parts of the patent (see enclosures). So far, claim 3 is the only part of A1 that is not disclosed in its priority document. We are enclosing herewith further annexes A2–A5, which we hope might be of use to you in preparing this opposition.

File inspection of Annex 4 (A4) has shown that the published version of A4 is identical to the application JP2019567901 from which A4 claims priority.

The file of the patent further revealed that claim 3 was added during examination and was not comprised in the application as originally filed. This claim is of particular concern to us. Our engineers are working on a future cold mirror system based on two new polymers having a much higher refractive index difference of at least 0.12. However, as we are presently still using a polycarbonate-polyethylene system in our device, a possible fallback position should also be addressed.

Kind regards,
T. Fever

Enclosures:

Annex 1: EP 3 858 221 B1 (paragraphs 0001-0010, 0012-0014, 0016-0018, 0020-0027, Figs. 1, 2 and claims 1-3)

Annex 2: US2013/2345678 A1

Annex 3: EP3 091 234 A1

Annex 4: EP 3 789 012 A2

Annex 5: US2019/6789012 A1

(19) Europäisches Patentamt
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(11) **EP 3 858 221 B1**

(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Infrared thermometer**

Infrarotthermometer

Thermomètre à infrarouge

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[0001] Medical conditions are often accompanied by fever, which is an increase of the body core temperature above a normal range in response to inflammation, infection, dehydration or other disorders.

[0002] Traditional contact measuring methods of the body temperature are based on placing a liquid thermometer or an electrical contact thermometer in a location of the body which maintains a fairly stable temperature, such as in the armpit, mouth or rectum. Such methods require that the contact be maintained at least for several seconds or even minutes.

[0003] However, to measure the temperature of the body more quickly, in particular when screening large numbers of patients, thermometers based on the detection of infrared radiation emitted by the eardrum or the forehead have been developed.

[0004] Such devices are based on the general principle that, as a body warms up, the total electromagnetic radiation emitted increases rapidly with the absolute temperature and the spectral maximum of the emitted light shifts to shorter wavelengths. The temperature can thus be determined by measuring the radiation emitted by the body using suitable sensors. As the temperature of the human body lies in the range of 35–42°C, the maximum of the emitted radiation is found in the infrared (IR) part of the electromagnetic spectrum, which comprises longer wavelengths than red light.

[0005] IR sensors generate a signal, the strength of which corresponds to the detected intensity of IR light, and the thermometer comprises a processor which calculates, using an appropriate calibration, the body temperature from the signal strength.

[0006] One favourable location for measuring IR radiation corresponding to the body core temperature is the eardrum, which is located close to the hypothalamus and shares with it a blood flow from the same source. Therefore, the temperature inside the ear is the first to react to any change of body temperature. Moreover, the ear forms a relatively closed cavity and the eardrum is thus less affected by the external environment than other regions, such as the armpit.

[0007] Nevertheless, measurement of the body temperature via the eardrum requires the insertion of a thermometer probe into the ear canal, which typically results in contamination of the probe. Moreover, the insertion of the probe may prove impractical, in particular if the temperature is to be measured very quickly or if the patient is a newborn.

[0008] An alternative region for radiation temperature measurement is the forehead, which is easily accessible for measurement, even without direct contact of the probe with the skin. However, as the forehead is exposed to the environment, external conditions may influence the relation between the detected IR radiation signal and the body temperature. Therefore, as is generally known in the prior art, in forehead measurement mode the ambient temperature needs to be taken into account to ensure a measurement with usable reliability.

[0009] There exist in the prior art various IR thermometers which determine the body temperature from eardrum or forehead temperature measurements. Some of these devices are even capable of being used for both types of measurements through the addition of suitable adapters, often in the form of a cap which is attached to the probe in the forehead mode.

[0010] However, due to the influence of different conditions found in the ear and at the forehead, the processor calculating the body temperature must use different formulas depending on the measurement region. Thus, the system has to recognise the actual measurement mode.

[0011] Only available in part 2

[0012] The present IR thermometer system according to claim 1 provides a main body with a probe which is shaped such that it can be inserted into the ear canal for measurement of the eardrum temperature. Further, the system comprises a cover which can be releasably attached to the main body. Further embodiments are defined in claims 2 and 3.

[0013] The hygienic problem caused by the contact of the probe with the ear canal is addressed by providing the thermometer with a sterilisation system according to claim 2. Either the main body or the cover comprises an ultraviolet (UV) light source that directs UV light into the space between the probe surface and the inner surface of the cover. This inner surface is coated with a material that efficiently reflects the UV light such that the light emitted from the source reaches all portions of the probe surface. The UV light eliminates any microbes on the probe surface such that the probe is sterilised.

[0014] The cover also allows for a further measurement mode in which the cover is placed against the forehead of the patient. To switch between in-ear mode and forehead mode, a proximity sensor disposed in the cover switches the thermometer system to forehead mode when the distance between the cover and an object is below a predefined value.

[0015] Only available in part 2

[0016] The present invention will be illustrated with reference to the following figures:

[0017] Fig. 1 shows an embodiment of the temperature measurement system comprising a main body and a cover.

[0018] Fig. 2 shows, in an enlarged cross-section, a part of the main body and the cover.

[0019] Only available in part 2

[0020] Fig. 1 shows a thermometer system capable of being used in an in-ear mode and a forehead mode. The system comprises a thermometer main body 10 and a detachable cover 30. One end of the main body 10 includes a measuring probe 20, which is inserted into the ear canal in in-ear mode.

[0021] As shown in more detail in Fig. 2, the probe comprises a central recess 21. At a first end of the recess, an IR sensor 22 is located. The second end of the recess, facing away from the main body, is covered by a first window 31 which is made of a material allowing IR radiation to pass. When the user inserts the probe into the patient's ear, IR radiation emitted from the patient's eardrum passes through the window 31 into the recess 21, which guides it to the sensor 22.

[0022] The main body 10 houses electronic components. A control circuit 11 is provided, which is connected to the IR sensor 22 and to an ambient temperature sensor 17. Further, a mechanical ON/OFF power switch 12 and a touch-sensitive display 15 are provided on the main body's rear surface. When the thermometer is activated via the ON/OFF power switch 12, the control circuit 11 selects in-ear mode by default. Hence, the signal measured by the sensor is processed using the formula corresponding to in-ear mode to calculate the temperature.

[0023] The IR sensor 22 transforms the IR radiation into an electrical signal. This signal is passed via electrical contacts to the control circuit 11, which processes the signal and determines a temperature for the patient according to the in-ear mode using the appropriate formula. The temperature value is displayed on the display 15.

[0024] To enable the forehead temperature measuring mode, the cover 30 is attached to the main body 10 using a releasable snap-fit connection. As shown in Fig. 2, the first end of the cover 30 is a flat surface 32 facing away from the main body 20. In this flat surface 32, a first aperture closed with a second window 33 provides a clear path for the passage of IR light towards IR sensor 22. The flat surface 32 comprises a second aperture 34 and a proximity sensor 35 placed behind that aperture. The proximity sensor detects a distance between the flat surface 32 and an object surface and transmits the distance value to the control circuit 11 via a wireless connection. When the distance detected is below a threshold because the flat surface 32 is close to the forehead of a person, the control circuit switches the thermometer system to forehead mode. The mode switching by the proximity sensor 35 allows for an automated selection of the correct mode without requiring mechanical elements. In forehead mode, the body temperature is calculated using a formula taking into account the signal of the ambient temperature sensor 17.

[0025] To enable sterilisation of the probe 20 after use in the ear canal, the probe surface comprises at least one further recess 25, in which a light emitting diode (LED) 26 emitting UV light is placed. The cover 30 has an inner surface 36 shaped to create a space 37 between the probe surface and the cover inner surface when the cover is attached to the main body 10. To provide optimal sterilisation, the UV light needs to be homogeneously distributed in the space 37. Therefore, inner surface 36 is provided with a coating 38 having a high reflectivity for UV light.

[0026] In the present embodiment, the same cover can be used for sterilisation and in forehead measurement mode. To enable the passage of IR light from a body to be measured to the IR sensor 22, a coating applied to the second window 33 permits the passage of IR light while reflecting UV light. For this purpose a so-called cold mirror coating 39 made from multiple alternating layers with different refractive index n_{UV} for the UV light is applied on the second window 33.

[0027] A particularly cost-effective cold mirror multilayer coating is formed from two different polymers. In a favourable option, polycarbonate (PC) layers (n_{UV} = 1.586) are alternated with either polymethyl methacrylate (PMMA) (n_{UV}= 1.49) or polyethylene (PE) (n_{UV}= 1.50) layers.

Further paragraphs only available in part 2

Further paragraphs only available in part 2

Claims

Claims 1-3 only available on screen

Claims 4-7 only available in part 2

Claims 4-7 only available in part 2

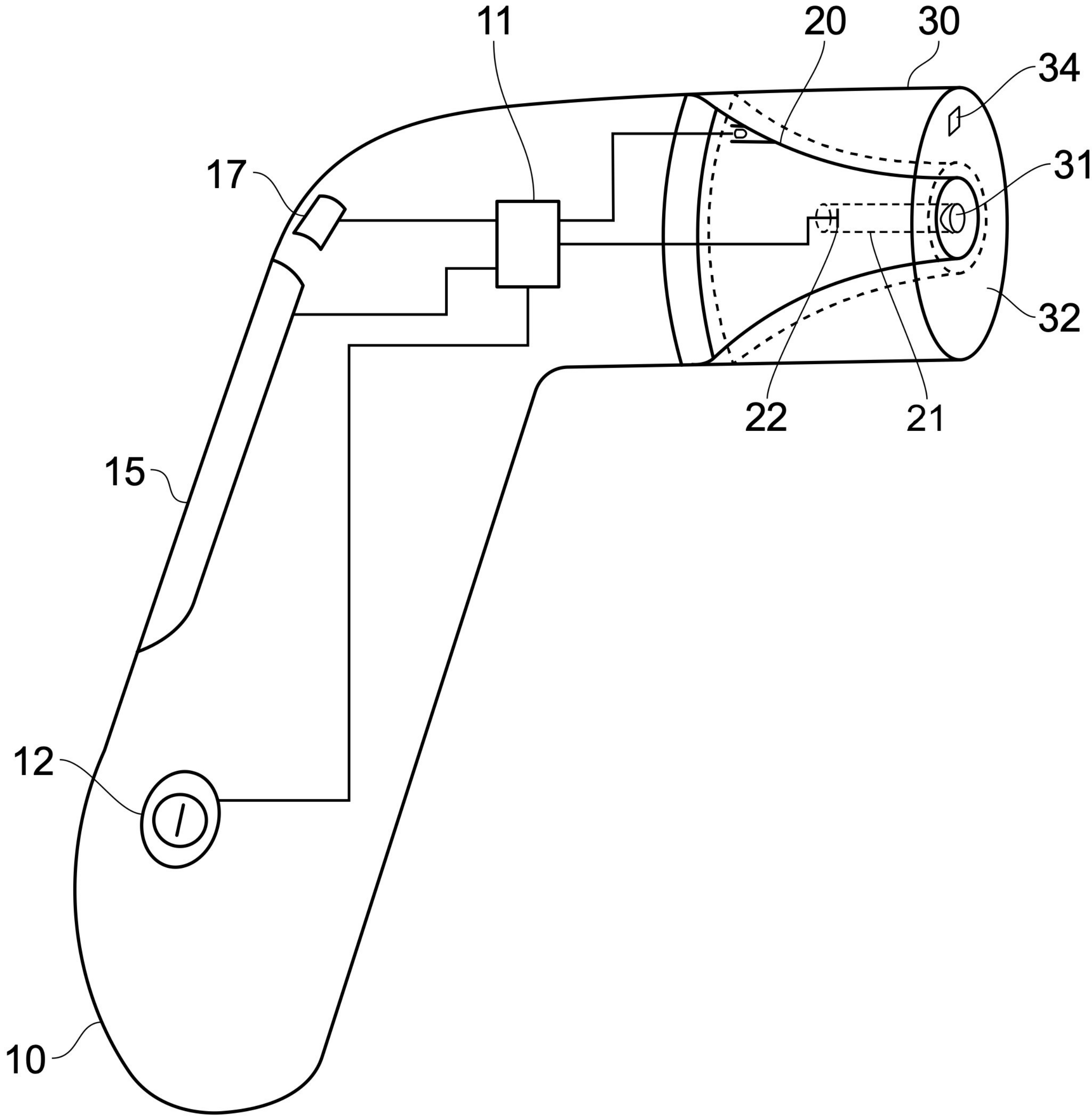

FIG. 1

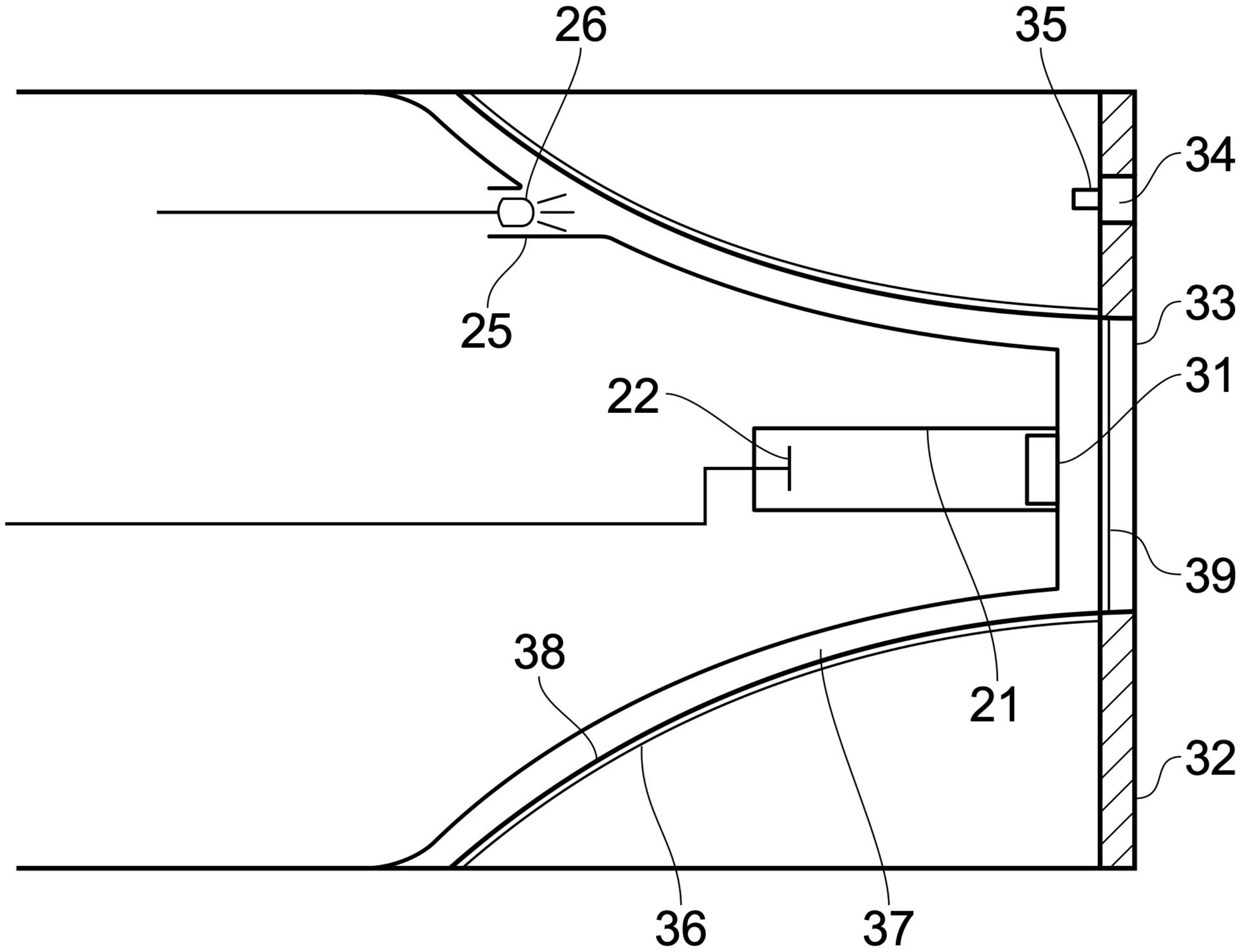

FIG. 2

Fig. 3 only available in part 2

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(10) Publication number: **US 2013/2345678 A1**
(43) Publication date: **21 November 2013**
(22) Filing date: **21 May 2013**
(30) Priority: **21 May 2012**

Ultraviolet cold mirrors

[0001] Ultraviolet cold mirrors are coatings that efficiently reflect ultraviolet light and allow visible and infrared light to pass through.

[0002] They can be used in applications where separation of UV light from the visible light and IR light is desired. Such applications include projection systems and photocopiers as well as surgical and dental lighting, illumination systems and measuring instruments. In particular, they provide a solution whenever light sources emit UV radiation, which can be harmful to objects or persons, and it is necessary to prevent the leakage of this UV light. At the same time, openings in the respective housings allowing transmission of IR light are often desired to release the heat radiation from the light source.

[0003] Previously known cold mirrors typically comprise an uneven number of high and low refracting layers of dielectric materials, such as zinc sulfide and magnesium fluoride. Such layers are usually deposited in a vacuum deposition process on glass substrates.

[0004] In contrast to the prior art, the present invention provides an all-polymeric cold mirror with a UV-reflecting and IR-transmitting function, comprising alternating layers of two polymers, each having a different optical refractive index.

[0005] This cold mirror is superior in several aspects. First, the deposition of polymer layers does not require a vacuum, and thus the mirror can be produced at a lower cost. Second, the mirror results in a deformable thin foil, which can be laminated to a large variety of substrates, such as glass or polymeric materials allowing transmission of IR and visible light. This permits the production of windows for openings in respective housings of the applications mentioned above.

[0006] An example of the cold mirror layer sequence is shown in Fig. 1.

[0007] In the embodiment of Fig. 1, an all-polymeric cold mirror is illustrated. The mirror has a repeating unit AB, where A is a first polymer and B is a second polymer. The two polymers A and B differ in their refractive index, n_1 and n_2 respectively, by at least 0.03 for UV light. By selecting a suitable thickness for the repeating unit and providing a sufficient number of repeating units, the harmful UV light with 200–300 nm wavelength can be reflected effectively. As the chosen polymers do not strongly absorb infrared light, an efficient transmission of this light is ensured. One suitable combination of polymeric materials is polystyrene as the first polymer A and polyethylene as the second polymer B.

[0008] The present all-polymeric cold mirror may be produced as a thin sheet material by a cost-effective co-extrusion process wherein the required layer thicknesses can be precisely adjusted. The resulting sheet material may be used as self-supporting sheet or laminated to polymeric or non-polymeric substrates.

Claims

1. All-polymeric cold mirror, comprising first and second polymeric materials deposited in a sequence of alternating layers of said first and second polymeric material, wherein at least 50% of the infrared light is transmitted, while UV light is reflected effectively.

2. All-polymeric cold mirror according to claim 1, wherein the first polymeric material is selected from a group comprising polystyrene and polycarbonate and the second polymeric material is selected from a group comprising polymethyl methacrylate and polyethylene.

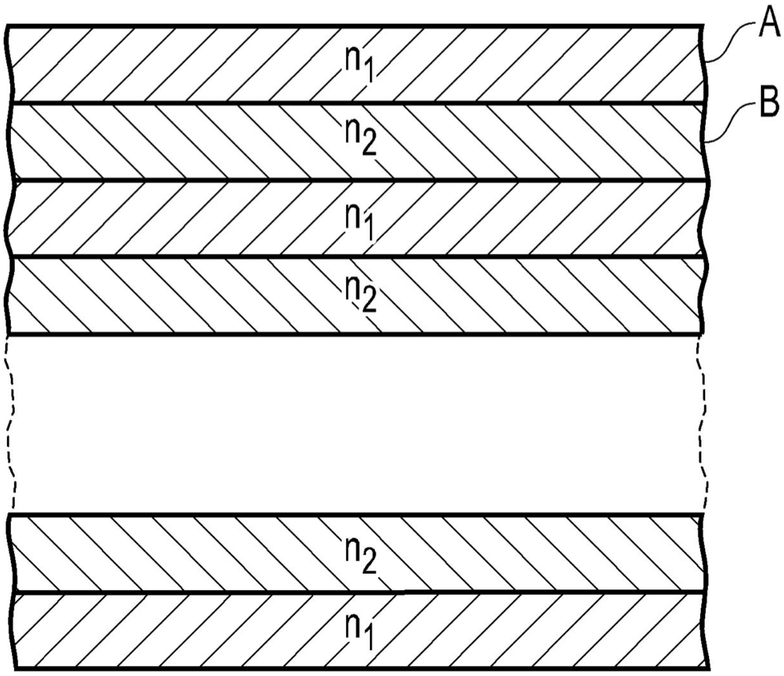

FIG. 1

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(11) Publication number: **EP 3 091 234 A1**

(43) Publication date: **15 July 2016**

(22) Filing date: **14 January 2016**

(30) Priority: **14 January 2015 DE 102015123456**

Sanitising IR thermometer

[0001] The present invention relates to a thermometer for body temperature measurement, wherein the thermometer is capable of sanitising its own head.

[0002] The body temperature can be measured with or without contact to the body. While non-contact thermometers allow for a simple and convenient measurement, the measurement result is less accurate than with contact thermometers.

[0003] Ear thermometers are one type of contact thermometers. During use of an ear thermometer, a part of the probe shaped to form a cylinder or cone is inserted into the ear. The direct contact of the probe with the skin involves a risk of viruses or bacteria present on the skin being transmitted from one patient to the next. Accordingly, in the past, such transmission was blocked by using a disposable cover over the surface of the probe portion. However, there was a problem in that the disposable cover had to be changed every time the temperature of a different person was measured, involving increased cost and waste.

[0004] To overcome this problem, the present invention provides an infrared thermometer that is capable of sanitising the probe portion of the thermometer.

[0005] Fig. 1 illustrates an external view of the thermometer with the removed probe cover.

Fig. 2 illustrates the illumination of the probe portion during the sanitisation process with the probe cover attached.

[0006] The thermometer according to an embodiment of the present invention shown in Fig. 1 includes a handpiece 101 and measures body temperature through a probe portion 130, which, when inserted into the ear canal, detects infrared rays from the eardrum. Further, a probe cover 200 is provided, which has a flat front surface 202 such as is known from covers for medical thermometers configured to be placed against the forehead of a patient. When the probe cover 200 is coupled to the handpiece 101 via a ring-shaped snap joint, a coupling space 300 is formed between the probe portion 130 and the inner surface 220 of probe cover 200.

[0007] Either the handpiece 101 or the probe cover 200 comprises a sanitisation unit 230 for emitting UV light. The sanitisation unit 230 is located so that the ultraviolet light is emitted into the coupling space 300. The inner surface 220 of the probe cover may include a reflector layer for reflecting ultraviolet light emitted by the sanitisation unit.

[0008] A coupling detection unit 120a, 210b for detecting coupling between the probe cover 200 and the handpiece 101 is further provided.

[0009] The handpiece 101 includes a power supply unit, a control button 170, a display unit 180, an infrared sensor module 140, a control unit 150 and a handpiece-side portion 120a of the coupling detection unit. The infrared sensor module 140 is positioned at the proximal end of a recess 145 in probe portion 130. The recess is provided with a metal coating which ensures that light is effectively reflected towards the sensor module 140. The recess 145 is dimensioned to limit the angle of view such that only radiation from the eardrum is detected.

[0010] As shown in more detail in Fig. 2, the probe cover 200 comprises a conical outer surface 201 and a flat front surface 202. The centre of the flat front surface 202 has a hole 203. In the first embodiment, the sanitisation unit 230 comprising a UV light emitting diode is mounted in hole 203.

[0011] The control unit 150 is electrically connected to each of the control button 170, the handpiece-side portion 120a of the coupling detection unit, the sanitisation unit 230 and the infrared sensor module 140.

[0012] For body temperature measurement, the control unit 150 receives a signal from the sensor module 140 and processes this signal. Conventional algorithms and procedures are then used to obtain a body temperature. The numerical value of the calculated temperature is displayed on the monochrome, numerical-only display 180. This allows for a robust and small-sized display which can be integrated directly into the handpiece 101 during manufacture such that it forms an integral portion of a watertight and shock-resistant handpiece structure.

[0013] The control unit 150 also initiates the sanitisation operation when detecting a signal from the coupling detection unit 120a, 210b. This operation is activated by pushing a spring-loaded pin 214 situated on the handpiece 101 with an actuation member 210b provided on the probe cover 200. In addition, the actuation member 210b closes an electrical connection between the handpiece 101 and the probe cover 200. Upon movement of the pin 214, a coupling signal is sensed by the control unit 150, the temperature measurement is switched off and the sanitisation unit 230 is activated.

[0014] When power is provided to the sanitisation unit 230, it emits UV light having a wavelength of 200–280 nm into the coupling space 300. A highly reflective coating 220, composed of, for example, gold or another highly reflective metal, directs the UV light to the probe surface where it damages the microorganism DNA and thus performs microbial decontamination.

[0015] A second embodiment not shown in the figures differs from the first embodiment in that an additional recess is provided in the surface of probe portion 130, and instead of mounting the sanitisation unit 230 in the probe cover's front surface 202, it is mounted within the additional recess. The position of the recess is such that UV light emitted from the sanitisation unit 230 reaches the entire surface of probe portion 130 via reflection by the coating 220 provided on the inner surface of the probe cover 200. In the second embodiment, the coupling detection unit 120a, 210b is provided on the probe portion and probe cover in the same manner as in the first embodiment.

[0016] In order to avoid the undesired escape of harmful UV light through the front surface, the hole 203 in the flat front surface 202 is closed by a removable polymeric plug that does not transmit UV light. Further, detaching the plug from the probe cover 200, allows the passage of infrared light and thereby enables forehead temperature measurements.

[0017] This arrangement has the advantage that no releasable electrical connection to the probe cover 200 is required, thereby reducing device failures due to faulty electrical connections.

Claims

1. Infrared thermometer (100) for measuring the body temperature in the ear, comprising
   - a handpiece (101) with a probe portion (130) and a probe cover (200) attachable to the handpiece (101) such that the probe cover (200) defines a coupling space (300) between the probe portion (130) and the cover (200),
   - a sanitisation unit (230) emitting UV light into the coupling space (300),
   - a coating (220) with high reflectivity for UV light provided on the inner surface of the probe cover (200).

2. The thermometer of claim 1, wherein the coating is a metal coating, in particular a gold coating.

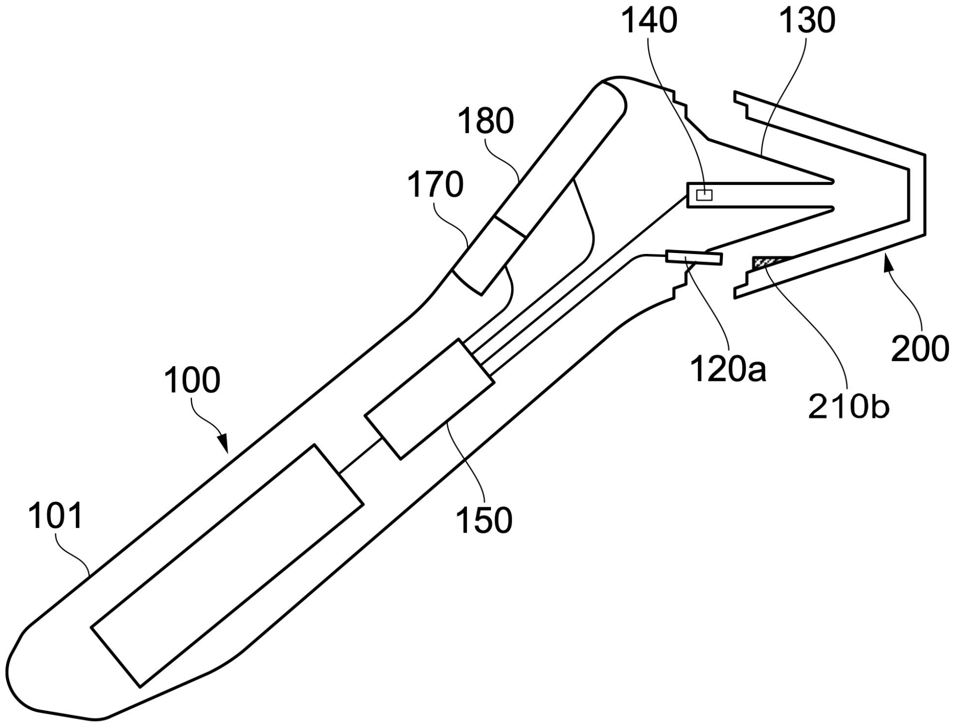
140
130
180
170
100
101
150
120a
200
210b

FIG. 1

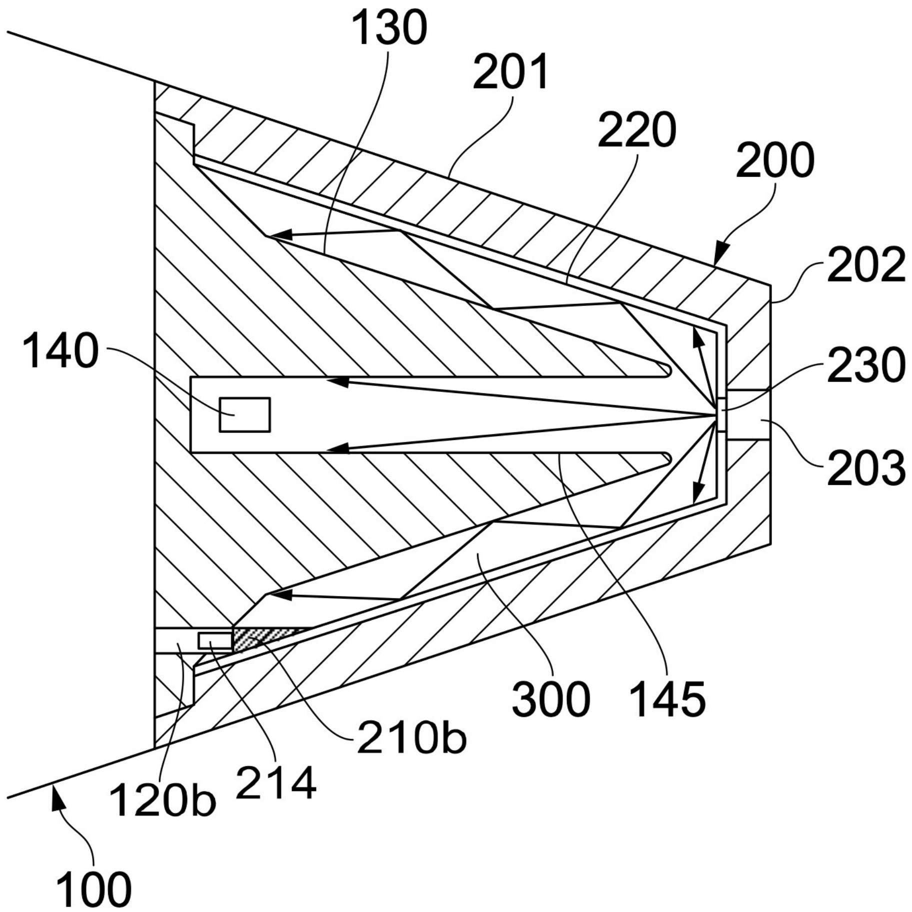
130
201
220
200
202
140
230
203
300
145
210b
214
120b
100

FIG. 2

(12) European Patent Office

(21) Application number: **20456789.4**

(11) Publication number: **EP 3 789 012A2**

(43) Publication date: **07 January 2021**

(22) Filing date: **07 July 2020**

(30) Priority: **08 July 2019 JP 2019567901**

Thermometer ear plug

[0001] The present invention relates to a thermometer that measures the body temperature of a target person by determining the radiation emitted from the eardrum.

[0002] For example, constant long-time monitoring of body temperature may be necessary as a part of physical condition management for a patient undergoing surgery or a worker performing heavy physical work. For such applications, it is important that the thermometer can be worn continuously without causing discomfort.

[0003] Some body temperature thermometers measure the temperature by insertion of a specially adapted probe into the ear. An example of such a device is the EARIX 3.2 ear thermometer. However, as experiments with a commercially obtained sample of this device have shown, the shape of its probe cannot be easily modified for constant wearing.

[0004] In order to achieve the above object, the ear thermometer according to the present invention is shaped similar to an in-ear type earphone.

[0005] Further, effects of the environment, such as systematic measurement errors caused by IR light emitted from the walls of the ear canal, are minimised.

[0006] As shown in Fig. 1 and 2, according to an aspect of the present invention the ear thermometer includes a probe PB including an infrared sensor SN for measuring the temperature of the eardrum 250. The probe includes a probe body 20 to be inserted into the ear canal 201, a housing 10 supporting the probe body 20, and an exchangeable in-ear type earpiece 12 attached to the probe body 20. The earpiece 12 prevents contact between the probe body 20 and the inner walls of the ear canal 201. Earpieces 12 of different sizes can be attached to allow a comfortable fit in the ear canal of target persons with different ear anatomy.

[0007] The earpiece 12 includes an engaging portion 12c engaging with a groove 20a in the probe body 20. The probe body 20 comprises a hollow tubular portion 150, with an inner wall that is coated with a reflective material such as gold. A sensor SN sensitive to IR radiation is located at the base end of the probe body 20.

[0008] For the temperature sensing operation, the probe is inserted into the ear canal 201. IR radiation from the eardrum 250 enters the top portion of the tubular portion 150 and is guided to the sensor SN, which generates an electrical signal. As shown in Fig. 2, arranging the sensor at the base end of tubular portion 150 restricts the acceptance angle of the sensor such that, due to the geometric arrangement, mostly IR radiation from the eardrum reaches the sensor.

[0009] The housing further comprises a controller 500, which calculates the body temperature from the electrical sensor signal. Further, the controller comprises a Bluetooth module allowing the thermometer to be connected to an external mobile device such as a smartphone. Using an appropriate app on the smartphone, the temperature determined can be displayed to the user.

[0010] The app further comprises an in-ear measurement software module allowing read-out of the sensor signal during the process of inserting the ear plug into the ear canal. Using the read-out result, a background signal level can be determined. Sending this background signal level to controller 500 and subtracting it during the actual temperature calculation finalises the temperature sensing operation. This achieves an effective suppression of the systematic measurement errors of radiation from the ear canal walls.

[0011] The display and processing of the temperature on a device external to the thermometer enables the provision of customisation options, for example with respect to colour, font size, etc., in accordance with user preferences. Further, advanced processing of the measurement signal can be implemented. The app can also comprise a body temperature monitoring software displaying a status of the patient.

[0012] In addition, the thermometer may optionally comprise a sound output device 400 such as a speaker. The sound output device is connected via the controller 500 to the Bluetooth module and allows the use of the in-ear device as a conventional in-ear speaker. To activate the speaker feature, the user presses the mechanical push-button 14, which deactivates the temperature measurement and enables listening.

Claim 1

Thermometer device for insertion into the ear canal, comprising a housing, a probe tube having a proximal end and a distal end, the proximal end being attached to the housing, an IR radiation sensor located at the proximal end of the tube, an in-ear type probe body being attachable to the probe tube, wherein the probe body is shaped such that IR radiation from the eardrum enters the distal end of the probe tube when the thermometer device with the in-ear type probe body attached is inserted into the ear canal.

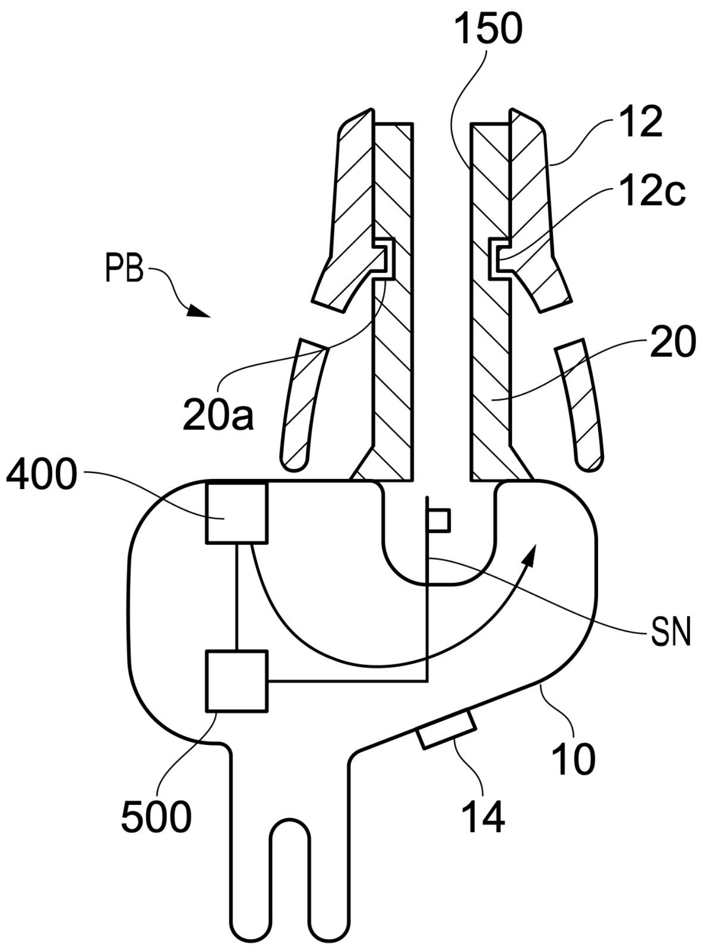

FIG. 1

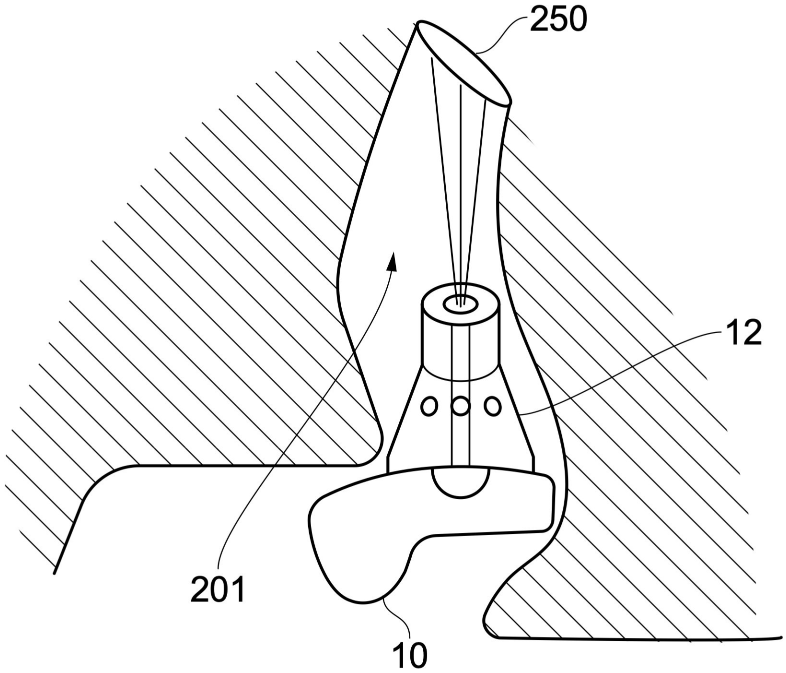

FIG. 2

(19) United States

(21) Application number: **16/123,456**

(10) Publication number: **US2019/6789012 A1**

(43) Publication date: **28 February 2019**

(22) Filing date: **28 August 2018**

(30) Priority: **28 August 2017**

Multi-mode radiation thermometer

[0001] The present invention relates to a body temperature measuring device that can be used in different measurement modes.

[0002] Several infrared thermometers measuring the temperature of a patient are known in the art. Besides the traditional ear thermometer, which is configured to be inserted into the ear canal, an infrared (IR) thermometer capable of being used as an ear thermometer and as a forehead thermometer is known. In the latter configuration, thermal radiation from the patient's external body surface is measured in the temporal region of the forehead, which is more exposed to the environment. It is then of particular importance to take the ambient temperature into consideration in the body temperature calculation. Both the aforementioned ear and forehead thermometers can be referred to as contact thermometers because a portion of the thermometer is brought into contact with the patient when measuring their body temperature.

[0003] In view of the foregoing, the thermometer of the present invention comprises a housing, a temperature sensor, a cap, and a control circuit. It provides for in-ear measurements when the cap is in a first position and forehead contact measurements when the cap is in a second position and placed against the forehead of a patient.

[0004] Fig. 1 depicts the exterior view of an infrared thermometer with the cap in a first position.

Fig. 2 depicts the cap in a second position and shows some interior components of the IR thermometer shown in Fig. 1.

[0005] As shown in Fig. 1, the thermometer 10 comprises a housing 12, including a probe 14 configured to be inserted into a body cavity, such as the ear canal of a patient. The probe 14 has a front end facing the body whose temperature is to be measured. The thermometer further includes an activation button 62 and a display 64, both connected to a programmable multi-purpose control circuit 26.

[0006] As shown in Fig. 2, a cylindrical supporting element 17 made from metal is located inside the probe 14. The thermometer includes an IR sensor 16 that is fixed in the cylindrical supporting element 17 in a suitable position along the axis of the element 17. In this embodiment the IR sensor 16 is positioned close to the front end of the probe 14, though other positions may be envisaged. The IR sensor 16 passes its signal to control circuit 26 via an electrical connection. The housing 12 is internally metalized to shield any radio interference between surrounding wireless devices and the control circuit 26.

[0007] Furthermore, an ambient temperature sensor 15 is connected to control circuit 26 and mode selector switch 27. The control circuit determines the body temperature of the patient from the IR radiation sensor signal and the ambient temperature signal, thereby ensuring reliable measurements under all ambient temperature conditions.

[0008] The thermometer 10 also includes a cap 22. The cap 22 is configured to be slidable with respect to the housing 12, and can be positioned in a first sensing position, which is the retracted position shown in Fig. 1. Here, the probe 14 is exposed and insertable into the ear canal where radiation from the eardrum is sensed.

[0009] The cap 22 can be slid forward into a second position shown in Fig. 2. In this position, the front surface of the cap 22 is flush with the sensor entrance window 18. By using a sliding connection, the cap 22 stays permanently mounted to the housing to prevent its loss.

[0010] In this measurement setting, the front surface 23 of the cap 22 can be brought into contact with the temporal region of the patient's forehead. The IR sensor senses the radiation from the forehead and the control circuit 26 calculates the patient's body temperature using the IR sensor signal and the ambient temperature signal.

[0011] The in-ear mode and the forehead mode involve different algorithms for the processing of the sensed signals by the control circuit 26. To select the processing algorithm for each mode, the control circuit 26 receives input from the mode selector switch 27. The switch is activated when the cap 22 slides back into in-ear mode position and a selector pad 24 provided on the cap 22 presses down switch 27. Moving the cover 22 forward into forehead mode position, shown in Fig. 2, deactivates the switch 27. The switch 27 also indicates to the user the correct position of the cap 22 for in-ear mode because the switch provides tactile feedback when pushed.

[0012] In all measurement modes the calculated body temperature is shown on the display 64. As a display unit, a commercially available touch-sensitive graphic color display with a 1.5 inch (38 mm) diagonal is used.

[0013] The touch display allows the user to change from Celsius to Fahrenheit and further enables the input of the patient’s name and age. The measured temperature value can be stored together with the patient’s personal data in a non-volatile storage integrated in the control circuit. Stored temperature values can be retrieved to review the evolution of the patient's temperature.

[0014] The display unit may optionally comprise an integrated speaker that is connected to the control circuit. This speaker allows an alarm to sound in all measurement modes when the calculated body temperature exceeds the critical threshold of 37.5°C or 99.5°F, thereby directing the user's attention to a potentially critical patient temperature level. In the present embodiment, a three-tone alarm sounds but in a further modification the user can select from various other preset sound signals.

Claims

1. A thermometer, comprising:
   a housing including a probe for insertion into the ear canal of a patient;
   a temperature sensor positioned in the housing; and
   a cap configured to cooperate with the housing, the cap capable of being positioned in a first position exposing the probe and a second position wherein the cap front is flush with the probe front end.

2. The thermometer of claim 1, further comprising a temperature range indication unit, and means indicating that a temperature threshold is exceeded.

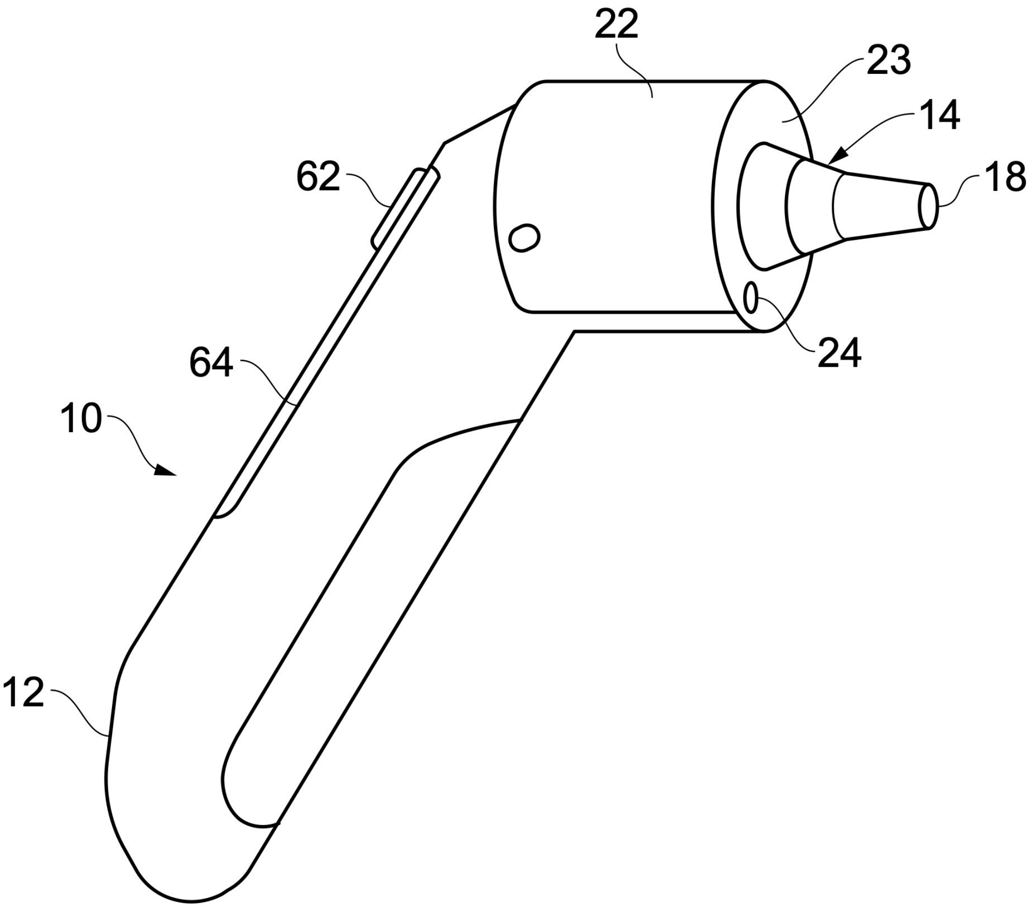

FIG. 1

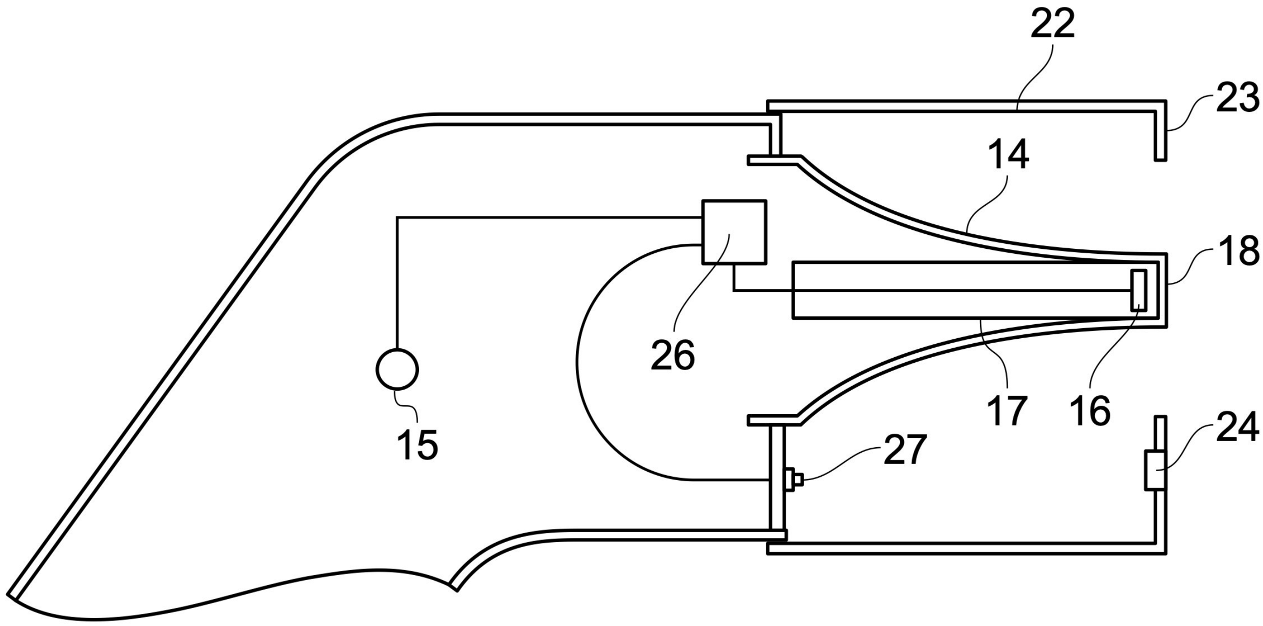

FIG. 2