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Abreu

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(54) **DEVICE FOR MEASURING THE INFRARED OUTPUT OF THE ABREU BRAIN THERMAL TUNNEL**

(71) Applicant: **GEELUX HOLDINGS, LTD.**, Tortola (VG)

(72) Inventor: **Marcio Marc Abreu**, Bridgeport, CT (US)

(73) Assignee: **Geelux Holdings, Ltd.**, Tortola (VG)

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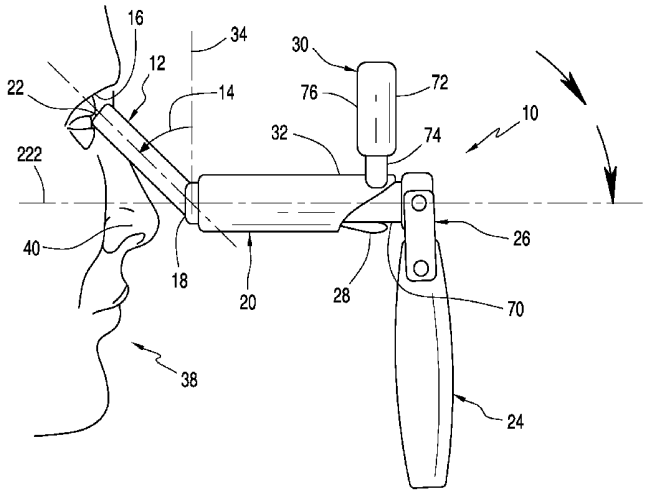
Primary Examiner — Lisa M Caputo
Assistant Examiner — Philip L Cotey
(74) *Attorney, Agent, or Firm* — Studebaker & Brackett PC

(57) **ABSTRACT**

A medical device for the measurement of brain temperature data through the Abreu brain thermal tunnel (ABTT) is described. Brain temperature measurement is the key and universal indicator of both disease and health equally, and is the only vital sign that cannot be artificially changed by emotional states. Currently, brain temperature is difficult to measure. However, the present disclosure describes a device that readily locates the Abreu brain thermal tunnel, and is configured to provide a non-contact temperature reading of the brain. Embodiments of the disclosed device enable an individual to measure their own temperature and enable medical professionals to measure the temperature of others.

14 Claims, 35 Drawing Sheets



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See application file for complete search history.

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* cited by examiner

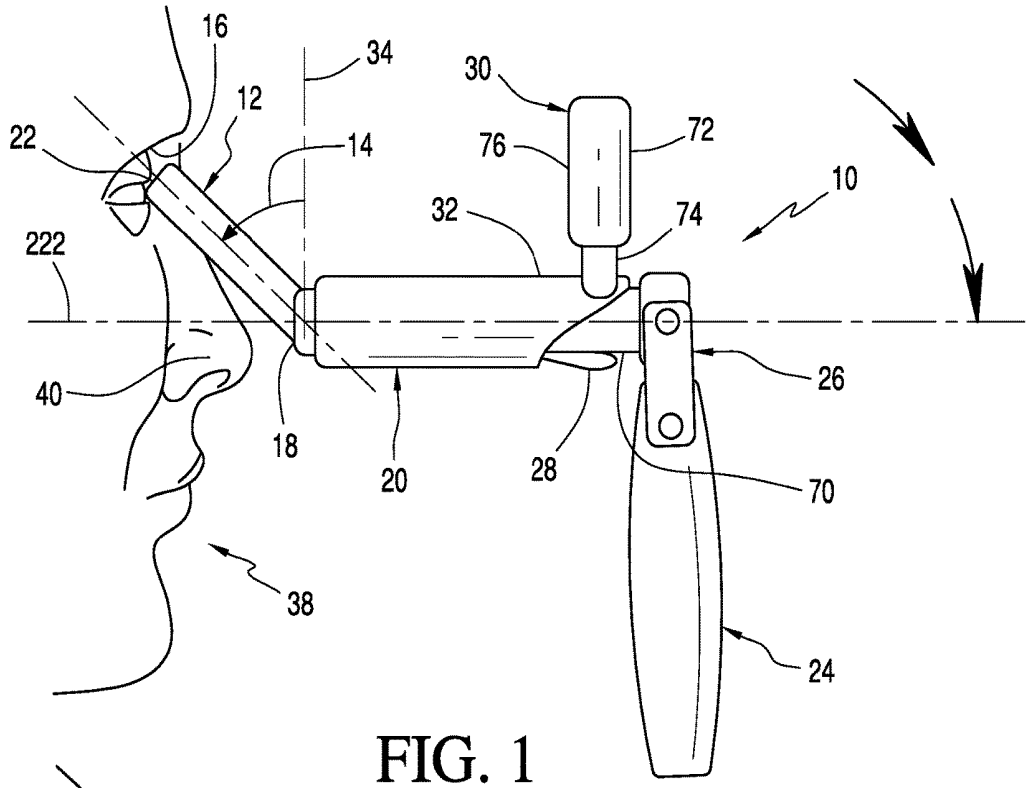
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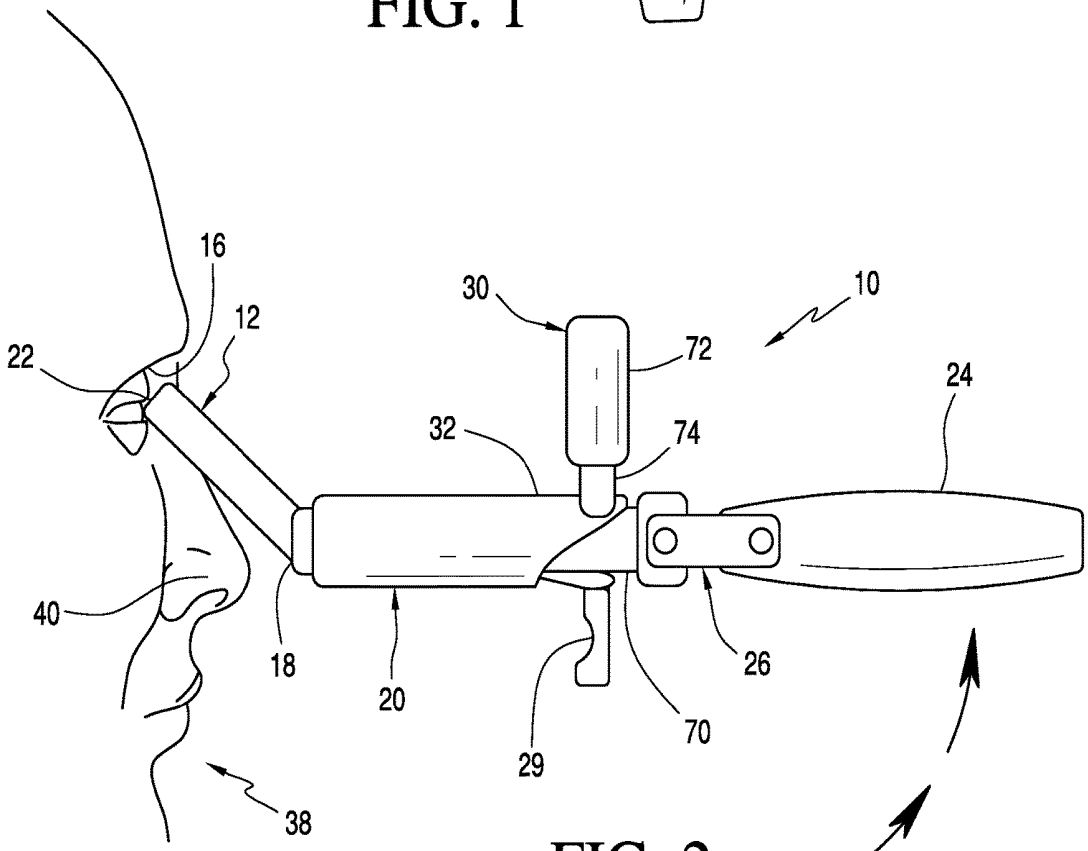
FIG. 1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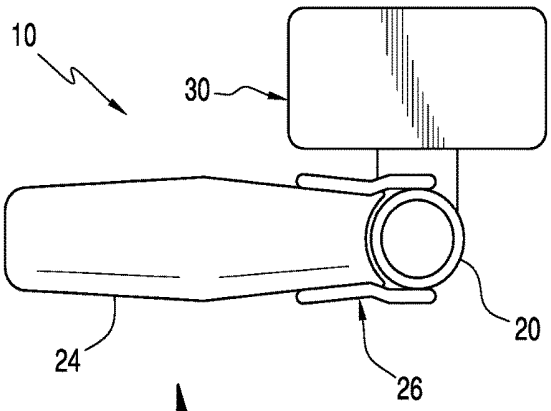

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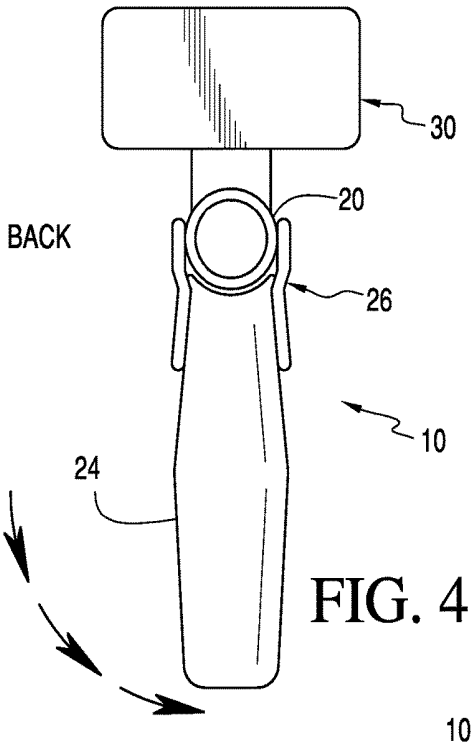

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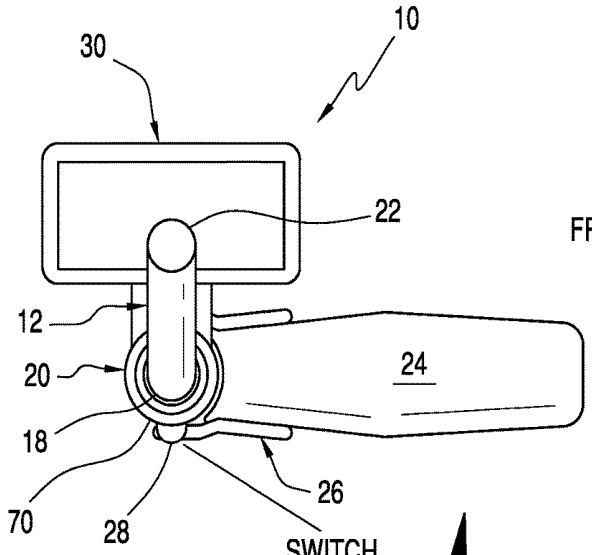

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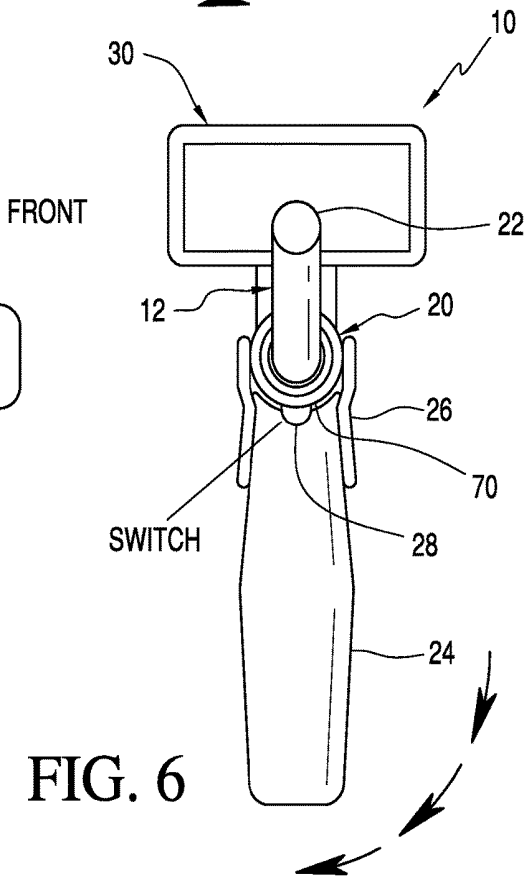
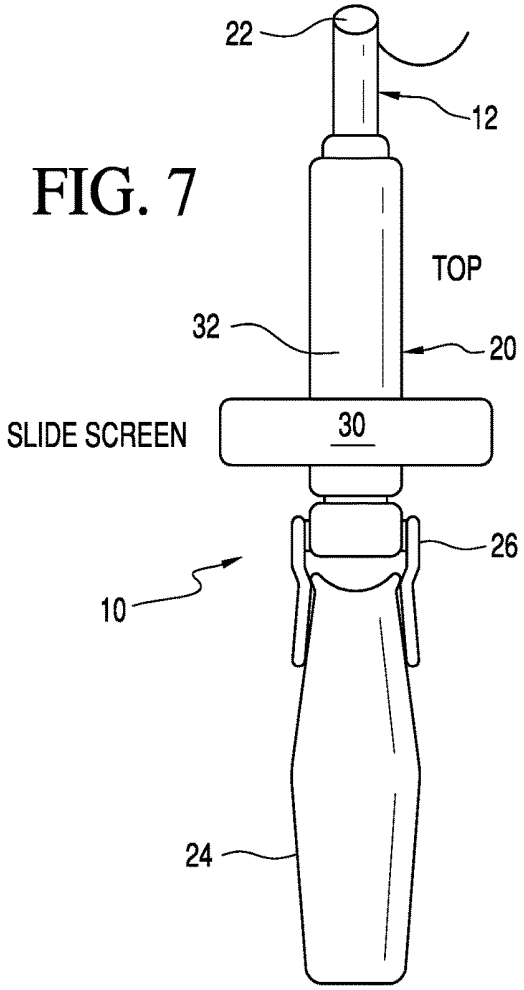


FIG. 6

FIG. 7



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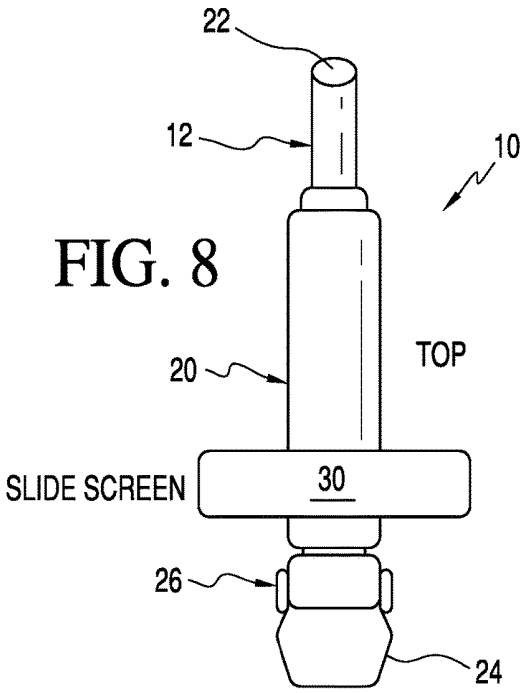

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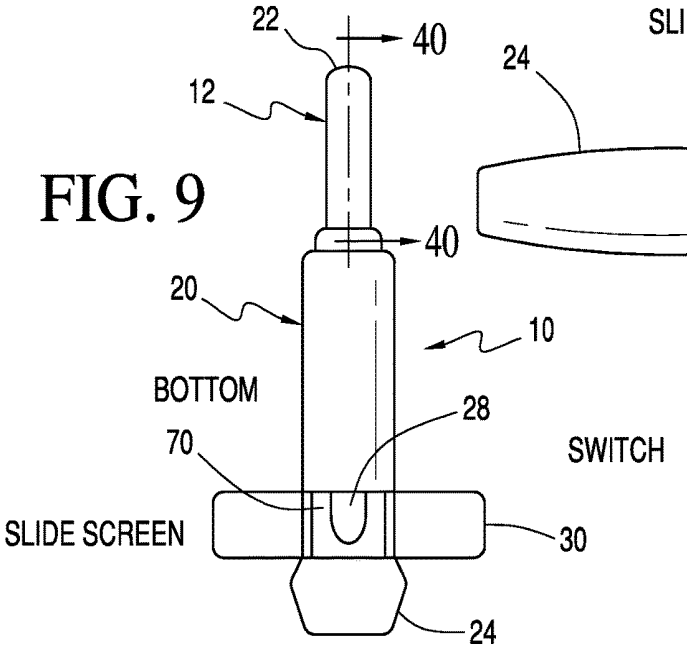

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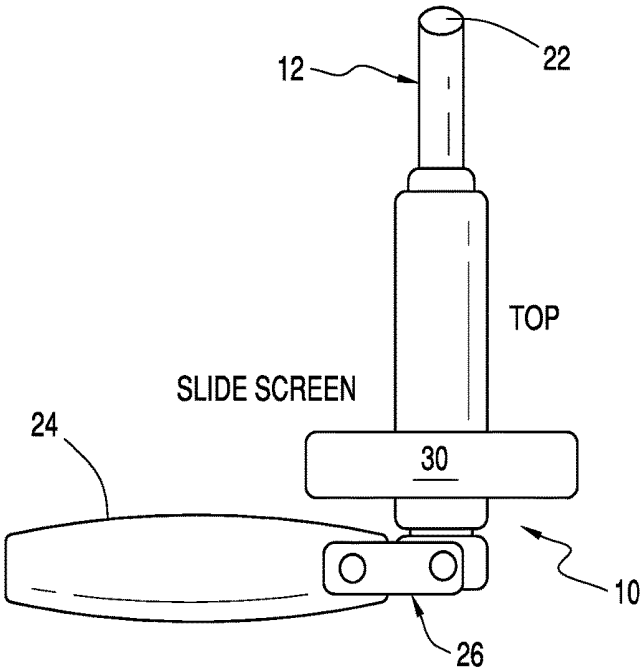

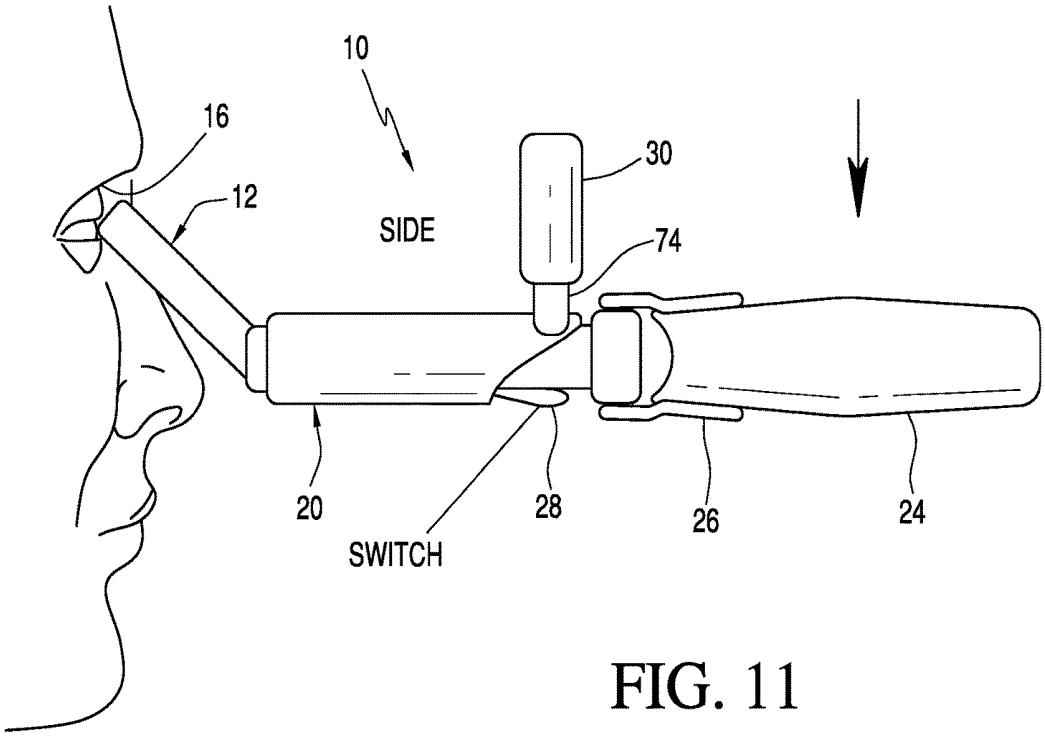
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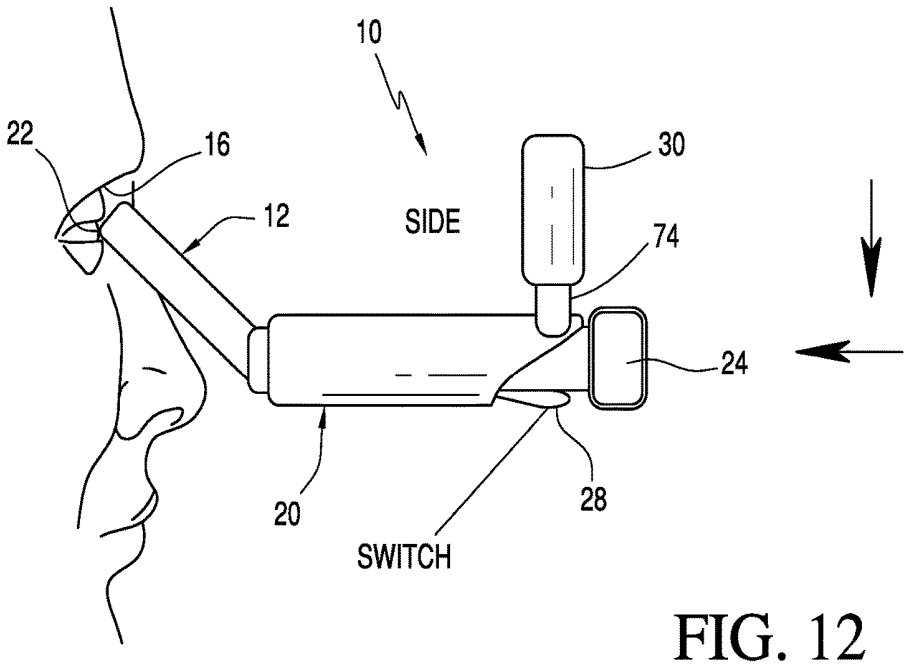
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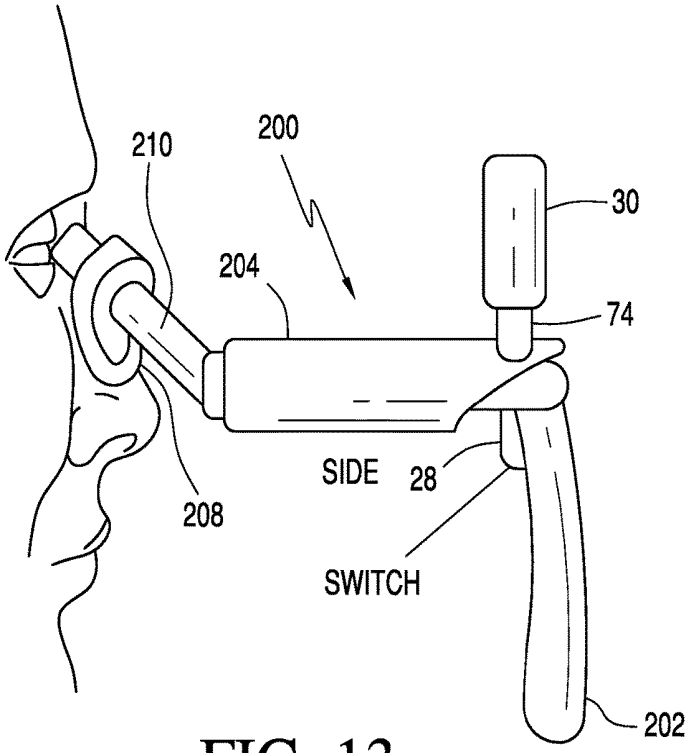
FIG. 12



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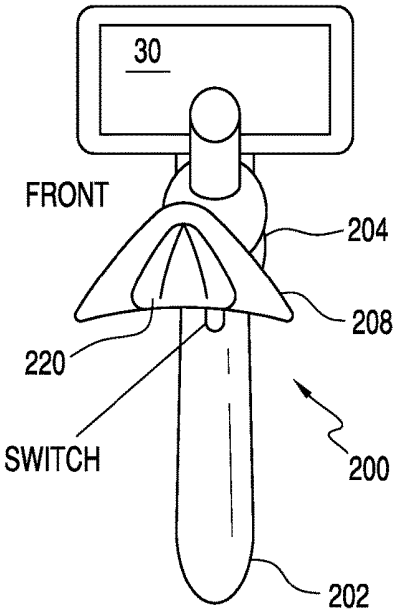

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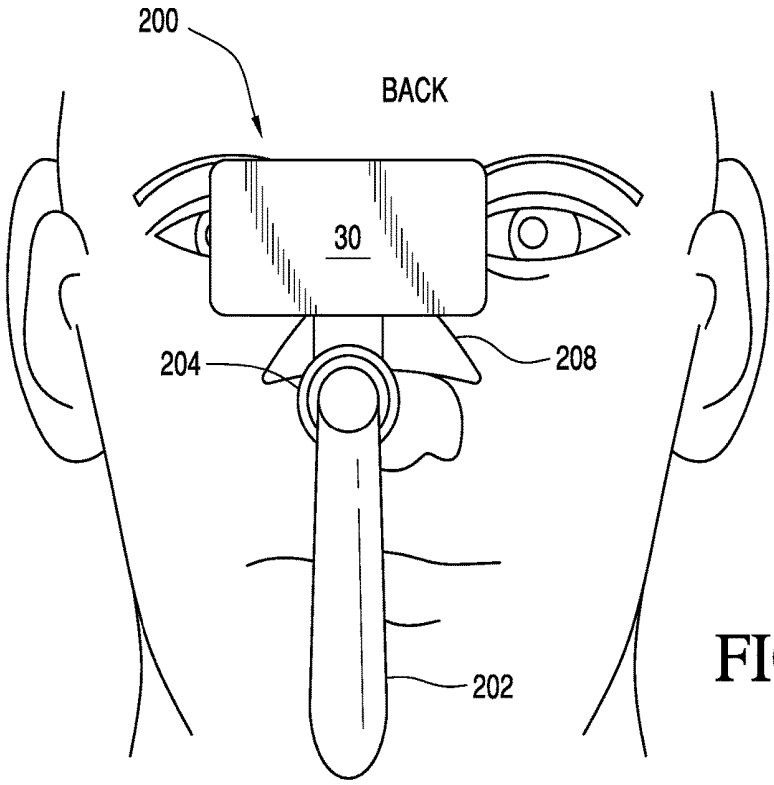

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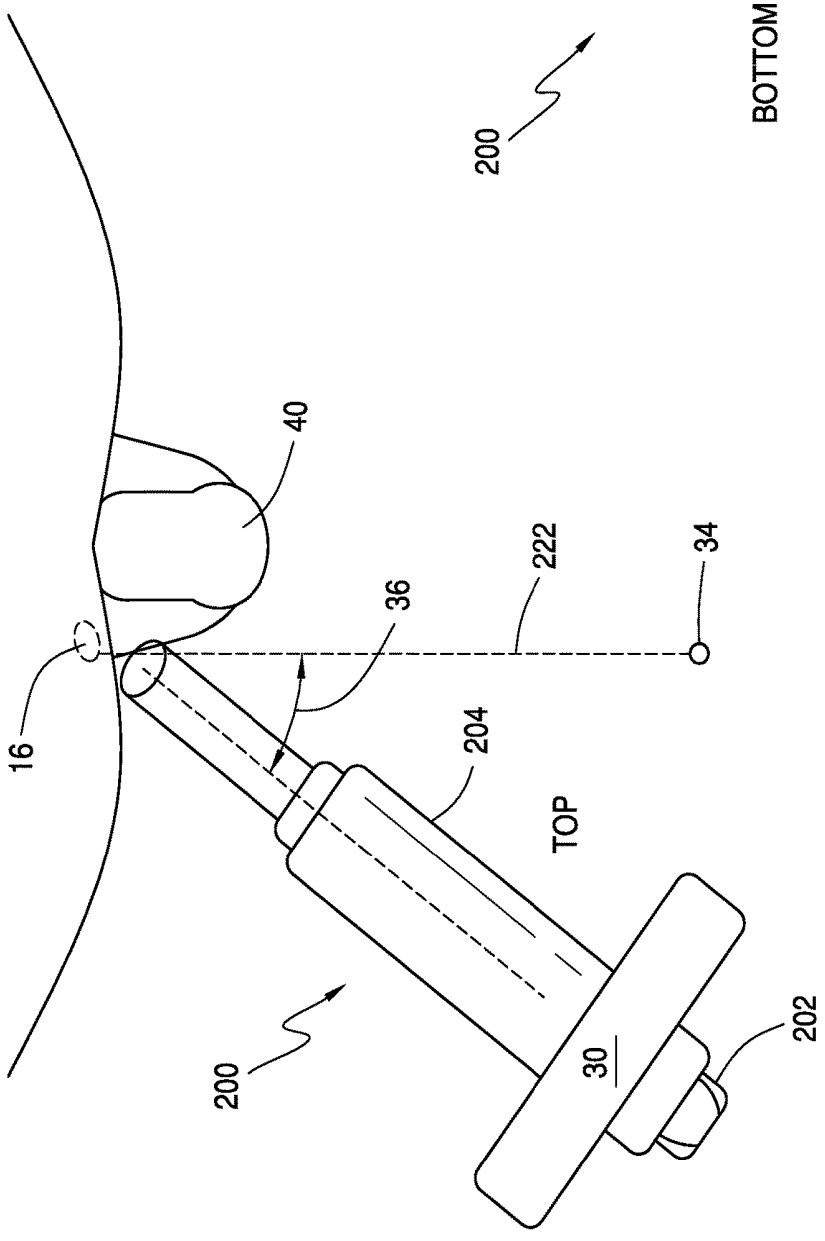
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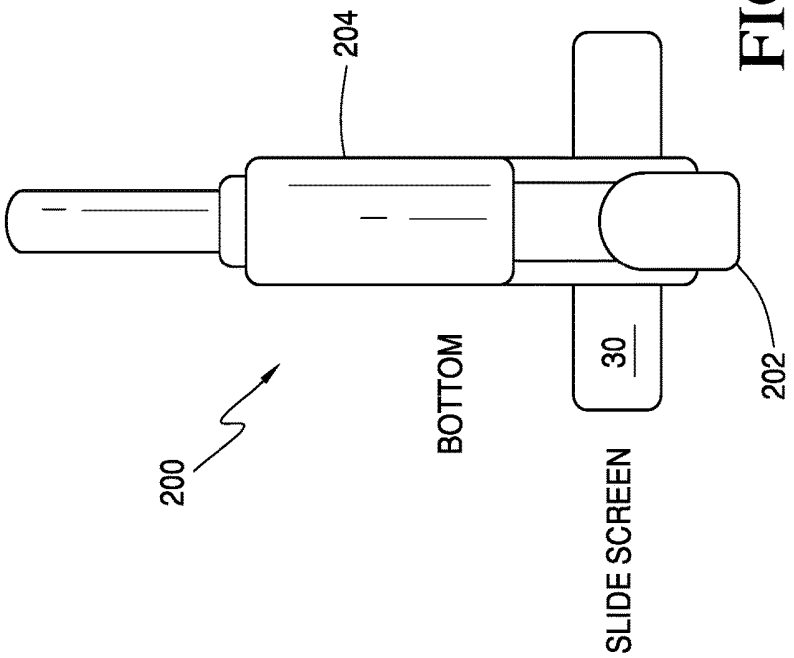
FIG. 16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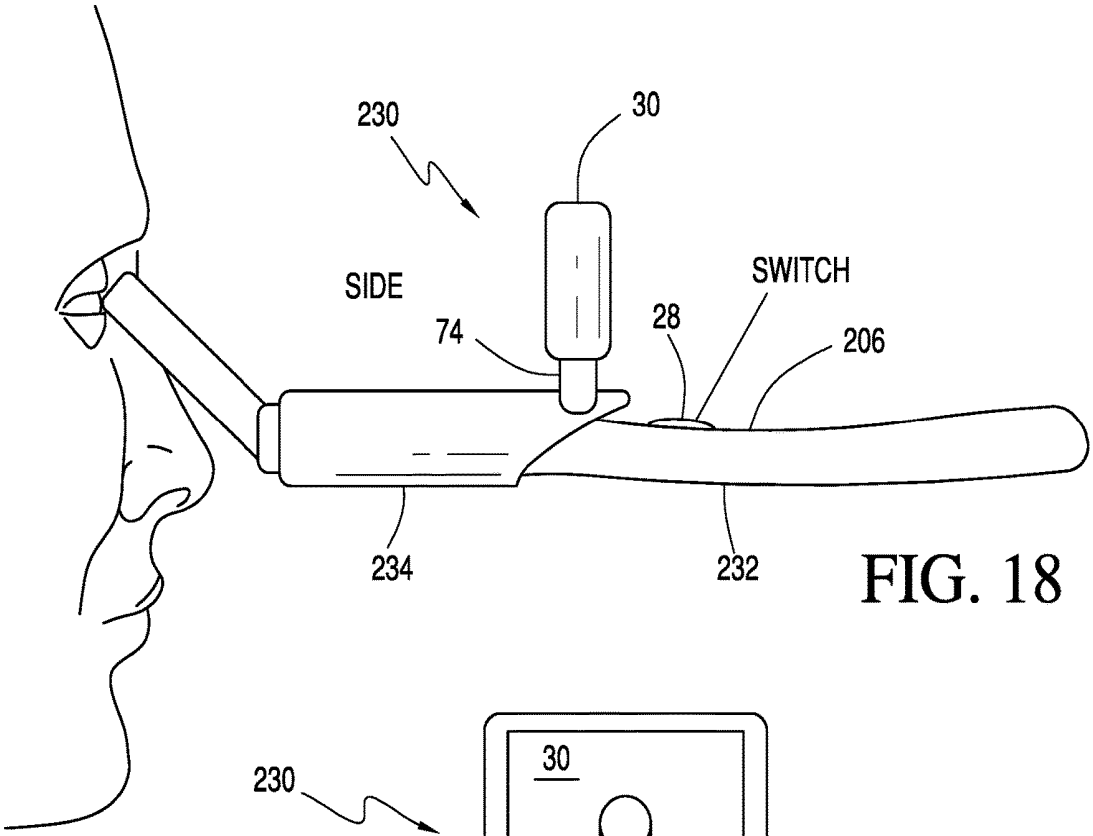

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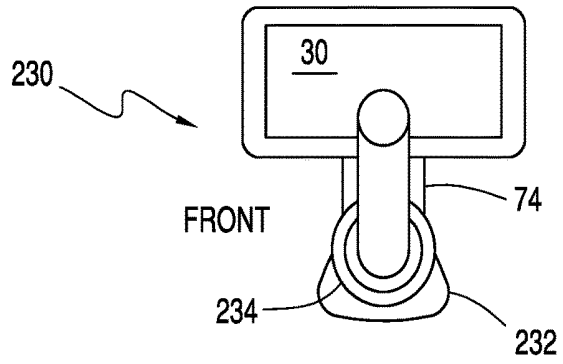

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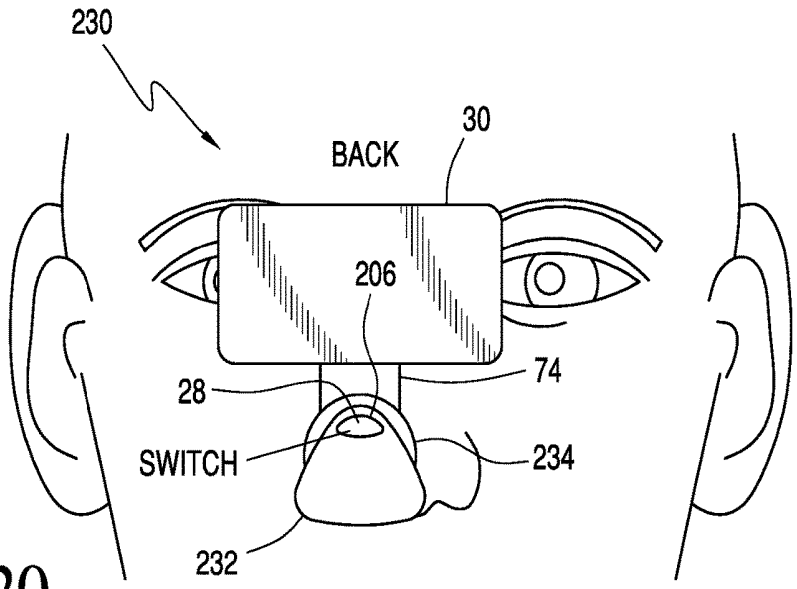

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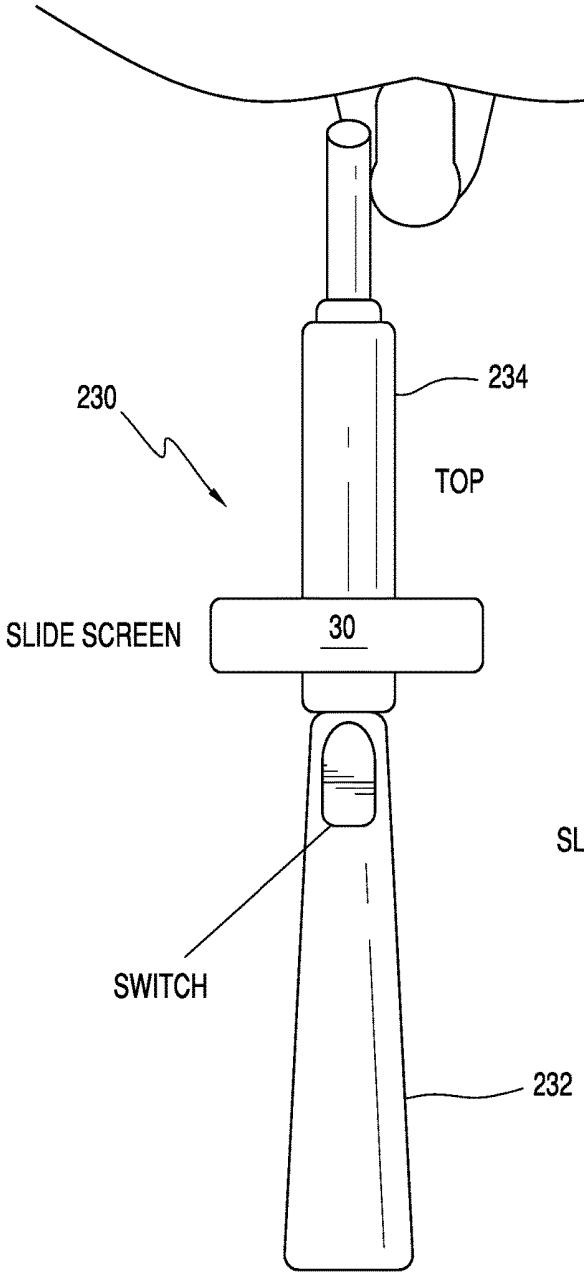
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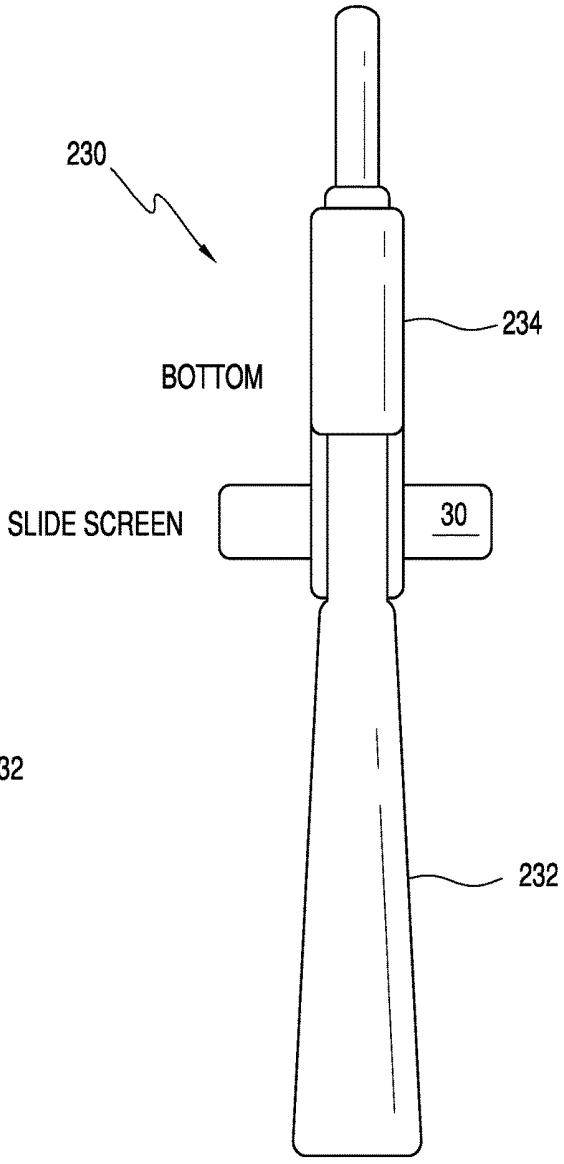
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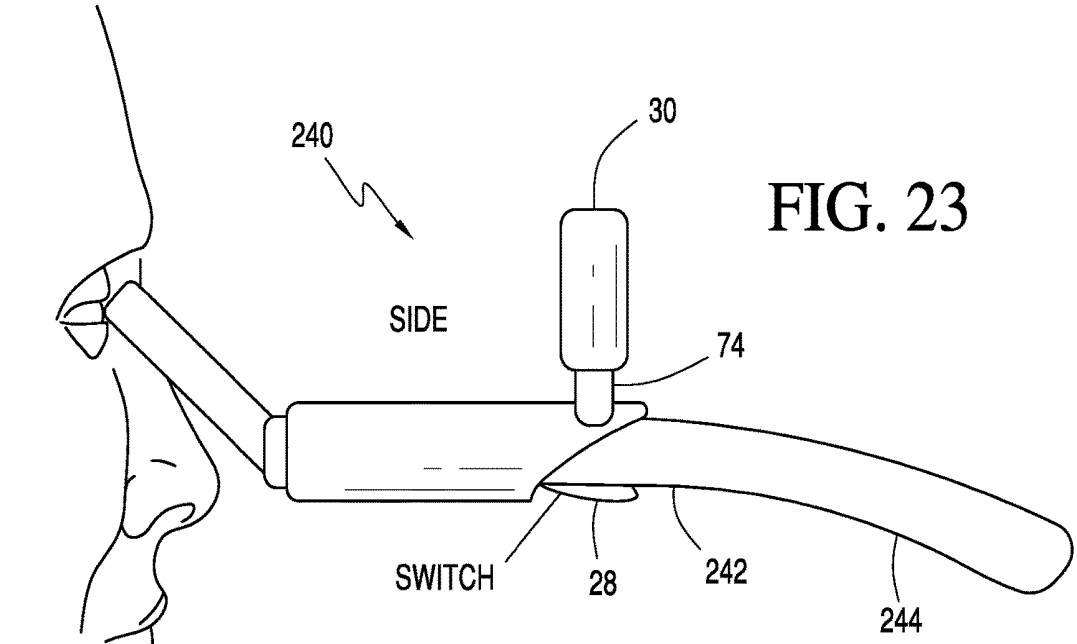

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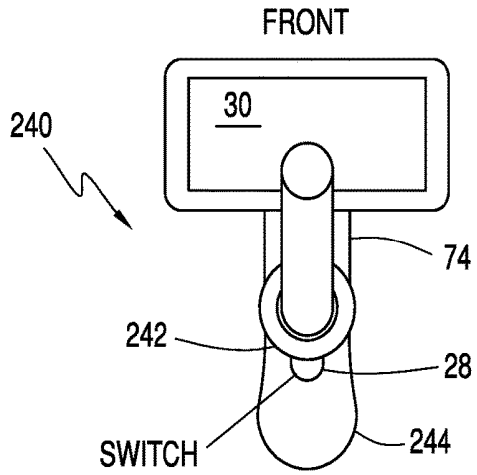

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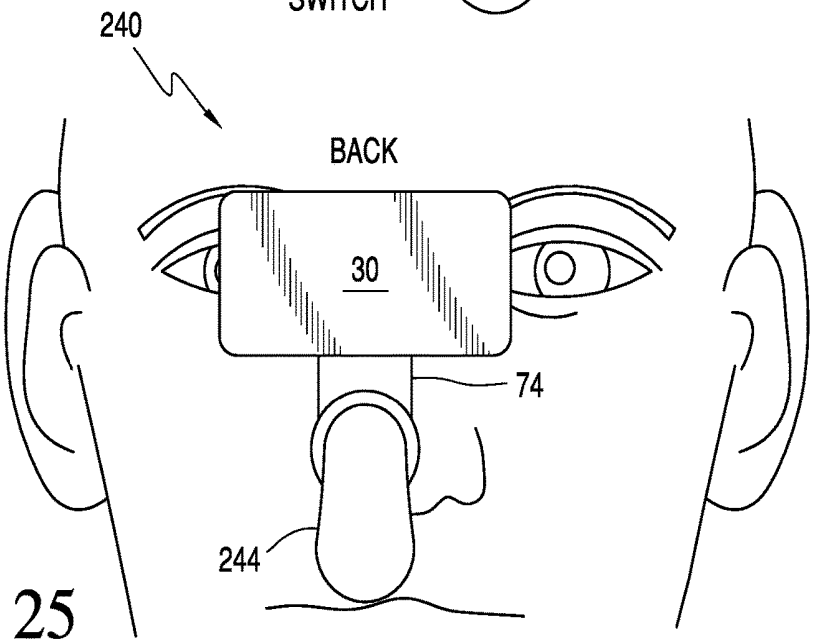

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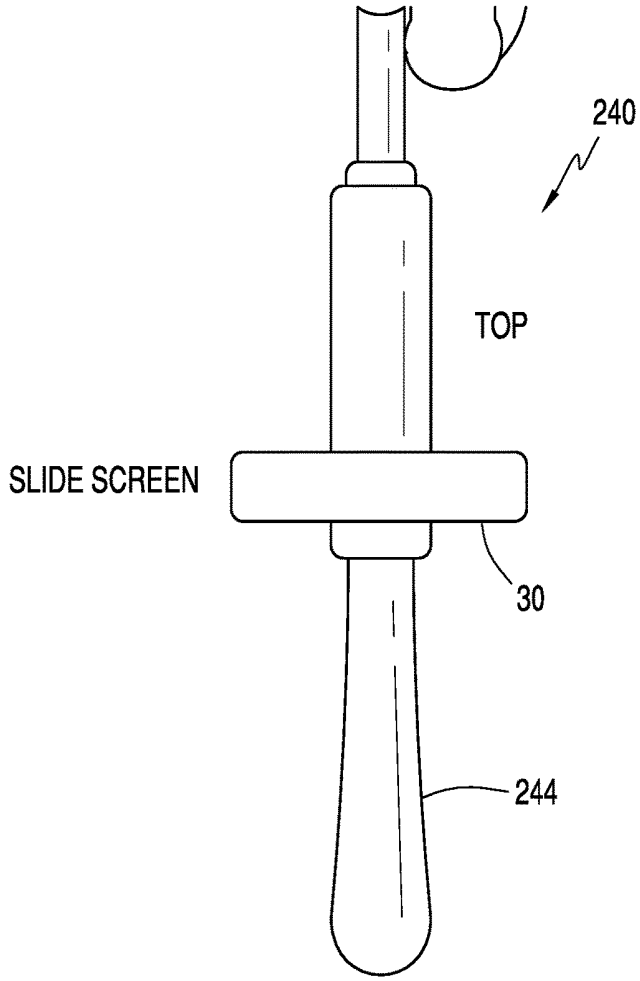
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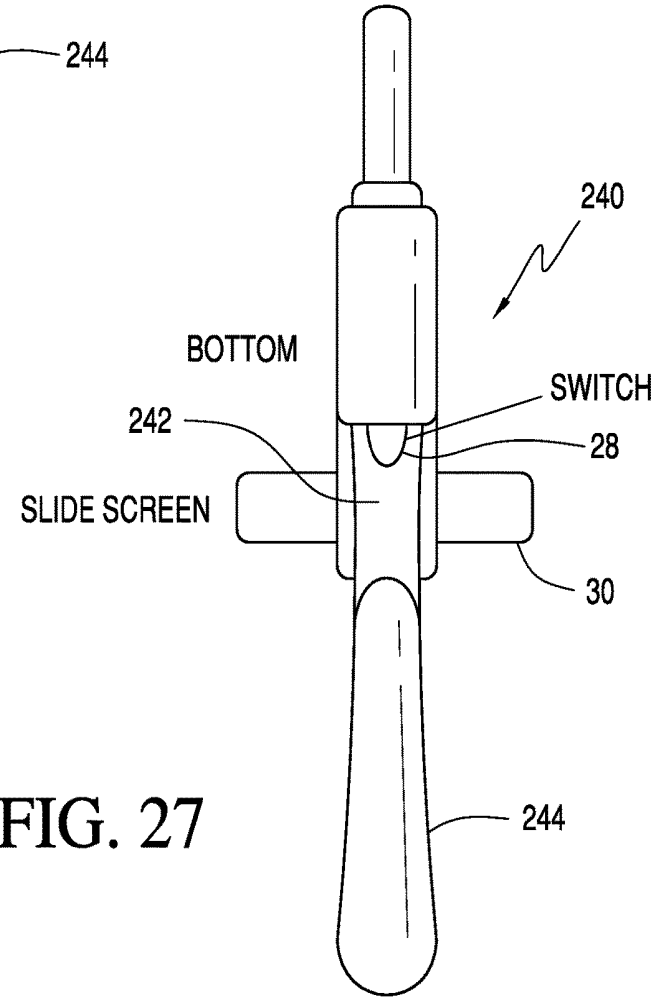
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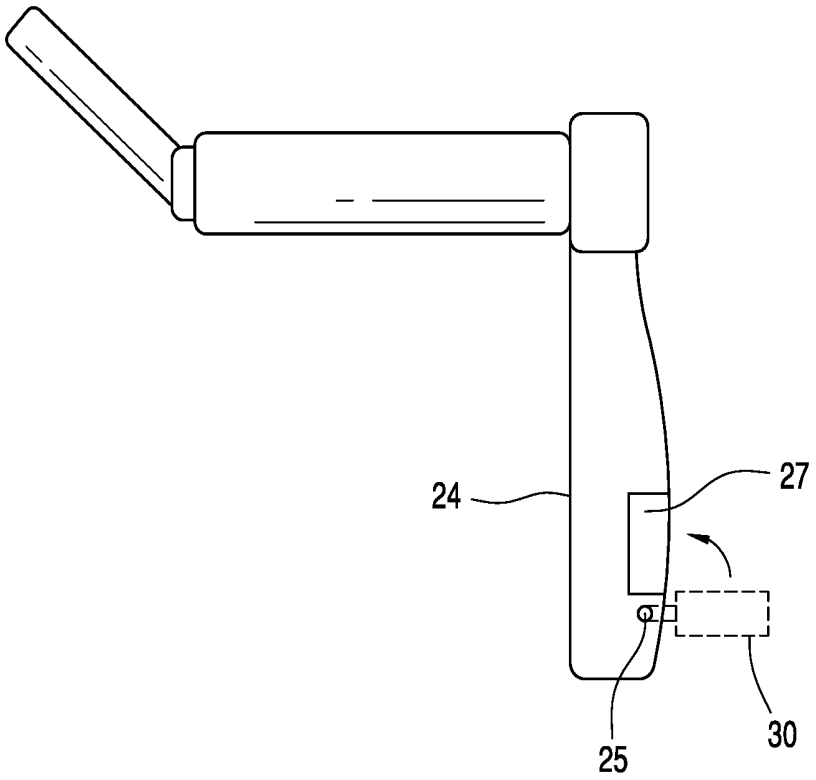

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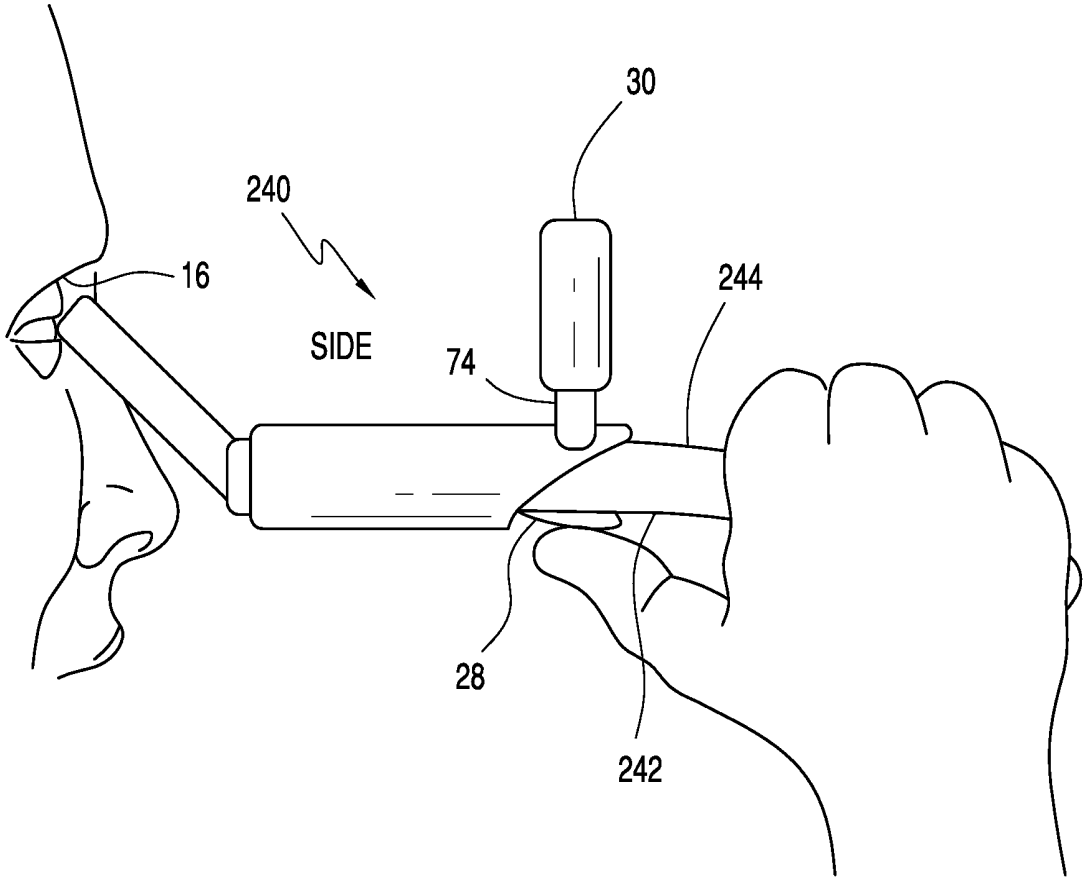

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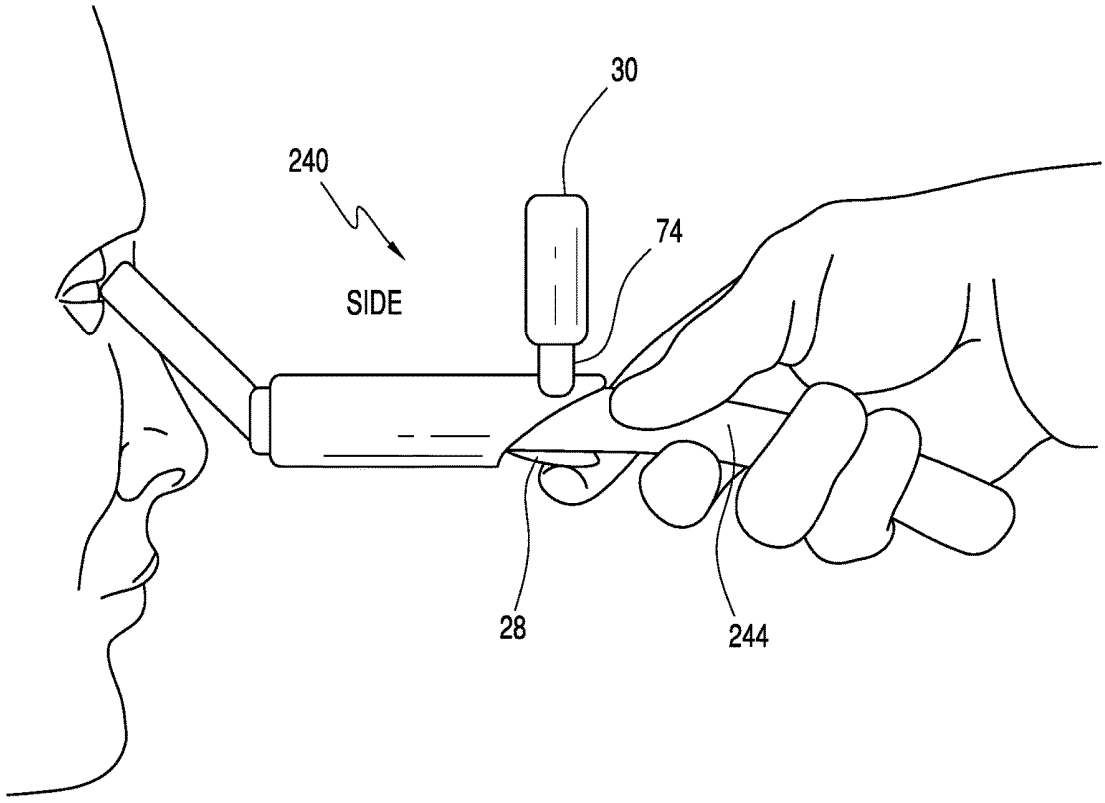

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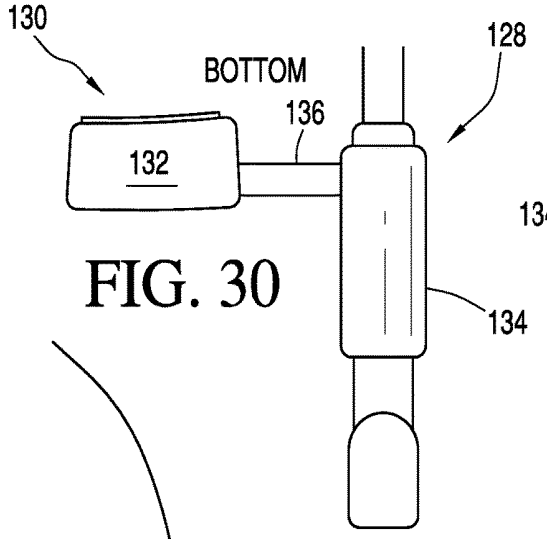

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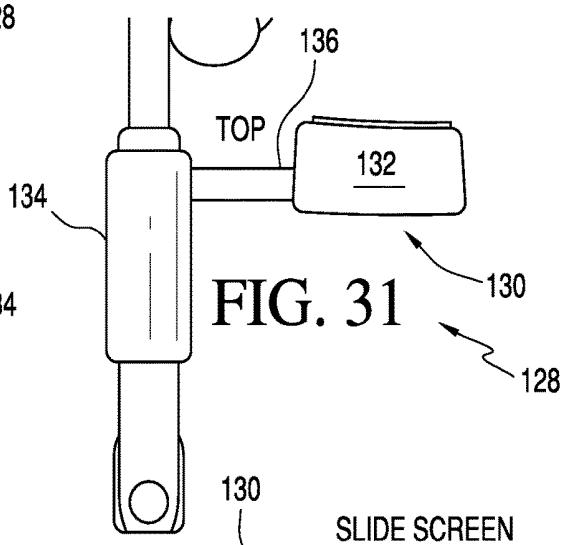

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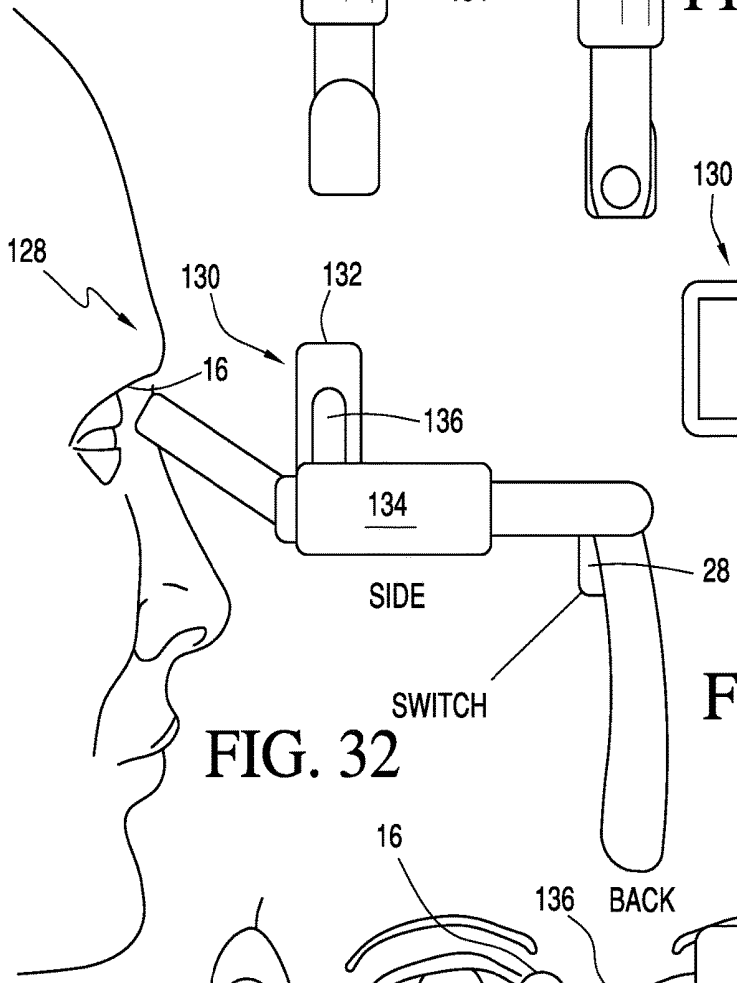

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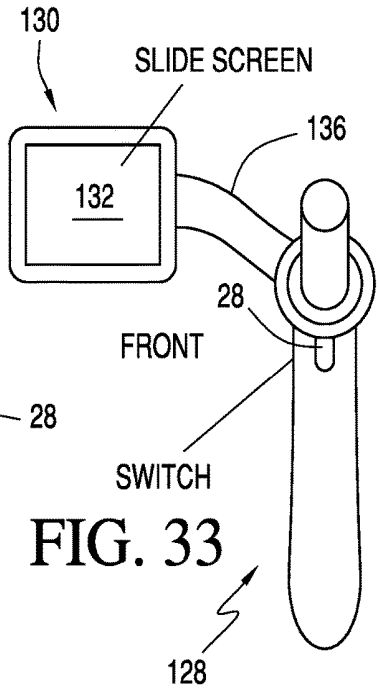

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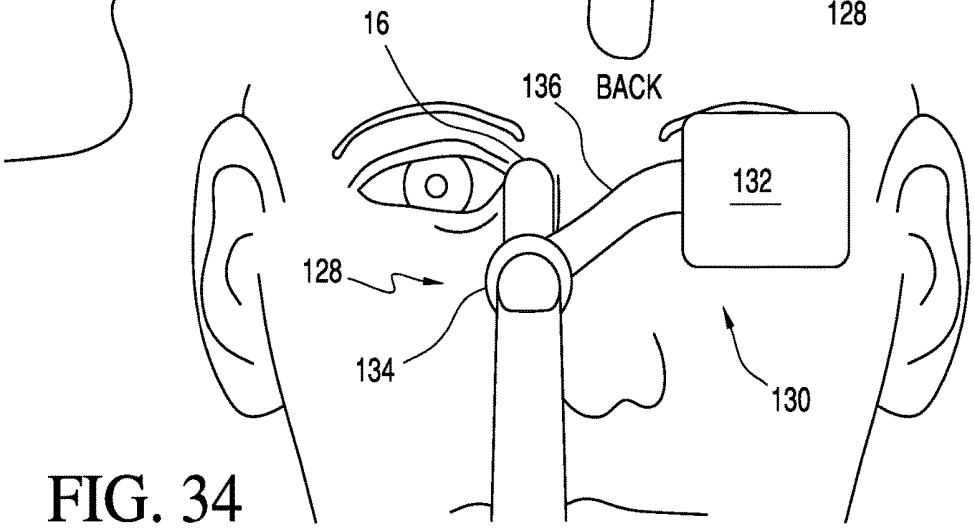

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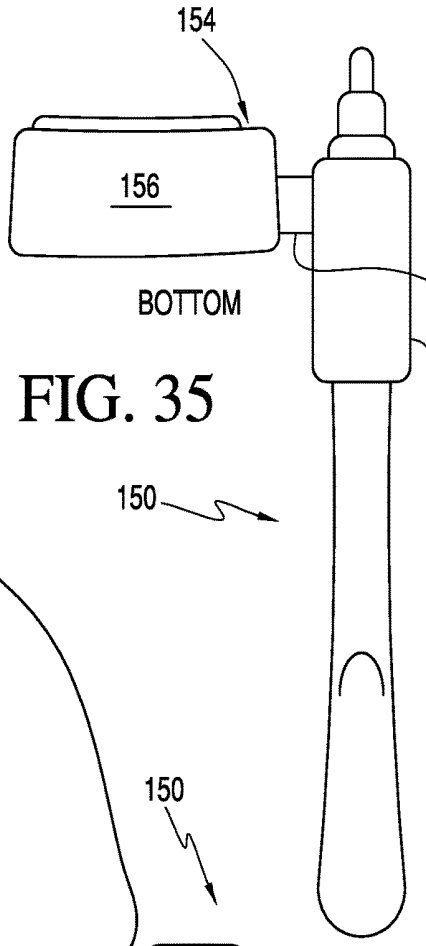

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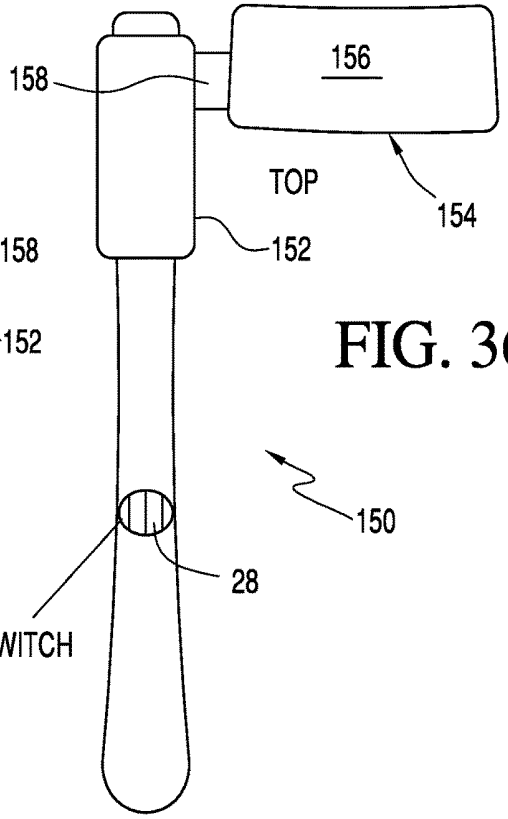

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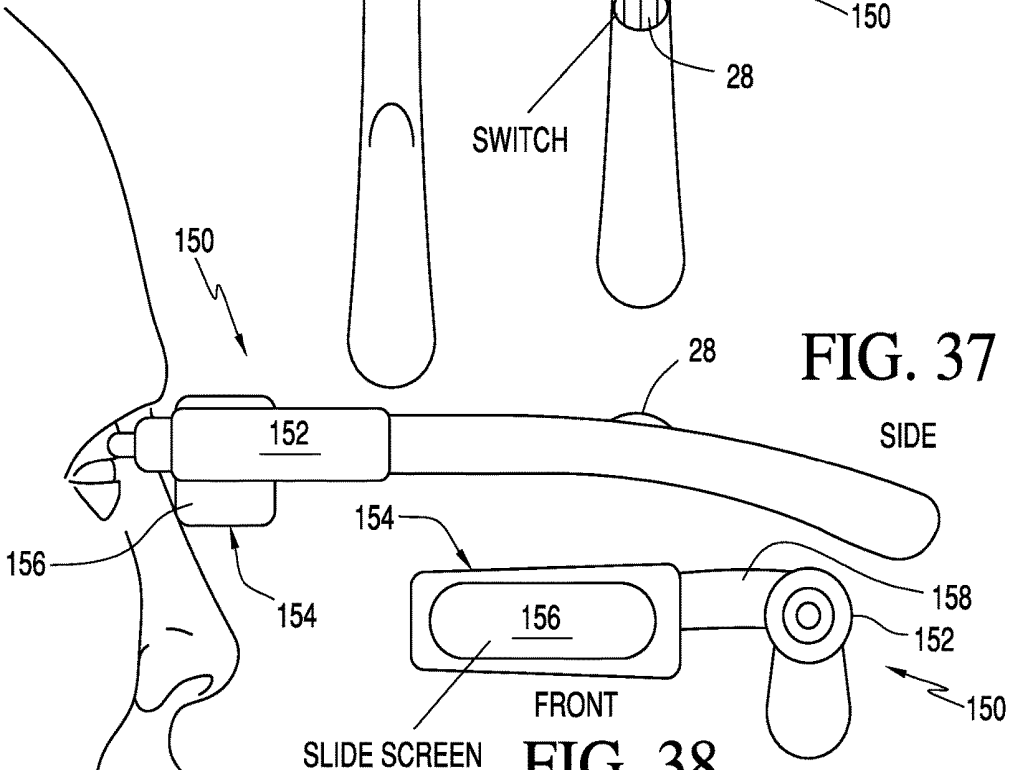
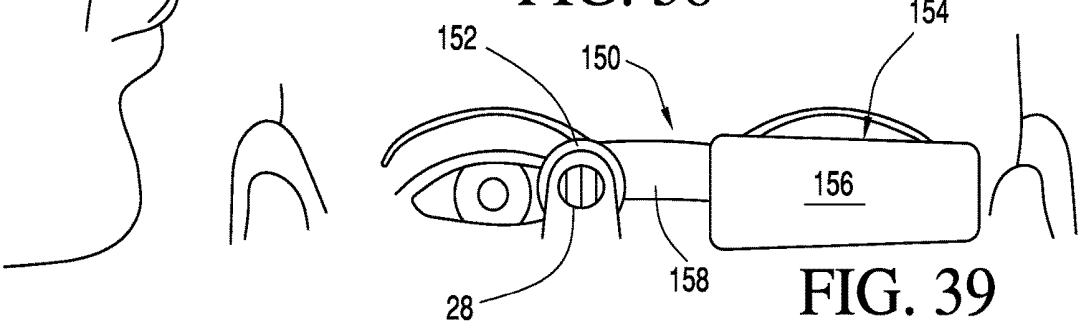


FIG. 37

FIG. 38



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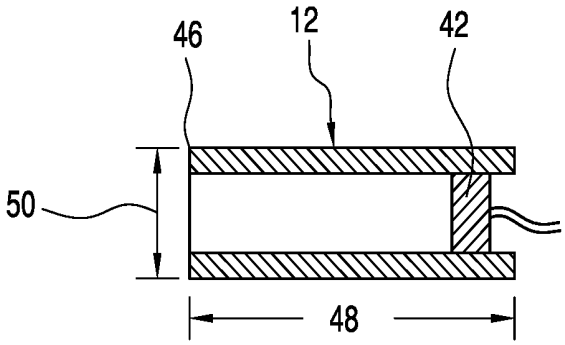

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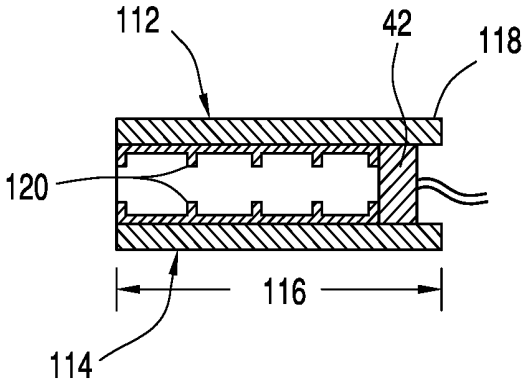

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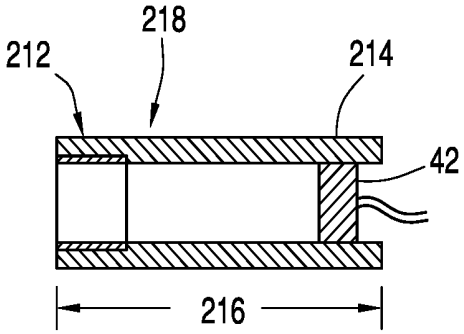

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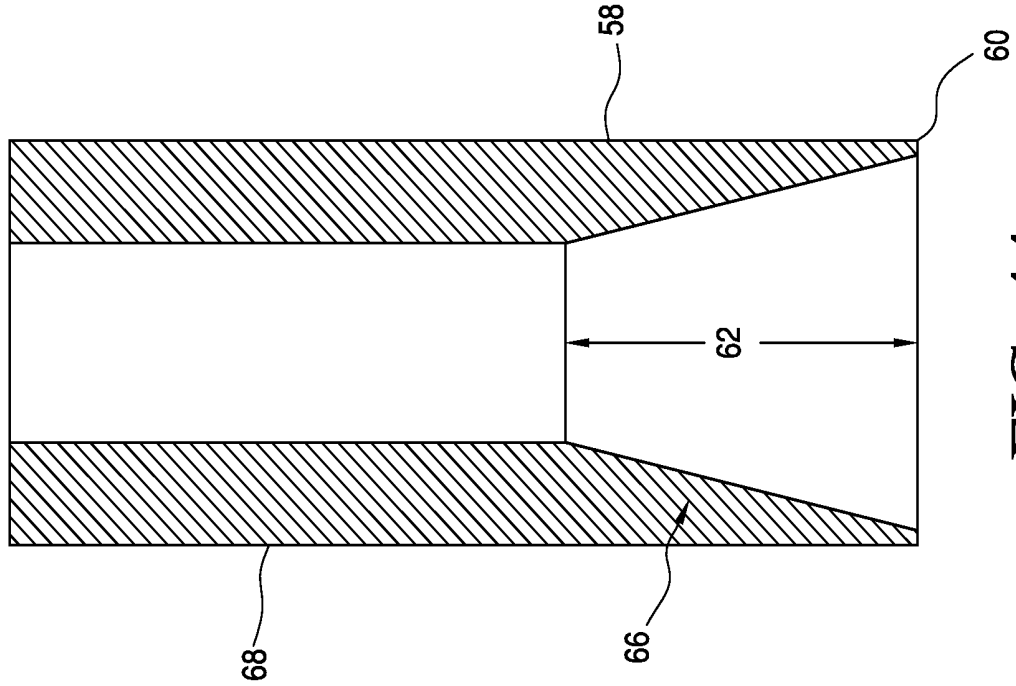

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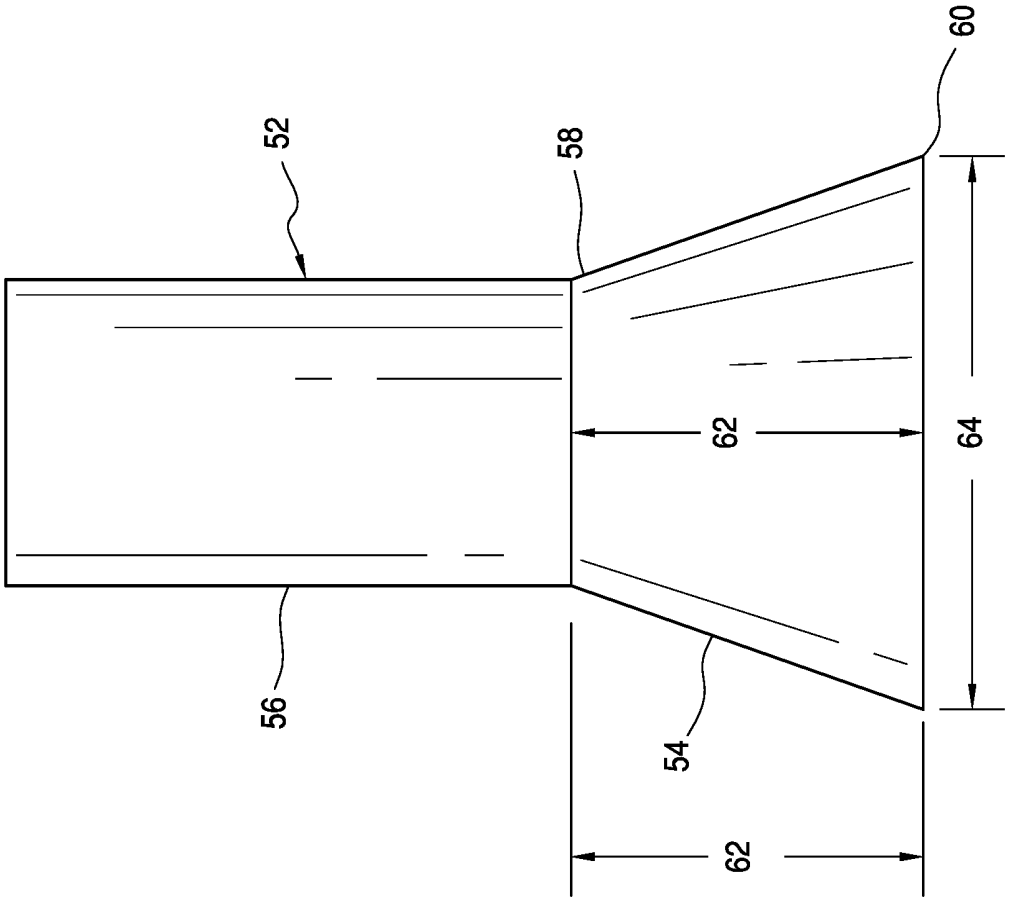

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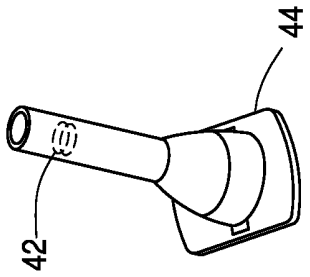

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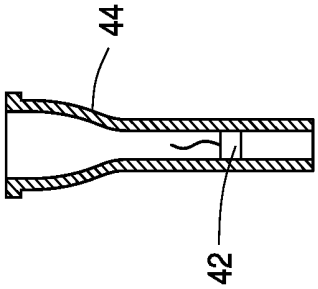

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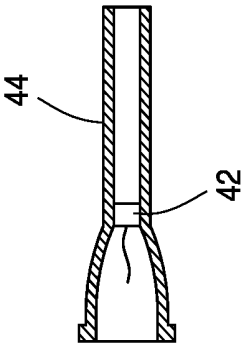

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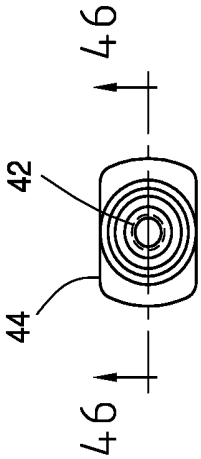

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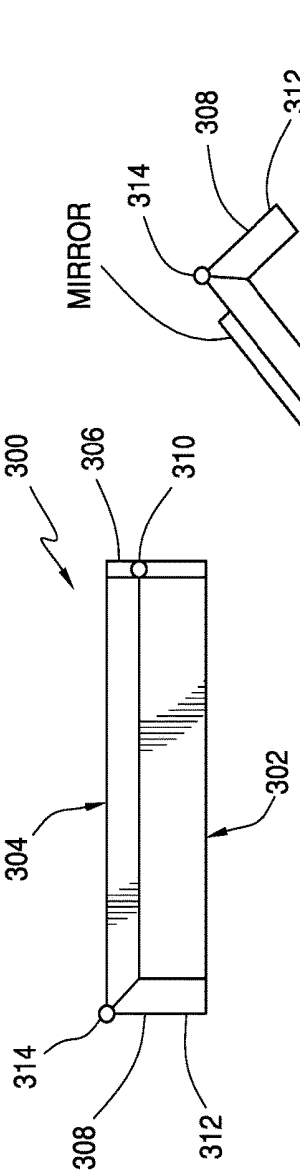

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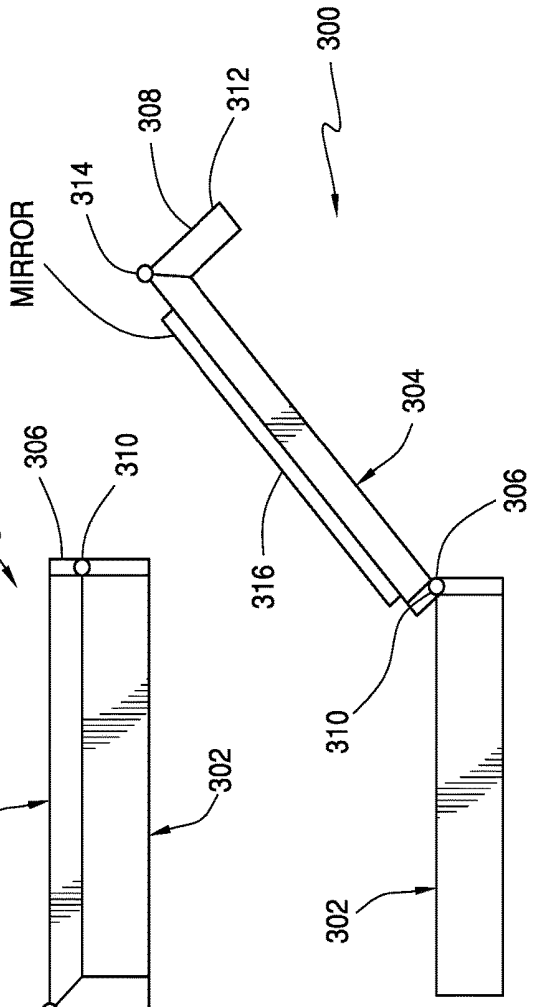


FIG. 50

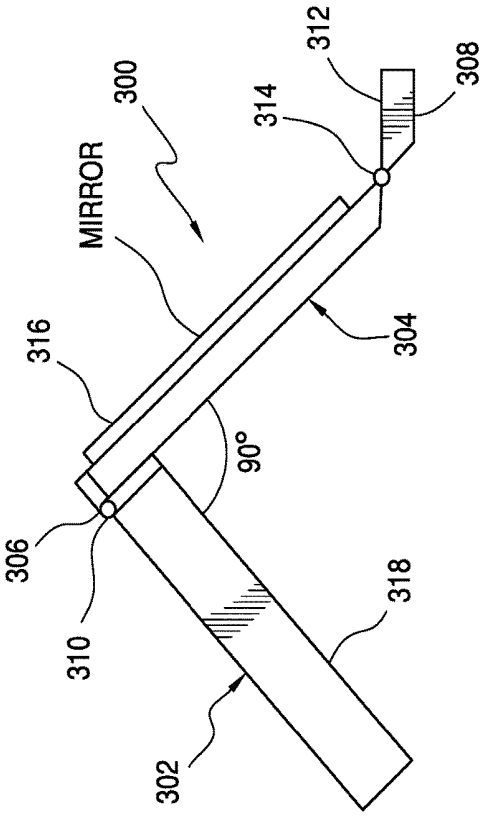


FIG. 51

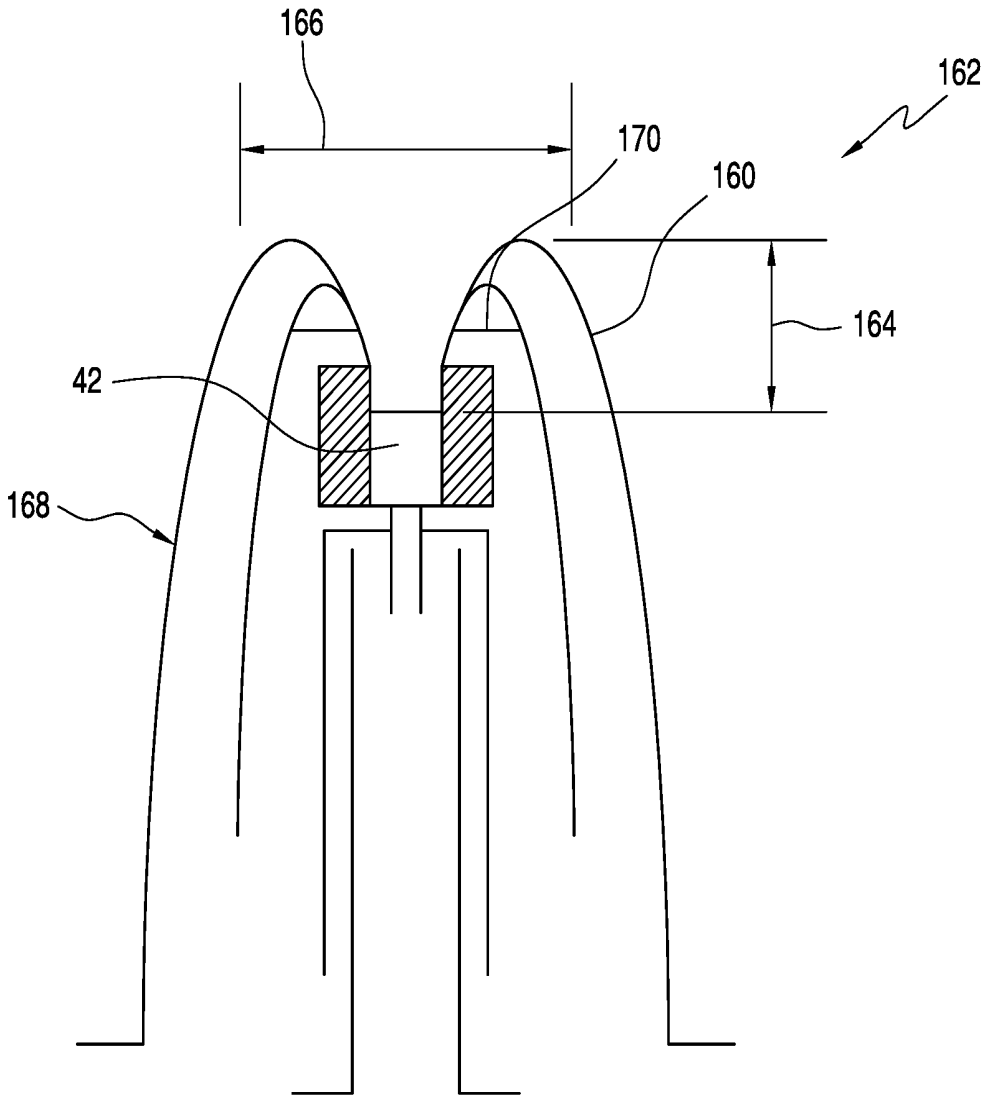
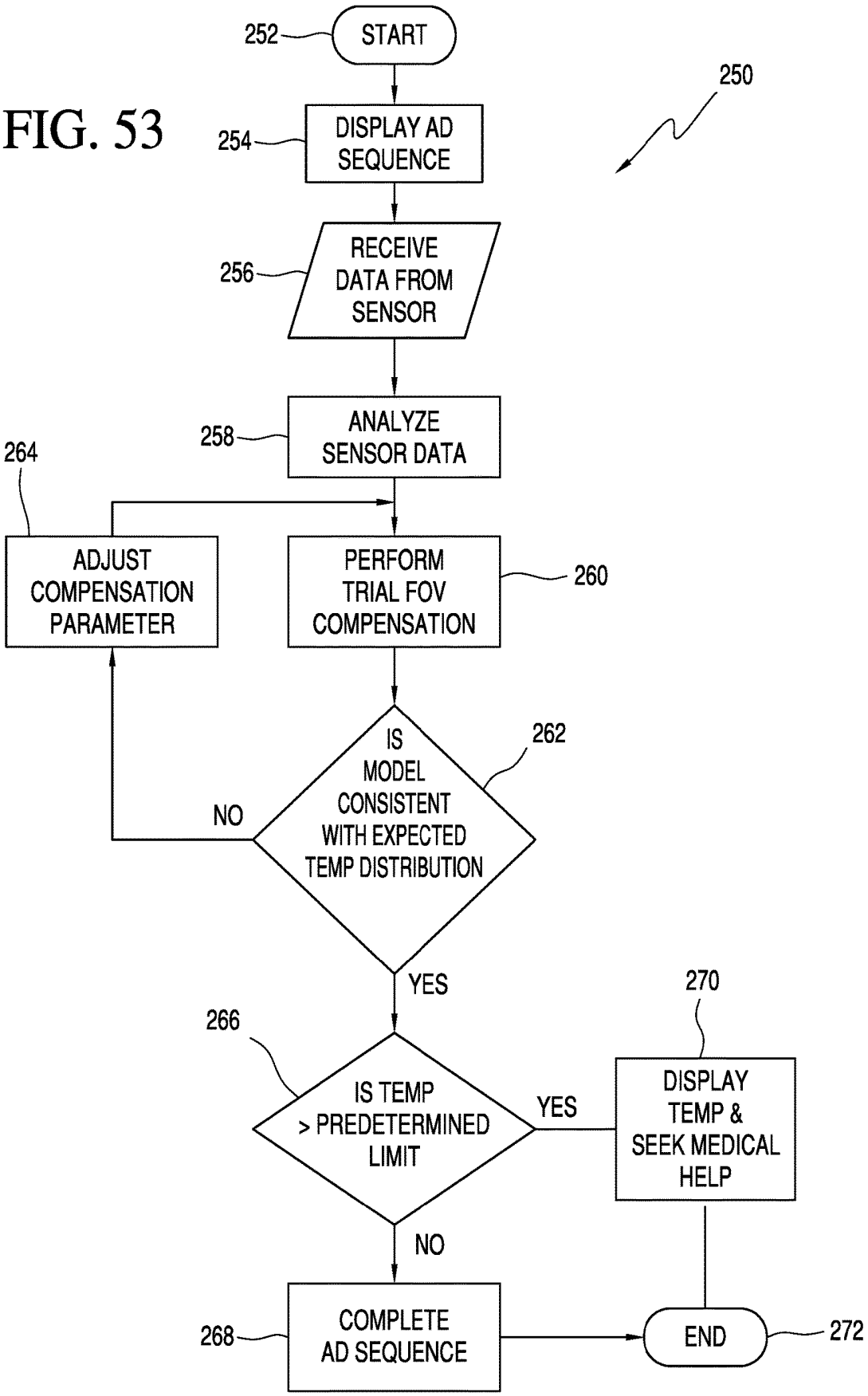


FIG. 52

FIG. 53


252
START
250
254
DISPLAY AD SEQUENCE
256
RECEIVE DATA FROM SENSOR
258
ANALYZE SENSOR DATA
264
ADJUST COMPENSATION PARAMETER
PERFORM TRIAL FOV COMPENSATION
260
262
IS MODEL CONSISTENT WITH EXPECTED TEMP DISTRIBUTION
NO
YES
270
266
IS TEMP > PREDETERMINED LIMIT
YES
DISPLAY TEMP & SEEK MEDICAL HELP
NO
268
COMPLETE AD SEQUENCE
END
272

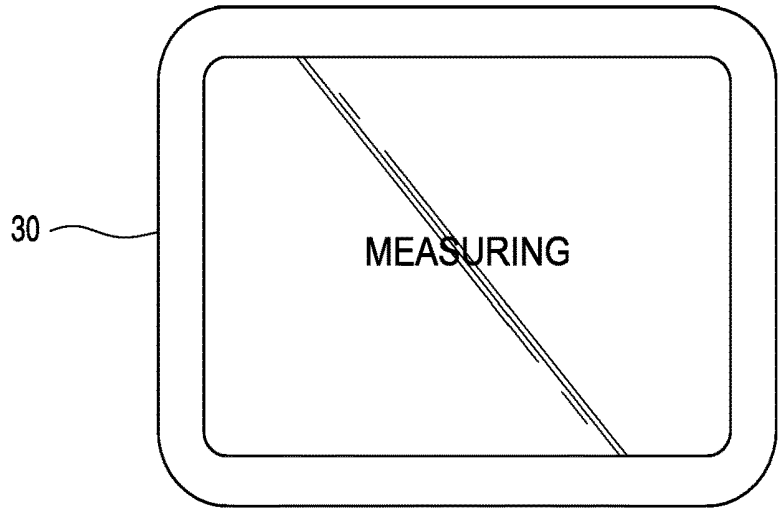


FIG. 54

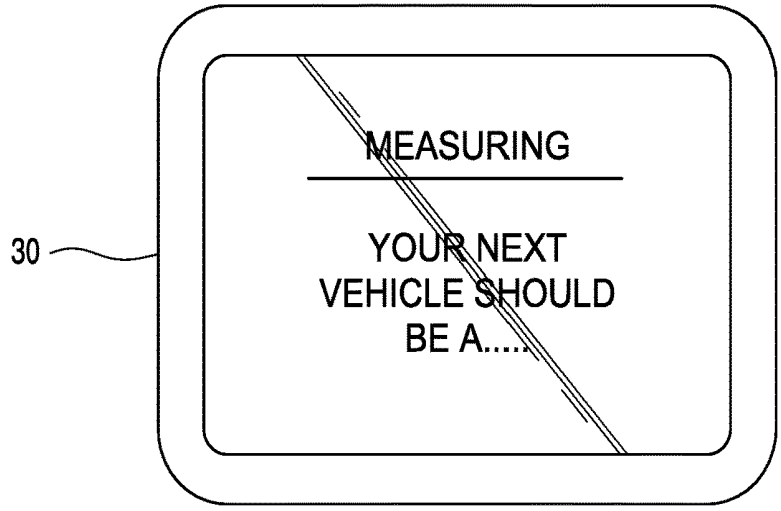


FIG. 55

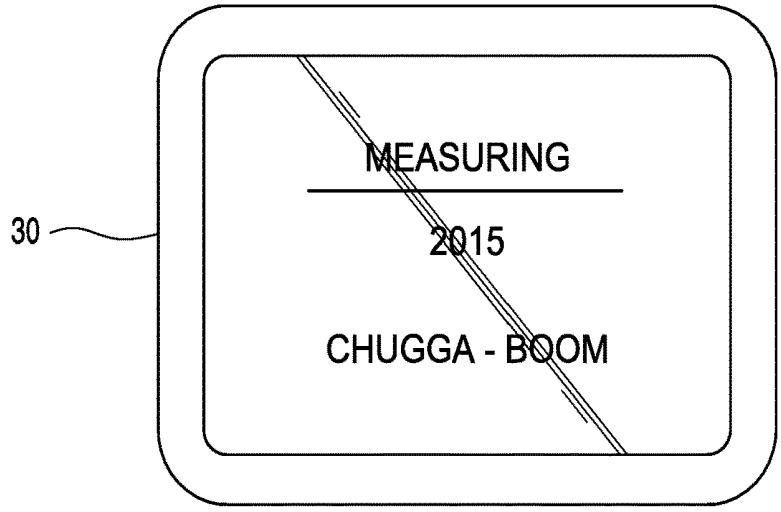


FIG. 56

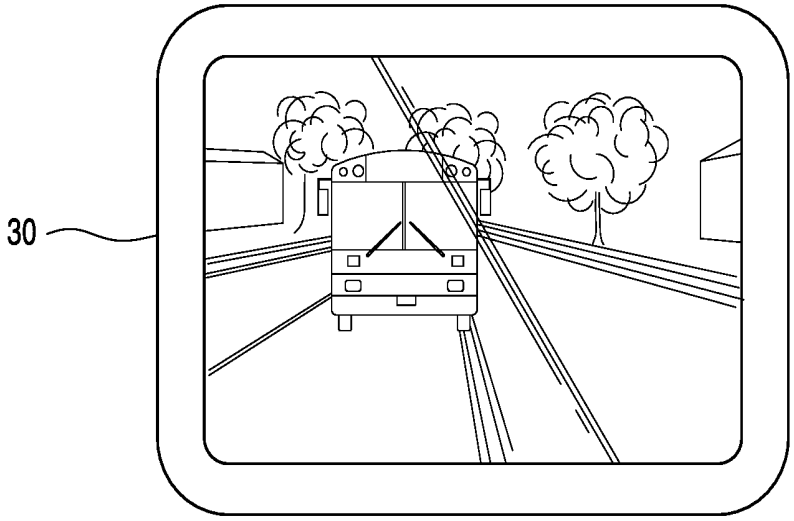

30

FIG. 57

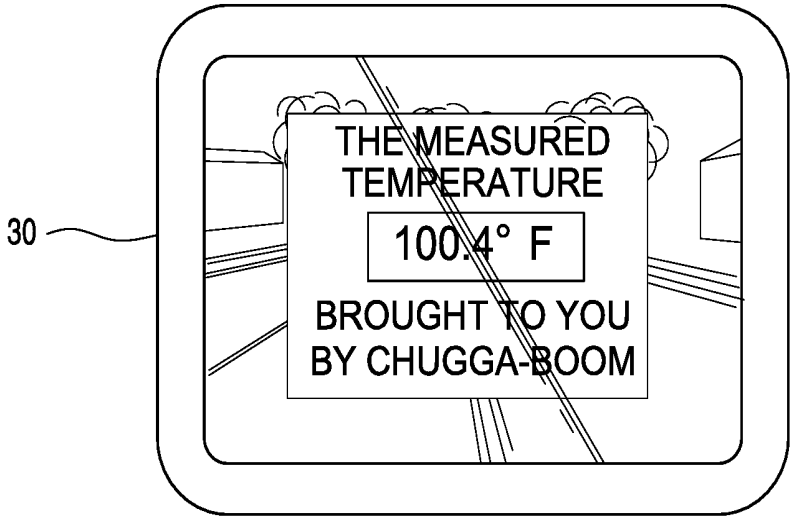

30
THE MEASURED TEMPERATURE
100.4° F
BROUGHT TO YOU BY CHUGGA-BOOM

FIG. 58

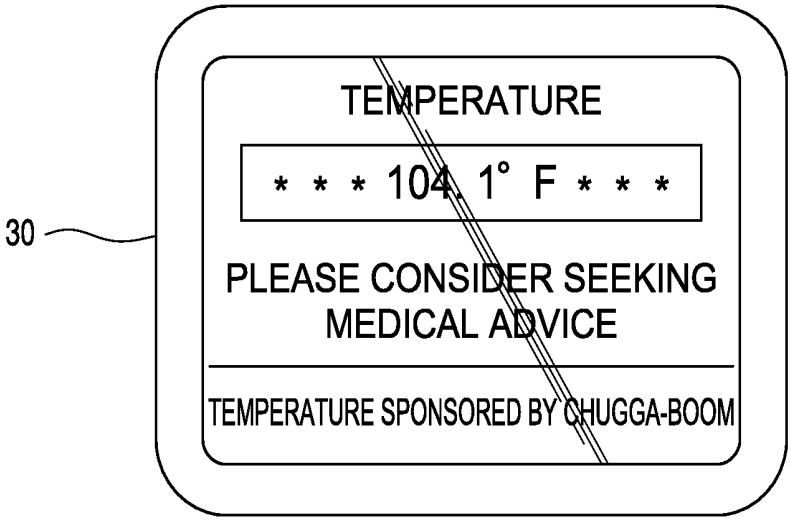

30
TEMPERATURE
* * * 104.1° F * * *
PLEASE CONSIDER SEEKING MEDICAL ADVICE
TEMPERATURE SPONSORED BY CHUGGA-BOOM

FIG. 59

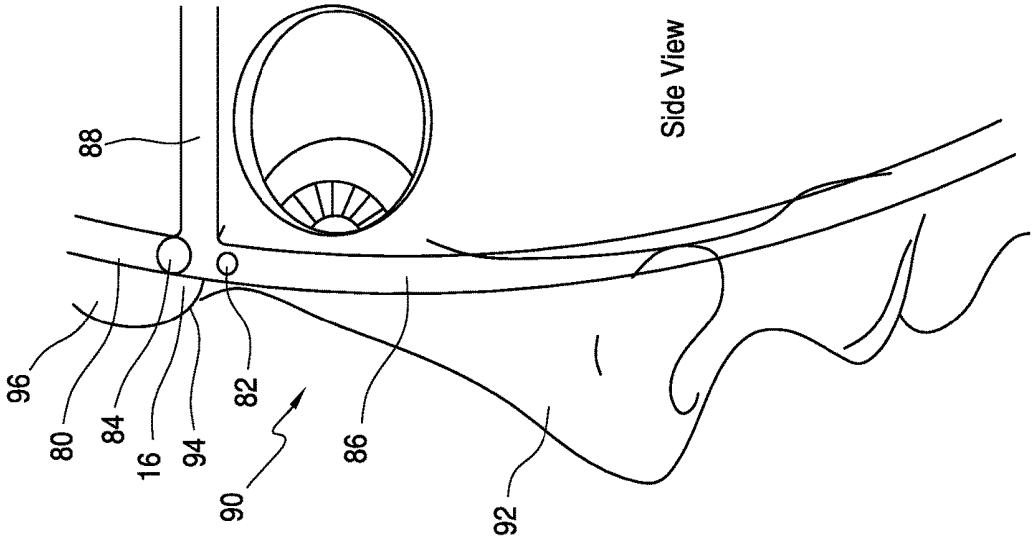

Side View
88
96
80
84
16
94
82
90
86
92

FIG. 61

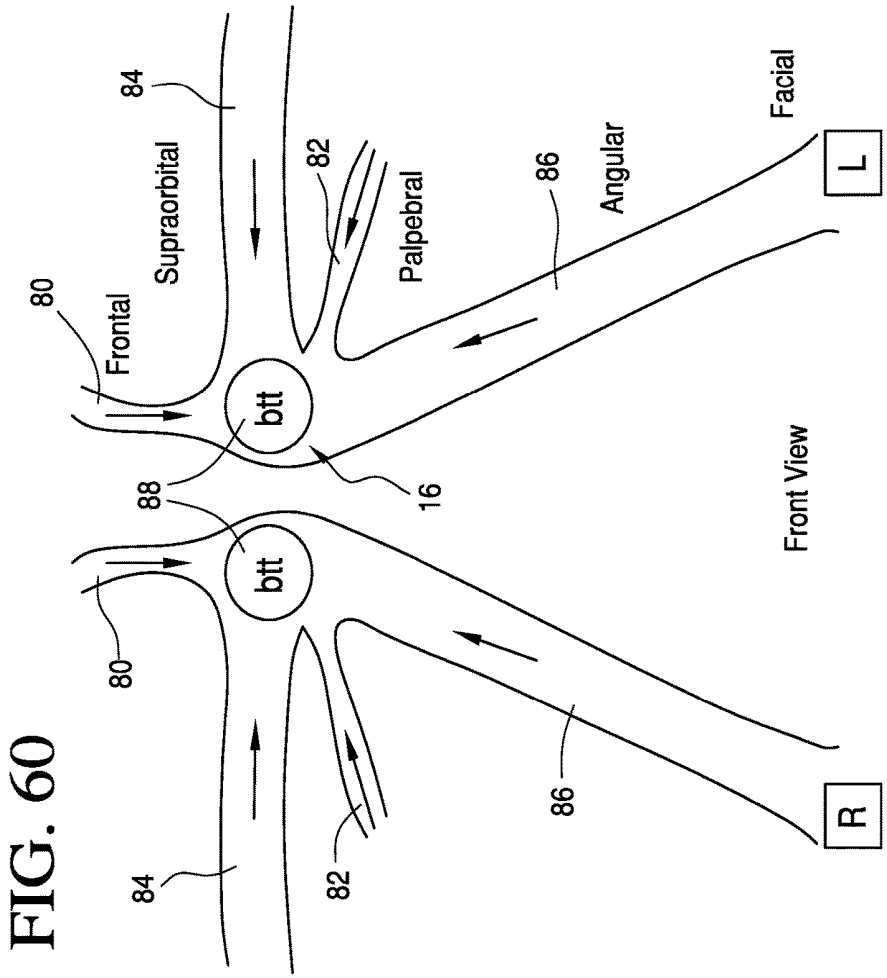

Front View
84
Supraorbital
82
Palpebral
86
Angular
Facial
L
80
Frontal
btt
88
16
btt
80
84
82
86
R

FIG. 60

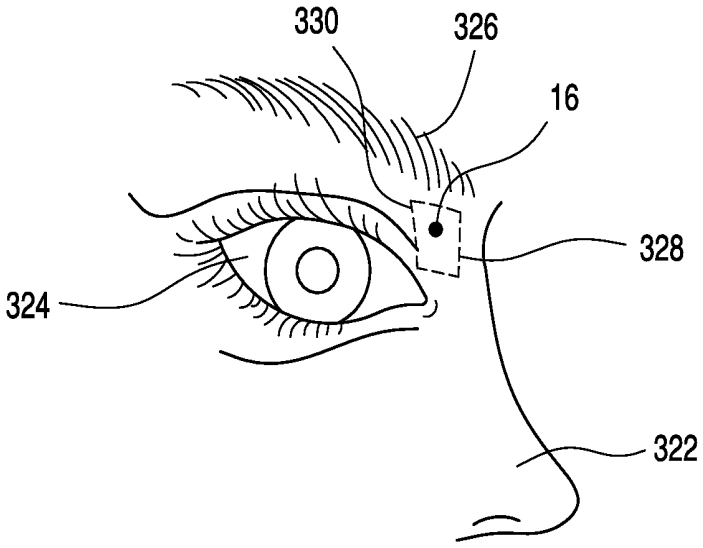


FIG. 62

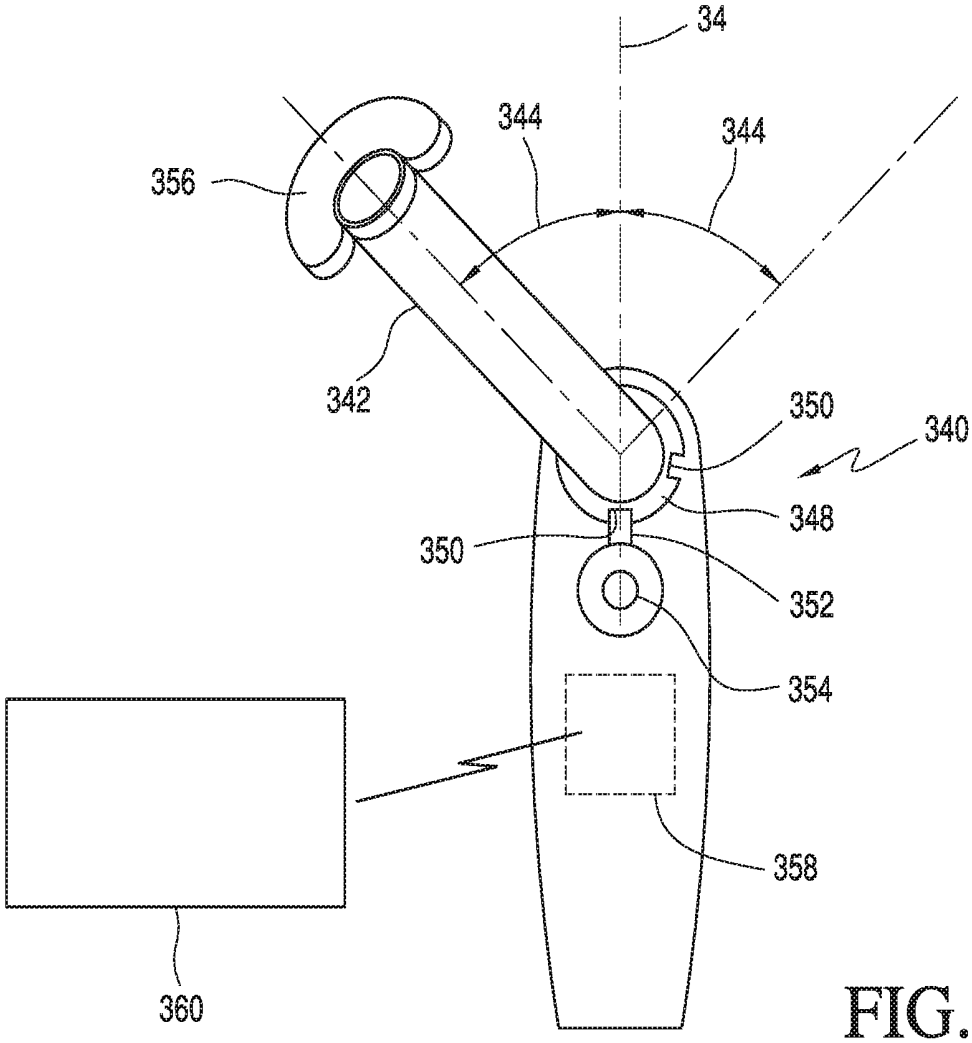


FIG. 63

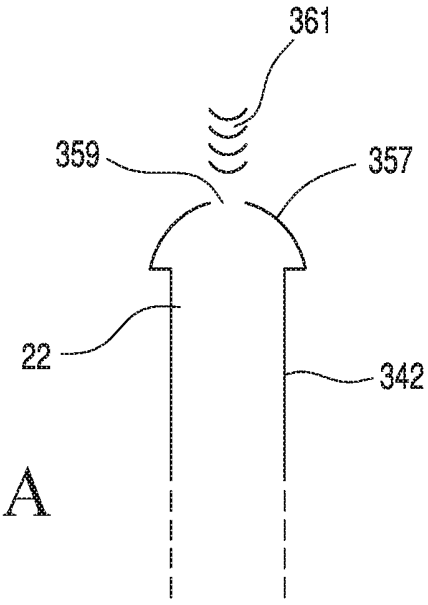


FIG. 63A

FIG. 63B

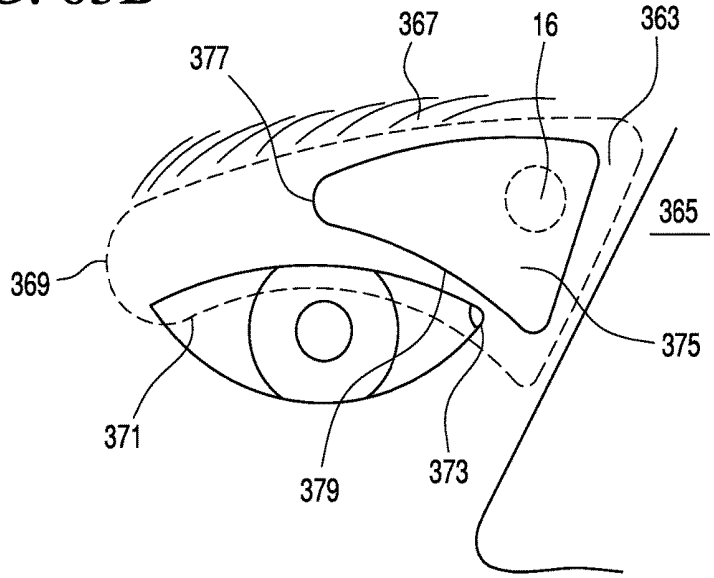


FIG. 63C

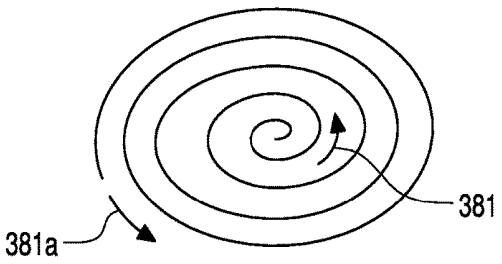
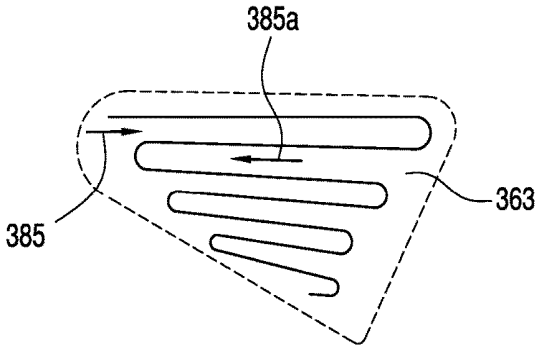


FIG. 63E



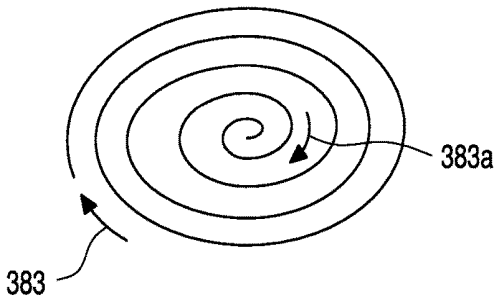


FIG. 63D

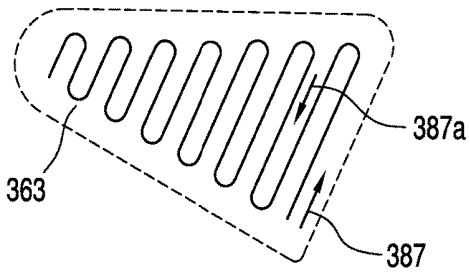


FIG. 63F

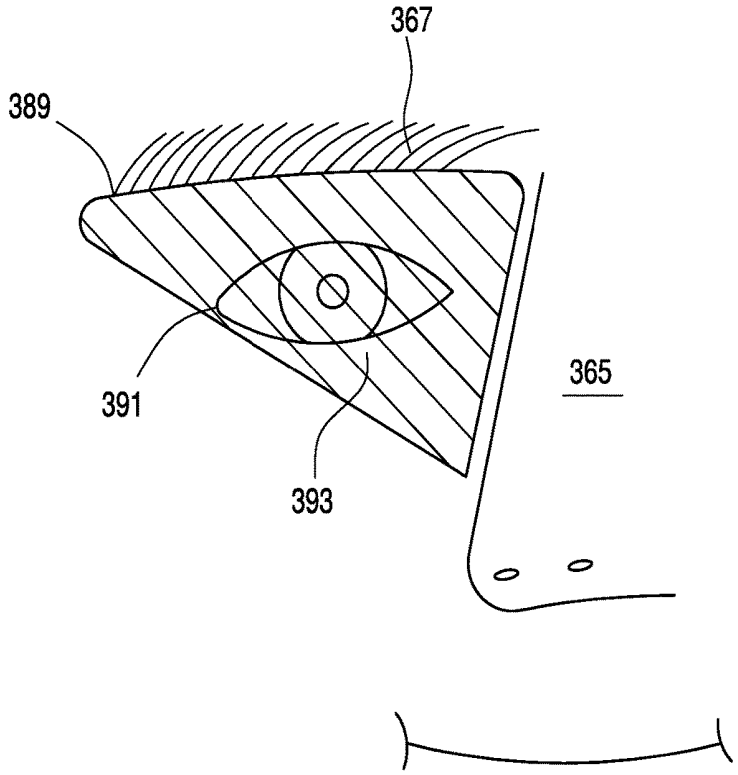
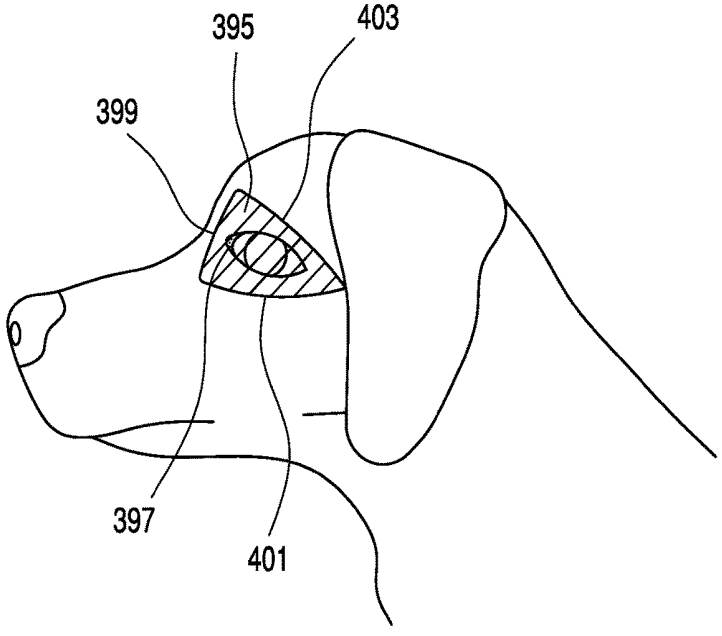


FIG. 63G

FIG. 63H



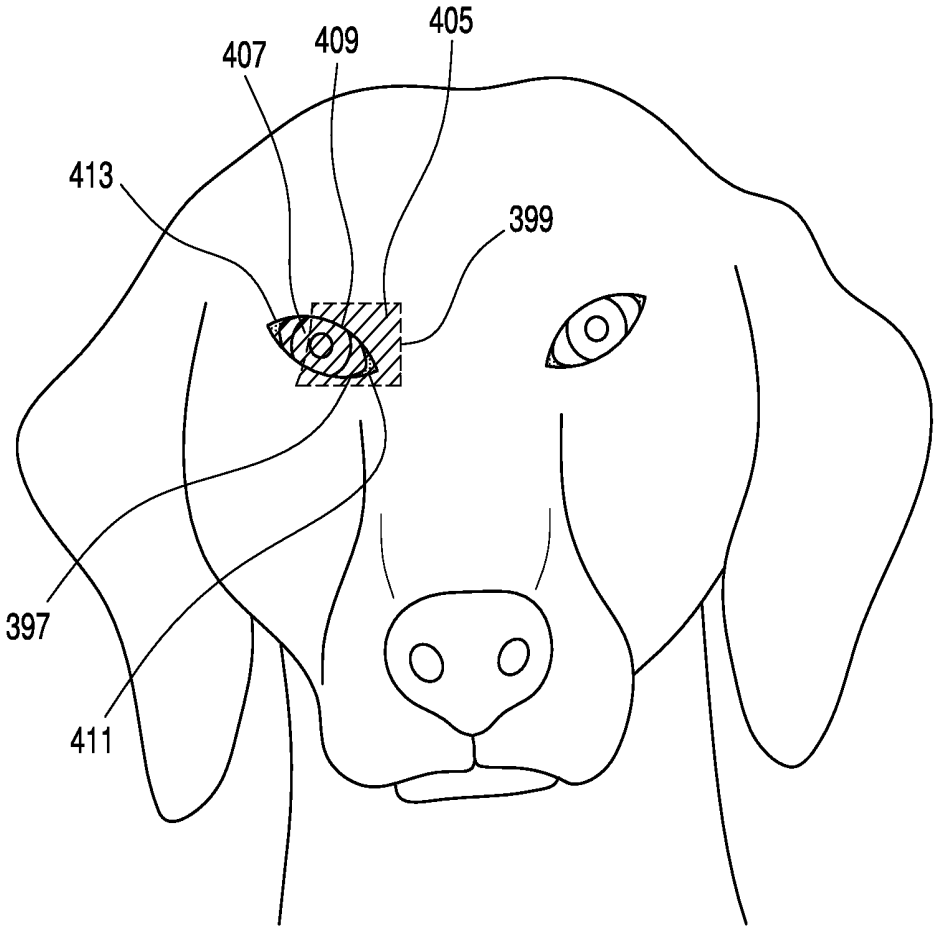


FIG. 63I

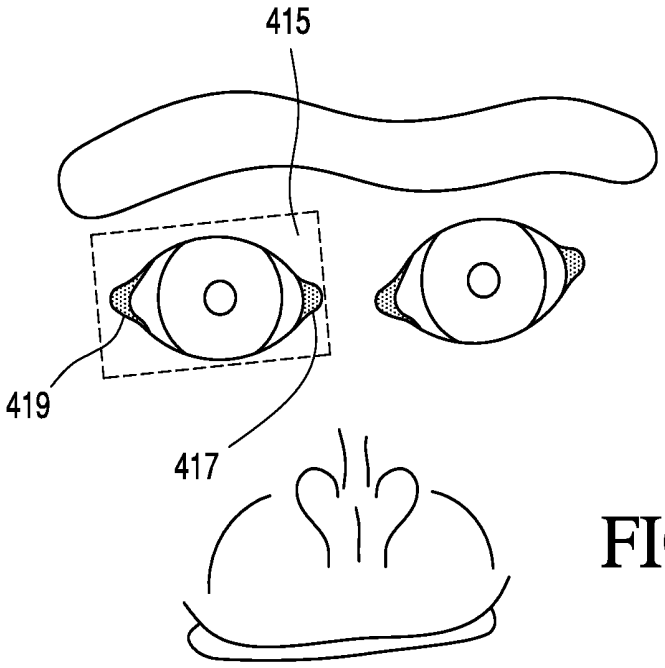


FIG. 63J

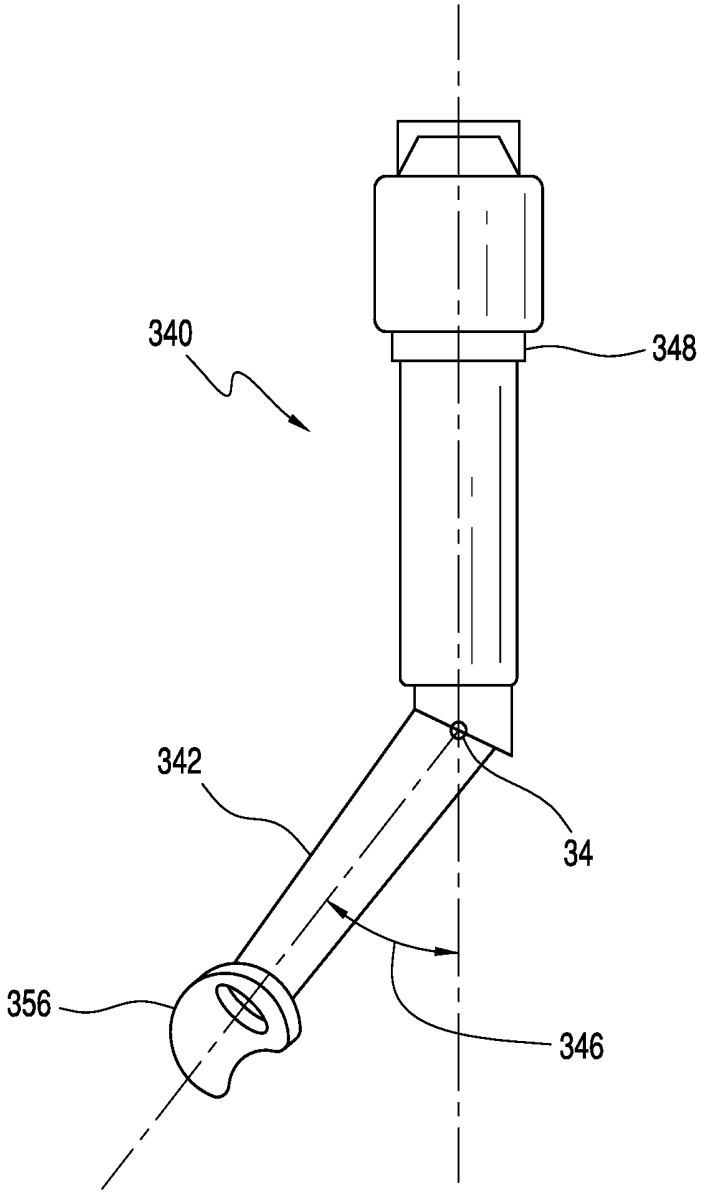


FIG. 64

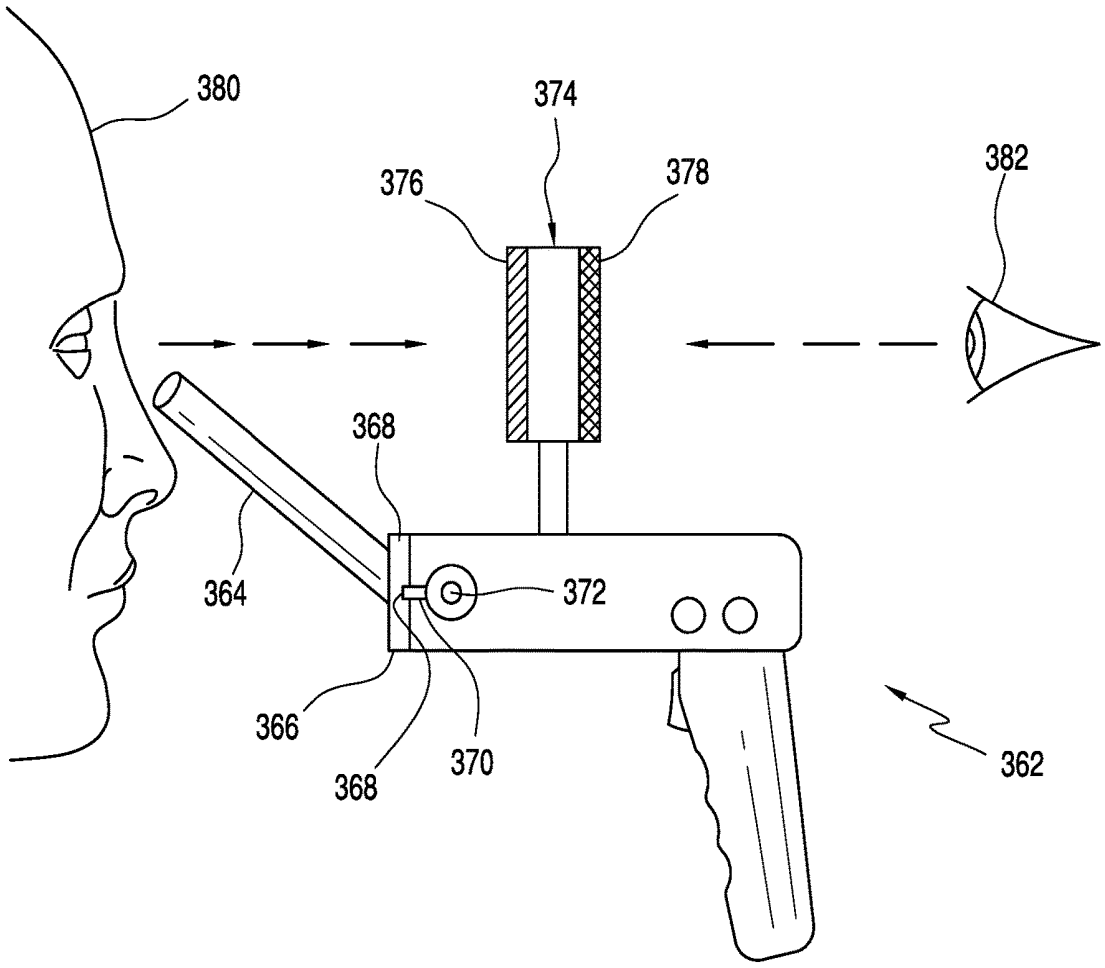


FIG. 65

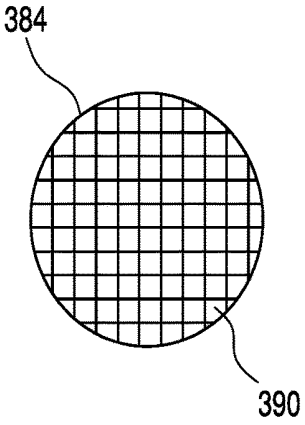


FIG. 66A

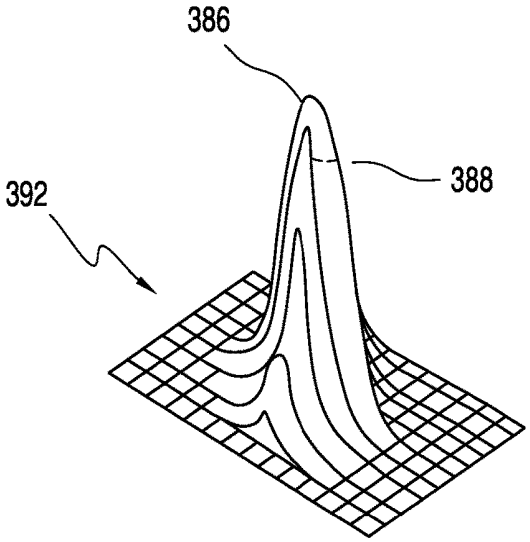


FIG. 66B

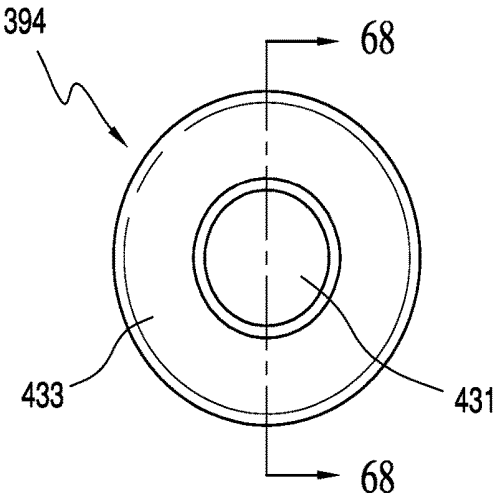


FIG. 67

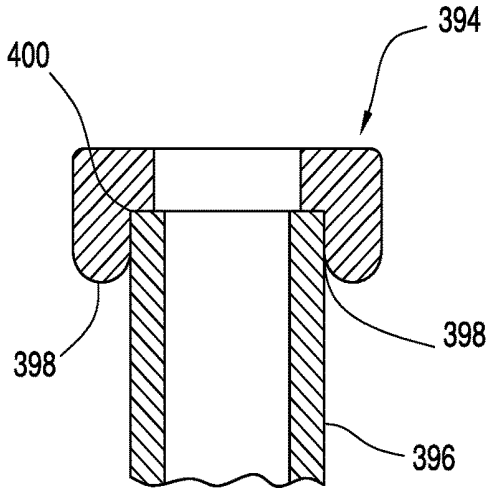


FIG. 68

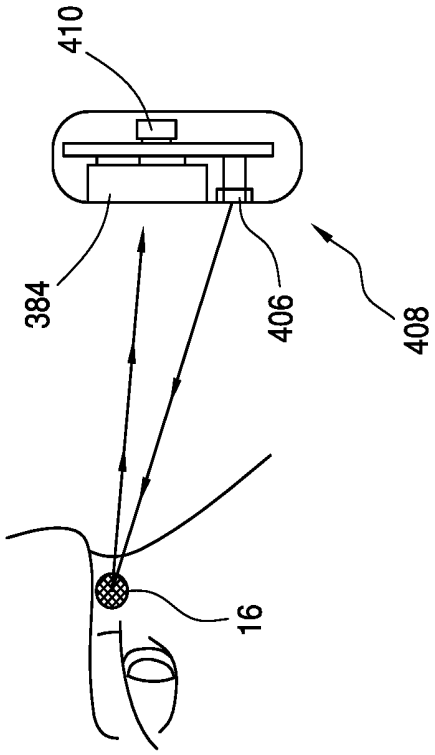


FIG. 70

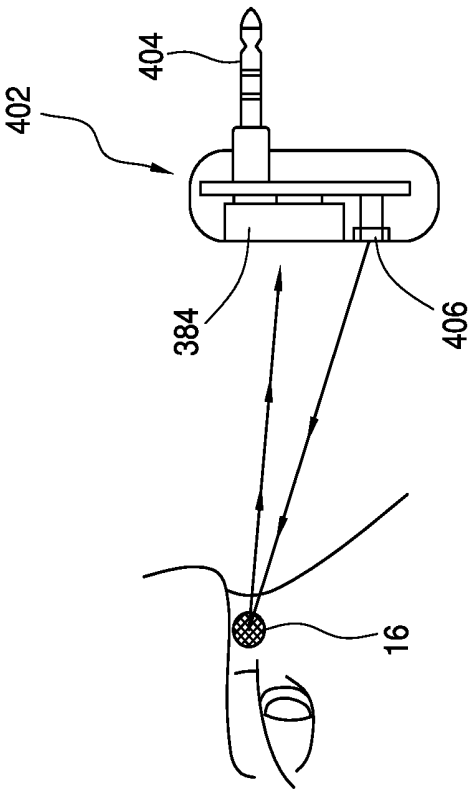


FIG. 69

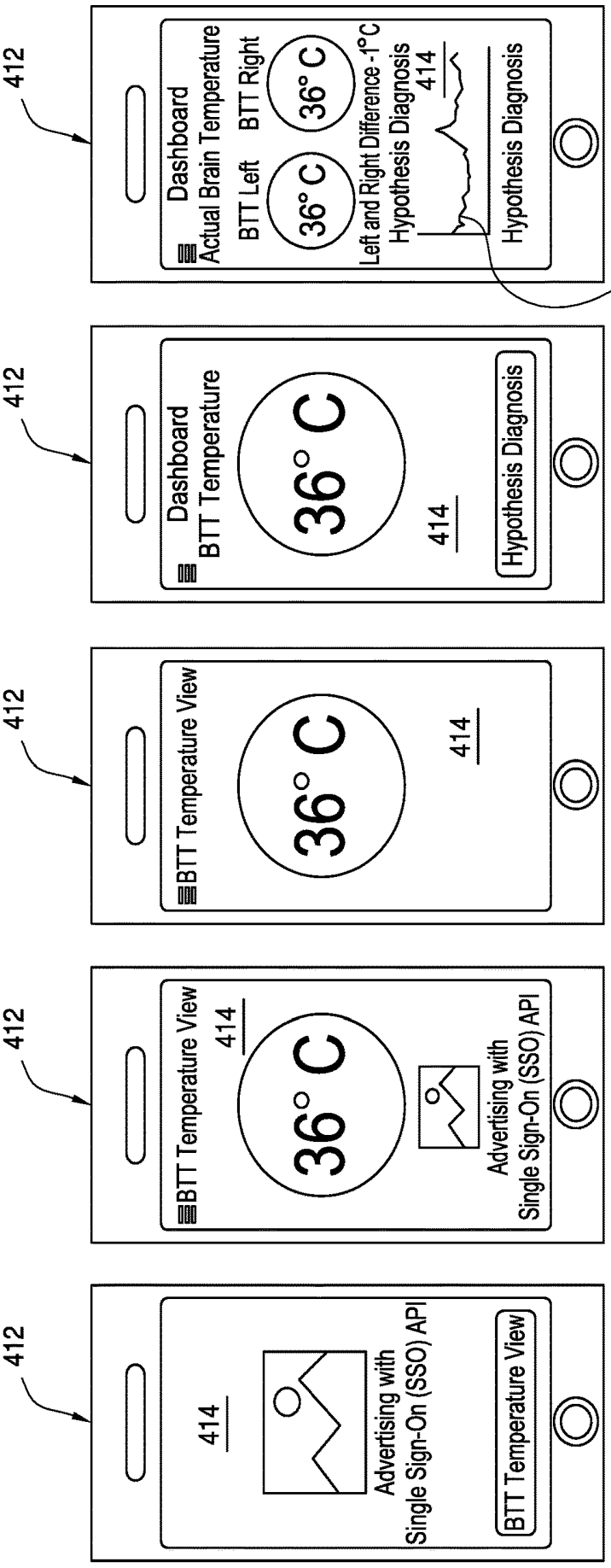


FIG. 71

FIG. 72

FIG. 73

FIG. 74

FIG. 75

DEVICE FOR MEASURING THE INFRARED OUTPUT OF THE ABREU BRAIN THERMAL TUNNEL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. patent application Ser. No. 14/593,848, filed Jan. 9, 2015 which claims the benefit of priority to U.S. Provisional Patent Application No. 61/926,155, filed on Jan. 10, 2014, which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

This disclosure relates to a medical device for monitoring biological parameters.

BACKGROUND

Diagnostics for measuring and monitoring an array of biological parameters exist. Among the many biological parameters that can be measured are pulse, blood pressure, heart function (EKG), brain function (EEG), temperature, etc.

SUMMARY

This disclosure provides a sensing device configured to interface with a human Abreu brain thermal tunnel (ABTT) terminus. The sensing device comprises a body portion, a handle portion, a viewing portion, and a sensing portion. The body portion includes a first end and a second end. The handle portion is positioned on the second end of the body portion. The viewing portion is positioned on the body portion, and the viewing portion includes a display. The sensing portion includes a sensor positioned on the first end of the body portion, and the sensing portion includes a free end. The free end is configured to receive a signal from the ABTT terminus, and having a field of view to capture at least the signal from a center portion of the ABTT terminus.

This disclosure also provides a sensing device configured to interface with a human Abreu brain thermal tunnel (ABTT) terminus. The sensing device comprises a body portion, a handle portion, a viewing portion, and a sensing portion. The body portion includes a first end and a second end. The handle portion is positioned on the second end of the body portion. The viewing portion is positioned on the body portion, and the viewing portion includes a display. The sensing portion includes an infrared sensor positioned on the first end of the body portion. The sensing portion includes a free end and is configured to allow positioning of the free end to receive infrared energy from the ABTT terminus, and includes a field of view to capture at least the infrared energy from a center portion of the ABTT terminus.

This disclosure also provides a sensing device configured to interface with a human Abreu brain thermal tunnel (ABTT) terminus. The sensing device comprises a body portion, a handle portion, a sensing portion, and a display. The body portion includes a first end and a second end. The handle portion is positioned on the second end of the body portion. The sensing portion includes an infrared sensor positioned on the first end of the body portion. The sensing portion includes a free end and is configured to allow positioning of the free end to receive infrared energy from the ABTT terminus, and includes a field of view to capture at least the infrared energy from a center portion of the ABTT terminus. The display is positioned on a separate electronic device configured to display data related to the infrared energy captured by the infrared sensor. The display is configured to present an advertisement while the infrared sensor receives infrared energy.

Advantages and features of the embodiments of this disclosure will become more apparent from the following detailed description of exemplary embodiments when viewed in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a sensing device in accordance with an exemplary embodiment of the present disclosure, with a handle portion in a first position.

FIG. **2** is a side view of the sensing device of FIG. **1**, with the handle portion in a second position.

FIG. **3** is an end view of the sensing device of FIG. **1**, with the handle portion in a third position.

FIG. **4** is an end view similar to FIG. **3**, with the handle portion in the first position of FIG. **1**.

FIG. **5** is an end view of the sensing device of FIG. **3**, shown from an end of the sensing device opposite the end shown in FIG. **3**.

FIG. **6** is an end view of the sensing device of FIG. **4**, shown from an end of the sensing device opposite the end shown in FIG. **4**.

FIG. **7** is a top view of the sensing device of FIG. **2**.

FIG. **8** is a top view of the sensing device of FIG. **1**.

FIG. **9** is a bottom view of the sensing device of FIG. **1**.

FIG. **10** is a top view of the sensing device of FIGS. **3** and **5**.

FIG. **11** is a view of the sensing device similar to the view of FIG. **2**, with the handle portion rotated by 90 degrees about an axis of the sensing device.

FIG. **12** is a side view of the sensing device of FIGS. **3** and **5**.

FIG. **13** is a side view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **14** is a front view of the sensing device of FIG. **13**.

FIG. **15** is a back view of the sensing device of FIG. **13**.

FIG. **16** is a top view of the sensing device of FIG. **13**, without a nose interface portion.

FIG. **17** is a bottom view of the sensing device of FIG. **13**, without the nose interface portion.

FIG. **18** is a side view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **19** is a front view of the sensing device of FIG. **18**.

FIG. **20** is a back view of the sensing device of FIG. **18**.

FIG. **21** is a top view of the sensing device of FIG. **18**.

FIG. **22** is a bottom view of the sensing device of FIG. **18**.

FIG. **23** is a side view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **24** is a front view of the sensing device of FIG. **23**.

FIG. **25** is a back view of the sensing device of FIG. **23**.

FIG. **26** is a top view of the sensing device of FIG. **23**.

FIG. **27** is a bottom view of the sensing device of FIG. **23**.

FIG. **27A** is a side view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **28** is a side view of the sensing device of FIG. **23** in operation.

FIG. **29** is a side view of the sensing device of FIG. **23** in operation.

FIG. **30** is a bottom view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **31** is a top view of the sensing device of FIG. **30**.

FIG. **32** is a side view of the sensing device of FIG. **30**.

FIG. **33** is a front view of the sensing device of FIG. **30**.

FIG. **34** is a back view of the sensing device of FIG. **30**.

FIG. **35** is a bottom view of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **36** is a top view of the sensing device of FIG. **35**.

FIG. **37** is a side view of the sensing device of FIG. **35**.

FIG. **38** is a front view of the sensing device of FIG. **35**.

FIG. **39** is a back view of the sensing device of FIG. **35**.

FIG. **40** is a sectional view of a sensing portion along the line **40-40** in FIG. **9** in accordance with an exemplary embodiment of the present disclosure.

FIG. **41** is a sectional view of another sensing portion similar to the sectional view of FIG. **40** in accordance with an exemplary embodiment of the present disclosure.

FIG. **42** is a sectional view of another sensing portion similar to the sectional view of FIG. **40** in accordance with an exemplary embodiment of the present disclosure.

FIG. **43** is a view of a cylindrical structure of a sensing portion in accordance with an exemplary embodiment of the present disclosure.

FIG. **44** is a sectional view of a cylindrical structure of a sensing portion in accordance with an exemplary embodiment of the present disclosure.

FIG. **45** is an end view of a wave guide in accordance with an exemplary embodiment of the present disclosure.

FIG. **46** cross-sectional view of the wave guide of FIG. **45** along the line **46-46**.

FIG. **47** is a cross-section view similar to FIG. **46**, showing the infrared sensor is a position different from FIG. **46**.

FIG. **48** is a partially sectioned view of a wave guide similar to the wave guide of FIG. **45**, showing the infrared sensor in a position different from FIGS. **46** and **47**.

FIG. **47** is a perspective end view of the wave guide of FIG. **45**.

FIG. **48** is a perspective end view of the wave guide of FIG. **45** from an opposite end shown in FIG. **47**.

FIG. **49** is a side view of a transport container in accordance with an exemplary embodiment of the present disclosure.

FIG. **50** is a side view of the transport container of FIG. **49** in an open position.

FIG. **51** is a side view of the transport container of FIG. **49** with a lid portion supporting the transport container.

FIG. **52** is a view of a wave guide in accordance with an exemplary embodiment of the present disclosure.

FIG. **53** is a sensing process in accordance with an exemplary embodiment of the present disclosure.

FIG. **54** is a viewing portion showing an indication of a measurement in accordance with an exemplary embodiment of the present disclosure.

FIG. **55** is the viewing portion of FIG. **54** showing a portion of an advertising sequence in accordance with an exemplary embodiment of the present disclosure.

FIG. **56** is the viewing portion of FIG. **54** showing another portion of an advertising sequence in accordance with an exemplary embodiment of the present disclosure.

FIG. **57** is the viewing portion of FIG. **54** showing yet another portion of an advertising sequence in accordance with an exemplary embodiment of the present disclosure.

FIG. **58** is the viewing portion of FIG. **54** showing a measured temperature in combination with a portion of an advertising sequence in accordance with an exemplary embodiment of the present disclosure.

FIG. **59** is the viewing portion of FIG. **54** showing a temperature with a recommendation to consider seeking medical advice in addition to a sponsor message in accordance with an exemplary embodiment of the present disclosure.

FIG. **60** is a simplified view of the ABTT and facial veins associated with the ABTT.

FIG. **61** is a simplified partial cross-sectional view through a human skull in a vertical direction, showing the Abreu brain thermal tunnel and certain other facial features.

FIG. **62** is a view of a face showing an ABTT terminus in an ABTT scan area.

FIG. **63** is an end view, which may be considered a front view, of a sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**A is a side view of a second free end of a sensing portion in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**B shows exemplary areas to be scanned to locate the ABTT terminus.

FIG. **63**C shows a first method of scanning for the ABTT terminus in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**D shows a second method of scanning for the ABTT terminus in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**E shows a third method of scanning for the ABTT terminus in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**F shows a fourth method of scanning for the ABTT terminus in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**G shows another exemplary area to be scanned to locate the ABTT terminus.

FIG. **63**H shows an exemplary scanning area for an animal in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**I shows another exemplary scanning area for an animal in accordance with an exemplary embodiment of the present disclosure.

FIG. **63**J shows yet another exemplary scanning area for an animal in accordance with an exemplary embodiment of the present disclosure.

FIG. **64** is a top view of the sensing device of FIG. **63**.

FIG. **65** is a view of another sensing device in accordance with an exemplary embodiment of the present disclosure.

FIG. **66**A is a view of an infrared sensor or detector array in accordance with an exemplary embodiment of the present disclosure.

FIG. **66**B is a stylized output of the infrared sensor array of FIG. **66**A.

FIG. **67** is a view of an extension positioned on a sensing portion in accordance with an exemplary embodiment of the present disclosure.

FIG. **68** is a view of the extension and sensing portion of FIG. **67** along the line **68-68**.

FIG. **69** is a view of a sensing device or apparatus configured to be attached to a separate device in accordance with an exemplary embodiment of the present disclosure.

FIG. **70** is a view of a sensing device or apparatus similar to the sensing device of FIG. **69**, only configured to communicate with a separate device wirelessly.

FIG. **71** is a view of a display of an electronic device in accordance with an exemplary embodiment of the present disclosure.

FIG. **72** is another view of the display of FIG. **71**, showing the result of a measurement.

FIG. **73** is a view of the display of FIG. **71**, in accordance with another exemplary embodiment of the present disclosure.

FIG. **74** is a view of the display of FIG. **71**, in accordance with yet another exemplary embodiment of the present disclosure.

FIG. **75** is a view of the display of FIG. **71**, in accordance with a further exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION

The most precise, accurate, and clinically useful way of evaluating thermal status of the body in humans and animals is by measuring brain temperature. Brain temperature measurement is the key and universal indicator of both disease and health equally, and is the only vital sign that cannot be artificially changed by emotional states. All the other measurable vital signs (e.g., heart rate, blood pressure, and respiratory rate) can be influenced and artificially changed by emotional states or voluntary effort. Currently, brain temperature is difficult to measure. However, the present disclosure describes a device that readily locates the Abreu brain thermal tunnel, described further hereinbelow, and is configured to provide a contact or non-contact temperature reading of the brain. Embodiments of the disclosed device enable an individual to measure their own temperature and enable medical professionals to measure the temperature of others.

Body temperature is determined by the temperature of blood, which emits heat as infrared radiation. Adipose tissue (i.e., fat tissue) absorbs infrared energy, and the body is virtually completely protected with a layer of adipose tissue adherent to the skin. Thus, conventional measurement of temperature on the skin has traditionally been imprecise and inaccurate because previous techniques used sensors placed on skin characterized by the presence of adipose tissue. For example, temperature sensors have conventionally been placed under the tongue, on the forehead, in the armpit, and rectally. Because of the presence of fat, distance from flowing blood, or both, temperature measurements in surface locations typically require adjustment to compensate for the lower temperature level assumed to be in these locations as compared to core body temperature.

In addition to inaccuracy and imprecision, because conventional temperature measurements are contact measurements, such contact risks the transmission of communicable diseases. A non-contact device for the measurement of body core temperature would lower the likelihood of transmission of certain transmittable viruses and other illnesses, such as SARS, influenza and the like. A non-contact device configured to be positioned to read the infrared output of the Abreu brain thermal tunnel (ABTT), whether by an individual for self-measurement or by a medical professional, and configured to properly detect thermal disturbances such as hypothermia and heat exhaustion, would provide a simple, accurate and non-invasive device or apparatus for measuring brain temperature. Such capability is valuable in a clinical environment, such as doctor's offices, which may see many patients during the course of a day, typically requiring sanitary covers and/or sterilization of conventional thermometers. However, simple, accurate, and timely temperature evaluation is also valuable at home, so that urgent cases may be easily more readily diagnosed, such that the necessity of making doctor visits may at times be alleviated. Although many of the exemplary embodiments disclose a non-contact device, it should be understood that embodiments described herein can be used with a contact sensor or detector, such as those shown in exemplary embodiments.

Sensing and reporting systems have been disclosed which may be used individually or in combination, which are designed to access a physiologic tunnel to measure biological, physical, and chemical parameters of a human or an animal. Such systems have been described in U.S. Pat. Nos. 7,187,960, 8,172,459, 8,328,420, 8,721,562, 8,834,020, and 8,849,379, which are incorporated herein by reference in their entirety. Anatomically and physiologically speaking, the Abreu Brain Thermal Tunnel (herein referred to as ABTT), previously described by Applicant as the brain temperature tunnel, is an anatomic path that conveys undisturbed physiologic signals to the exterior of the body. The ABTT includes a direct and undisturbed connection between the source of the function (signal) within the body, which is the hypothalamus region of the brain, and an external point on the skin on, over, or adjacent to an end of the tunnel, which may be described as the ABTT terminus. This physiologic tunnel conveys continuous and integral data on the physiology of the body. As shown by Applicant, the ABTT has a unique configuration that includes high and low thermal conductivity areas, with the skin surface being free of fat (high thermal conductivity) and the internal portion of the ABTT surrounded by fat (low thermal conductivity). An undisturbed signal from within the body is delivered to the external point on the skin over, on, or adjacent to the end of the ABTT. A sensor or detector located at on the skin at the end of the tunnel allows optimal signal acquisition from the brain without interfering constituents and sources of error. In an exemplary embodiment, such signals are infrared signals, and the sensor or detector is an infrared sensor or detector. In another exemplary embodiment, the signals can be radio frequency signals, and the sensor or detector is a radio frequency receiver. In yet another embodiment, the signals are sound signals that may be in a frequency range above and below the typical range of human hearing, and the sensor or detector is a sound sensor or detector with the ability to receive the appropriate frequency range. In a further embodiment, the signals are magnetic or electromagnetic, and the sensors or detectors are magnetometers or other sensors configured to read magnetic energy. It should thus be understood that a plurality of energy forms, e.g., magnetic, sonic, optical, and radio energies, can be detected from the ABTT terminus.

It should also be understood that temperature at the ABTT terminus may also correspond to the core temperature or internal body temperature, which can occur, for example, when a person is at rest in a typical indoor environment, or skin temperature, which can occur, for example, in an environment where the temperature is above 99 degree F., depending on humidity, wind conditions, etc. Generally, core temperature and internal body temperature are synonymous when discussing such temperatures as being the internal temperature of the trunk of the body. Hence, for the purpose of description herein "brain temperature" is used for any temperature measured at the ABTT site.

A set of support structures designed to be attached to the body of a user to measure temperature through contact with the skin of the ABTT target area have been previously discussed and disclosed in one or more of the patents previously referenced. While such structures provide many benefits, an easy to use apparatus configured to measure brain temperature non-invasively without requiring contact to the skin provides benefits, potentially including increased accuracy, reduced chance of transmitting communicable diseases, and increased speed of measurement.

An apparatus configured with an infrared sensor and configured with an appropriate field of view for measuring the temperature of the ABTT target area, without including measurement or estimation of values of the surrounding areas, would also provide benefits to diagnosis and measurement of ABTT temperature. It should be understood, however, that comparative measurements or estimation of the surrounding area with respect to the ABTT terminus are within the scope of the invention. In an exemplary embodiment, an area surrounding the ABTT terminus of 10 centimeters in diameter of a circle truncated at or on the eyebrow may be measured for comparison to the ABTT terminus. In another exemplary embodiment, an area surrounding the ABTT terminus of 8 centimeters in diameter of a circle truncated at or on the eyebrow may be measured for comparison to the ABTT terminus. In yet another exemplary embodiment, an area surrounding the ABTT terminus of 6 centimeters in diameter of a circle truncated at or on the eyebrow may be measured for comparison to the ABTT terminus. In yet a further exemplary embodiment, an area surrounding the ABTT terminus of 3 centimeters in diameter of a circle truncated at or on the eyebrow may be measured for comparison to the ABTT terminus. It should be understood that the larger the area taken for comparison, the greater the processing time needed for analysis, and the longer it will take to receive results. Generally, these areas are centered on the ABTT terminus, which, as described herein, is approximately located in the mid-portion between the eyebrow and the eye, adjacent to the nose. In an exemplary embodiment, processing circuitry is adapted or configured to subtract or remove the surrounding areas around the ABTT terminus from the calculation of temperature. It should be noted that skin areas surrounding the ABTT terminus are typically at a lower temperature than the ABTT terminus. However, conditions can exist where the ABTT terminus is at a lower, cooler, or colder temperature than the ABTT terminus. In an exemplary embodiment, the apparatus is configured with a field of view for viewing an area on the surface of the skin on, over, or adjacent to the ABTT corresponding to the main entry point of the ABTT, which is an area with higher thermal emission compared to surrounding areas. In an exemplary embodiment, this area includes a diameter of 9 mm or less, more preferably an area with a diameter of 6 mm or less, and even more preferably an area with a diameter of 3 mm or less, and most preferably an area with a diameter of 2 mm or less, all of which are centered on the ABTT terminus. It should be understood that the ABTT area includes preferably the upper eyelid area and the area between the eye and the eyebrow. It should further be understood that the region or area used for comparison to the ABTT target area or terminus also includes the area of the caruncle and corner of the eye surface as the area measured by many embodiments of the present disclosure.

In an alternative embodiment, the field of view is larger than the ABTT terminus. In an exemplary embodiment, the apparatus is configured with a field of view for viewing an area on the surface of the skin on, over, or adjacent to the ABTT terminus corresponding preferably to an area with a diameter of 20 mm or less, more preferably to an area with a diameter of 15 mm or less, yet more preferably to an area with a diameter of 10 mm or less, and most preferably to an area with a diameter of 7 mm or less. In this embodiment, the apparatus is configured to resolve or locate the peak temperature of the ABTT region, which is representative of brain temperature. To resolve or locate the peak temperature, the apparatus may be configured with a controller or processor to analyze the input from an infrared sensor or any non-contact temperature sensor or detector. It should also be understood that a contact thermal sensor can be used and is within the scope of the invention. As described further herein, the controller may analyze the infrared (IR) intensity of individual pixels in the IR sensor and correlate the intensity to temperature. Alternatively, cumulative readings of the entire ABTT area may be acquired, and the resultant data may be mathematically adjusted by the controller to eliminate the regions outside the ABTT. Although some estimation may be required to calculate the temperature of the ABTT, as there may be anatomic differences among different people, the view of the hottest area can be calculated, despite using a view for seeing a spot or area larger than 3 mm.

In an exemplary embodiment, the wave guide of the infrared detector has a field of view for viewing an area of, by way of illustration, measuring 5 mm. This area includes the main entry/exit point of the ABTT terminus, which is typically the highest or hottest temperature, in addition to surrounding areas of a different, typically lower, temperature. The processor calculates the temperature of an annulus having a width of about 1 mm surrounding the ABTT and uses that number to determine the temperature of the hottest area. For example, if the 3 mm ABTT area has a temperature of 37 degrees C., and the surrounding area has a temperature of 36 degrees, then by viewing a 5 mm diameter an average temperature may be 36.5 degrees C., meaning approximately 0.5 degrees C. below the peak temperature of the ABTT area. The controller or processor then adds 0.5 degrees C. to achieve the temperature of the hot area (37 degrees C.).

In another exemplary embodiment, the apparatus is configured to include a field of view of 7 mm in diameter. The controller or processor then calculates the temperature of the area around the ABTT terminus, which may be an annulus that is 2 mm wide about the ABTT terminus, and the temperature difference of the area away from the ABTT terminus is added to the overall numerical value measured. As an example, an ABTT terminus of 3 mm in diameter measures 36.5 degrees C., and an apparatus with a 7 mm field of view measures the entire area at 35.6 degrees C. A temperature difference of approximately 0.9 degrees C. occurs because of the colder area surrounding the ABTT. In a manner of speaking, the ABTT is like an island of fire surrounded by a lake of cold water in which it becomes colder with distance from the ABTT "island." Thus, the controller or processor estimates that the surrounding 2 mm wide ring or annulus area of the ABTT causes about a 1 degree loss (predetermined loss used by the controller or processor to calculate the temperature of the ABTT terminus), and then the controller adds the 1 degree to the measurement obtained with a 7 mm spot or diameter field of view. Thus, in the present example, with a field of view of 7 mm and a measured average temperature of 35.6 degrees C. over the entire field of view, by adding 1 degree C. the final result is 36.6 degrees, which is very close to the true measurement of 36.5 degrees. A similar technique can be applied to any size area by increasing the numerical value of the added factor. It should be understood that this methodology and device or apparatus can include an array of infrared sensors, thermopiles, and the like in a variety of configurations, including but not limited to, preferably a 3×3 sensor array, a 4×4 sensor array, and a 5×5 sensor array. However, depending on the size of the sensor, a range between a 6×6 array to a 20×20 array can be used and it is within the scope of the invention. It should be further understood that the array may not be symmetrical, including

one sensor in the center surrounded by, as way of illustration, two to twenty sensors, and preferably surrounded by four or less sensors, most preferably eight or less sensors, and yet most preferably by twelve or less sensors. It should also be understood that the centrally located sensors can include more than one sensor, including, but not limited to, three centrally located sensors surrounded by other sensors. Processing for such an array or multiple sensors occurs in a similar fashion as described for identifying the temperature at the main entry point, and further includes the highest temperature and surrounding temperature. As disclosed, in certain situations, the highest temperature is not the main entry point of the ABTT (equivalent to brain temperature), and in this instance the lower temperature is the chosen temperature as the brain temperature, or the target temperature. It should also be understood that this methodology and device or apparatus can be used in other fields in which viewing the exact target is not possible and there is viewing of surrounding areas, or in which there is an undefined target area surrounded by areas of different temperature in the body.

In yet another exemplary embodiment, a thermal imaging camera views more than the ABTT terminus area, and by knowing the actual temperature of the surrounding areas, a controller of the thermal imaging camera can calculate the exact peak temperature level of the ABTT terminus. The controller uses the temperature of the area surrounding the ABTT terminus, which is represented by a temperature adjustment or compensation factor F. Temperature factor F is added to the measured temperature value in case the area surrounding the ABTT terminus is colder, or, alternatively temperature factor F is subtracted from the measured temperature value in the case the area surrounding the ABTT terminus is hotter than the main area. In a typical situation where the skin on, over, or adjacent to the ABTT terminus is hotter or warmer than skin surrounding ABTT terminus, temperature factor F increases with distance from the edge of the ABTT, or increases as a diameter of detector spot size increases; i.e., temperature adjustment or compensation increases with a detector field of view. In an exemplary embodiment, the apparatus includes a controller or processor adapted or configured to analyze the IR image or data and determine a temperature of the ABTT terminus, as well as including a non-transitory memory to store the values used in the calculation by the processor as well as the results of the calculation.

In a further exemplary embodiment, the present disclosure includes a hand-held apparatus for measuring brain temperature by way of the ABTT terminus, which serves as a useful tool in a variety of settings, from doctors' offices to personal homes. In an exemplary embodiment, the tool is configured to remove a degree of a "fright factor" that can accompany measurements taken at the ABTT target area, i.e., the ABTT terminus, and any apparatus being placed near the eyes of the person whose measurements are being taken. In an exemplary embodiment, the apparatus or device is configured to provide convenience in storing, carrying, and operation.

The presently disclosed embodiments are exemplary, and a person of ordinary skill will understand that certain changes and modifications of the present embodiments are inherent in the scope of the present disclosure.

The present disclosure describes embodiments of an apparatus for measuring temperature at the ABTT terminus or target region that is non-invasive and does not require contact of the sensor with the skin of a subject or patient. Alternatively, the tip of a probe or a wave guide may rest on the skin of a patient or subject at a physiologic tunnel, such as the ABTT terminus site positioned at a location that is in a region between the eye and the eyebrow.

The present disclosure includes an apparatus for collecting thermal radiation from an ABTT terminus, which may convert said thermal radiation, i.e., the intensity of the thermal radiation, into a brain temperature or core temperature, or the temperature of the skin itself. Such conversion is possible because the emissivity of human skin is known, and the IR sensor measures intensity. From these two values, temperature can be determined.

The present disclosure also provides methods for determining body temperature with such methods including steps of collecting thermal emission from the ABTT terminus, producing a signal corresponding to the thermal emission (i.e., intensity) collected, processing the signal (i.e., calculating the temperature), and reporting the temperature. It should be understood that a further step of adjusting the temperature according to the temperature of the surrounding area of the ABTT can be included, and is within the scope of the invention. It should also be understood that other biological parameters can be measured in a similar fashion, including chemical compounds such as glucose, cholesterol, alcohol, any analytes present in the body, any chemicals received by the body, any element produced by the body, such as antibodies, and any microorganisms present in the body. In embodiments where other biological parameters are identified, the radiation signature or the thermal signature of the element as received from the ABTT terminus is used to identify its presence or its concentration.

In a further exemplary embodiment, the value of the signal measured at the ABTT terminus is added to a Brain temperature Factor "BF" to determine the exact brain temperature. In this exemplary embodiment, factor BF can be calculated empirically by measuring the actual brain temperature and identifying the difference between temperature measured at the skin, and temperature measured inside the brain. The BF factor is then used to provide the actual brain temperature when measuring temperature at the ABTT terminus or ABTT skin site. The controller or processor uses the BF factor value stored in the memory, and then adjusts the value calculated by the apparatus to a value corresponding to the brain temperature. The method and apparatus includes a controller or processor and non-volatile memory that uses the values obtained at the ABTT skin terminus site to calculate the actual brain temperature based on the brain temperature values, i.e., the BF factor, measured experimentally. The BF factor calculated from brain parenchyma temperature provided the range of adjustment for determining brain temperature from the ABTT terminus on the eyelid skin. By way of example, but not of limitation, a preferred BF factor is equal to or less than 1.7 degrees C., more preferably the BF factor is equal to or less than 1.0 degrees C., even more preferably the BF factor is equal to or less than 0.5 degrees C., and yet most preferably the BF factor is equal to or less than 0.3 degrees C. The empirical or experimental measurements of brain temperature as well as the temperature at the ABTT terminus can be acquired by an apparatus or device described herein configured to measure temperature in the range of the ABTT terminus, including contact sensors, non-contact sensors (including infrared), and thermal imaging.

It should be understood that while the foregoing discussion describes adjustment or compensation factor BF, such factor is typically a relatively small value in humans given that the ABTT terminus is directly linked to the brain core in the region of the hypothalamus, but in certain situations

of extreme hot or cold, the BF factor can be of larger magnitude. Furthermore, empirical measurements indicate that measurements of temperature at the ABTT terminus are the most accurate type of temperature measurements of the human body, with variation from actual core temperatures equal to or less than 0.2 degrees C. Accordingly, the BF factor, while useful in providing very precise and accurate temperatures of the brain, is generally not a significant adjustment for humans. Furthermore, it should also be understood that the inherent configuration of the ABTT terminus is such that the BF factor value is, for most practical purposes, identical between human individuals. Thus, the same BF factor value can be used for compensation of temperature measurements for all people.

Additionally, while having a very precise and accurate measurement of brain temperature may be valuable in some circumstances, one of the most valuable benefits of measuring temperature at the ABTT terminus is the variation in relative temperature with time. Thus, having precise temperatures is often less important than analyzing temperature variation with time. Thus, the BF factor value in humans is more for the few situations where accuracy and precision are necessary.

While the BF factor value may be relatively unimportant for humans, animals do not have an ABTT terminus positioned on the skin and animals may have fur which reduces thermal conductivity, shifting the position of the equivalent of ABTT terminus in animals to an area of transition skin-mucosa located in the corner of the eye, frequently adjacent to the tear duct and caruncle or conjunctival surface (referred to herein as Transition Area). In some species, such as canines, felines and other predators, the equivalent of the ABTT terminus is located in the anterior (or medial) portion of the corner of the eye, in swine tend to be located in the posterior (lateral) corner of the eye, ovine tend to be located in the anterior corner of the eye, and primates such as chimpanzees tend to be located in both the medial corner and the lateral corner of the eye. The location in animals does provide a difference in temperature that benefits from the BF factor value, which ideally should be determined for each species of interest. The BF factor calculated from brain parenchyma temperature in canines provided an exemplary range of adjustment for determining brain temperature from the transition area. By way of example, but not of limitation, an exemplary BF factor for canines is equal to or less than 2.6 degrees C., more preferably the BF factor for canines is equal to or less than 1.6 degrees C., even more preferably, the BF factor for canines is equal to or less than 1.0 degrees C., and most preferably, the BF factor for canines is equal to or less than 0.5 degrees C.

In an exemplary embodiment, the components of the apparatus include a sensing portion for evaluating biological parameters, for example, the body temperature of a person using infrared wavelength sensors. This sensing portion can be hand held or fastened to a body portion so that it is at an optimal angle to access the Abreu brain thermal tunnel terminus or target area, or transition area in animals. This optimal angle is approximately perpendicular to the ABTT terminus, though variations of angle up to 30 degrees from perpendicular yield useful and relatively accurate measurements. Another preferred exemplary angle may include a 30 to 45 degree angle in which the sensor is viewing the ABTT terminus from below and in a diagonal position. The apparatus also includes an adjustable handle portion connected to the body portion of the device using a hinge or other adjustable connection apparatus, which allows a user to manipulate the apparatus for an optimal holding position for comfort during use. The apparatus includes a switch for operation. The apparatus may also include a viewing or display portion (e.g., slide screen, an electronic digital viewer, or any suitable display capable of displaying images and/or alphanumerical characters), which is mounted on an upper side of the main body portion so that the display is preferably located directly in the line of sight of the person whose measurements are being taken. In one exemplary embodiment, the viewer has a double sided display allowing viewing the display from the front or back, thus allowing a subject being measured to view the display and also an operator (e.g., a doctor, scientist, other medical practitioner, etc.) also to view the display. Another aspect of the invention as disclosed herein presents a box to enable safe storage, transportation, and use of the apparatus. In one exemplary embodiment, the apparatus includes a photo or video camera, preferably facing the ABTT.

Dissection of cadavers was undertaken as a part of understanding the unique characteristics of the ABTT. Cadaver dissection delineated anatomy, which may be seen in FIGS. **60**, **61**, and **62**, showing the convergence of four veins at ABTT target area or terminus **16**: frontal **80**, superior palpebral **82**, supraorbital **84**, and angular **86**. This area is unique, and is the only such area in the head, in which a vein, ABTT **88**, courses transversally with respect to the longitudinal extent of the human body into the center of the brain, with the opposite end terminating on the skin.

Additionally, ABTT target area **16** is extremely vascularized and is the only skin area in which a direct branch of the cerebral vasculature is located and covered by a thin skin without a fat layer. The main trunk of the terminal branch of the ophthalmic vein is located right at ABTT target area **16**, just above the medial canthal tendon supplied by the medial palpebral artery and medial orbital vein. ABTT target area or terminus **16** on the skin, supplied by a terminal and superficial blood vessel ending in a particular area without fat and void of thermoregulatory arteriovenous shunts, provides a superficial source of undisturbed biological signals including brain temperature, metabolic function, physical signals, and body chemistry such as glucose level, and the like.

Briefly, the blood from veins under the surface of a face **90** flows into ABTT **88**. Having converged at ABTT terminus **16**, the blood from these veins **80**, **82**, **84**, and **86** flows into the brain from ABTT terminus **16**, into ABTT **88**, and then into the center of the brain, at the cavernous sinus (not shown), which Applicant identified as a thermal storage area, and which is adjacent to the thermoregulatory center of the brain. From the thermal storage area, thermal energy in the form of hot or cold blood is distributed throughout tissues of the brain. It was also recognized by the Applicant that ABTT **88** includes bidirectional blood flow, from the brain to ABTT terminus **16** and from ABTT terminus **16** to the brain. Applicant recognized that the flow of blood through ABTT **88** represented a unique diagnostic to determine the condition of the brain and the body by measuring the thermal condition of ABTT terminus **16**. As seen in the histology of ABTT terminus **16**, as shown by Applicant in an unpublished co-pending application, the skin at ABTT terminus **16** is void of fat, thereby allowing thermal energy transmission from ABTT **88** through the skin at ABTT terminus **16**, where the thermal energy may be measured and analyzed to provide information regarding the condition of the brain and the body.

The approximate locations of the veins **80**, **82**, **84**, and **86** are shown in FIGS. **60** and **61** with respect to other facial features. Angular/facial vein **86** runs up alongside nose **92**, superior palpebral vein **82** runs along eyebrow **94**, and

frontal vein **80** and supraorbital vein **84** run under forehead **96**. It should be understood that arterial blood also runs in parallel in some areas, but said arterial blood does not go toward the center of the brain as the venous blood does.

Anatomically and physiologically speaking, the Abreu Brain Thermal Tunnel (ABTT) **88** includes a continuous, direct, and undisturbed connection between a thermal signal source within the brain and an external point on the skin at the end or terminus of the tunnel. Thus, the skin on, over, or adjacent to the end of ABTT **88** may be considered the ABTT terminus given the proximity of the skin to the end of the tunnel, and the lack of adipose tissue between the end of the tunnel and the interior surface of the skin. In the absence of insulating fat, skin is a good conductor, and thus the temperature of the skin over the end of ABTT **88** is nearly the temperature of ABTT **88** itself. Accordingly, the physical and physiological events at one end of the tunnel, inside the brain, are reproduced at the opposite end on the skin. ABTT **88** enables direct thermal signal transfer through the tunnel without interference by heat absorbing elements; i.e., elements that can absorb thermal energy transmitted by blood within the brain. The end of ABTT **88**, herein referred to as the "terminus" or "target area" on the skin, is located in a region between the eye and the eyebrow that measures about 14 mm in diameter measured from the medial corner of the eye at the canthal tendon and extends superiorly for about 12 mm, and then extends into the upper eyelid in a horn-like projection for another 22 mm. The lower portion of the ABTT terminus is adjacent to the punctual area (or tear duct), which can serve as a measurement area and/or a reference for placement of an ABTT support structure.

The ABTT terminus is located in a crowded anatomic area. Thus, positioning of a sensor or detector to measure a signal from the ABTT terminus requires appropriate geometry for optimal alignment with the end or terminus of the tunnel. The clinical usefulness of the tunnel can only be achieved with the proper positioning of a sensor in relation to anatomic landmarks and a support structure for the sensor. The tunnel is located in a unique position on the human body, with distinctive anatomic landmarks that help define the external geometry and location of the end of the tunnel. The main entry point of the tunnel is the preferred location for positioning the sensor, which is preferably positioned in a central area of a surface of a support structure and facing the skin. The support structure and supported sensor facing and/or touching the skin at the ABTT terminus includes an exemplary maximum dimension equal to or less than 18 mm, a more preferred exemplary maximum dimension equal to or less than 14 mm, an even more preferred exemplary maximum dimension equal to or less than 10 mm, and a most preferred exemplary maximum dimension equal to or less than 8 mm for optimum signal acquisition. A preferred exemplary embodiment for the measurement of biological parameters by accessing the physiologic tunnel includes sensors positioned in a particular geometric position on or in the support structure including an eccentric position.

In describing exemplary embodiments of the invention, specific terminology will be used for the sake of clarity. However, exemplary embodiments are not intended to be limited to the specific terms selected, and it should be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose. It should also be understood that each individual part or component and/or each individual embodiment or a combination of said parts or components and any embodiment is within the scope of the invention.

The support structure disclosed herein comprises a hand-held device that includes a sensor or detector adapted to receive and measure a signal from the ABTT terminus when the sensor is positioned to view the ABTT "target area," positioned on the ABTT "target area," or positioned adjacent to the ABTT "target area." It should be understood that besides a hand held device, any other configuration is within the scope of the disclosure, including table top, lap top, wall mounted, anchored to the body or head, and the like. The following aspects of the disclosed embodiments are described herein, these aspects being employed either separately or in any combination to comprise a device to measure, continuously or non-continuously, the temperature of the brain or any other biological parameters by contact or non-contact measurement of the skin of the ABTT "target area." A sensing device or apparatus, an exemplary embodiment of which is shown in, for example, FIG. **1**, and generally indicated at **10**, includes the following features:

A sensing portion **12** fixed at a predetermined angle **14** for capturing a signal by contact or non-contact from ABTT terminus **16**, with one end, which is a first end **18**, of sensing portion **12** connected to a body portion **20**, and a second free end **22** containing the sensor to receive energy from ABTT terminus or target area **16**. In an exemplary embodiment, the sensor is an infrared sensor. However, it should be understood that ABTT **88** and ABTT terminus **16** emit a plurality of energies and/or wavelengths. Accordingly, in other exemplary embodiments, the sensor, which in some circumstances may also be described as a detector, may be, for example, a sound or vibration sensor, a magnetometer, an electromagnet sensor, etc., configured to receive the signals transmitted through ABTT **88** and ABTT terminus **16**. Accordingly, when a particular type of sensor is described herein, such as an infrared sensor or detector, it should be understood that other types of sensors may be used as well, with any modifications required for the energy or frequency being measured or received. It should be understood that first end **18** may include a rotating mechanism to allow adjusting the angle. An exemplary predetermined angle **14** with respect to a line perpendicular to the ground, with a human patient or subject standing, head held level, is equal to or less than 20 degrees, or more preferably, an exemplary predetermined angle **14** is equal to or less than 45 degrees, or even more preferably, an exemplary predetermined angle **14** is equal to or less than 60 degrees, and most preferably, an exemplary predetermined angle **14** is equal to or less than 75 degrees;

A handle portion **24**, which may be adjustable in angle by an adjustable connection mechanism **26** that attaches or connects handle portion **24** to body portion **20**, or may be fixed to body portion **20** in a position optimized for holding sensing device **10**;

At least one switch **28** for activating the functions of sensing device **10**;

Viewing portion **30** (e.g., a slide screen portion, electronic digital display, standard display, projection display, transparent display, and the like) mounted on an upper portion **32** of body portion **20**, which provides an output for displaying information to people whose measurements are being taken, in part so that the attention of the subject or patient is diverted away from sensing portion **12**; and

Body portion **20**, which may comprise a printed electric circuit board or any circuitry, including a controller or processor or apparatus for processing, recording, activating, displaying, and transmitting data gathered by the sensor. Switch **28** may be positioned on body portion **20**. The at least one switch includes switch **28** or other actuating

mechanism for turning the apparatus on and off. Switch **28** may also activate measurements, or a separate switch or other actuating mechanism (not shown) may be provided for activating measurements. An external device such as cell phone, watch, eyeglasses, computer, and the like may also activate the apparatus.

It should be understood that although temperature is the biological parameter used to illustrate the exemplary embodiments of the present disclosure, other biological parameters and analytes can be measured and/or analyzed at any portion of the brain tunnel described in the disclosure, including from the skin surface, the periorbital and intracranial portion, and the opposite end of the brain tunnel, including the hypothalamus, thalamus and other brain tissues as the cerebral cortex. A radiation signature of any chemical compound can be quantified in the thermal emission of ABTT terminus **16**, or application of infrared energy to ABTT terminus **16** can generate a reflected infrared signal suitable for determining the concentration of analytes as well as determining the presence of any antigen, antibodies, or other substances, such as chemical compounds (e.g., drugs) present in the body or in the blood.

The disclosed embodiments comprise at least sensing portion **12** that is connected to body portion **20** of apparatus or device **10** according to the aspects of the disclosure. Sensing portion **12** serves as the free end of device **10**. Sensing portion **12**, to measure the temperature of the brain or other biological parameters using ABTT target area **16** most effectively, should be positioned so that it forms an optimal angle for measuring ABTT terminus area **16**. For brain temperature evaluation, tunnel area **16** includes mostly the area between the eye and the eyebrow, including the medial part of the upper eyelid area. Free end **22** of sensing portion **12** is most preferably located at the main entry point **16** of the tunnel, which is located on the skin 2.5 mm medial to the corner of the eye and about 3 mm above the medial corner of the eye. However, it should be understood that this location is approximate, and that the position of ABTT terminus **16** can vary by several millimeters, for example, plus or minus 5 mm, and most frequently plus or minus 3 mm. The diameter of main entry point **16**, i.e., ABTT terminus or target area **16**, is about 6 to 7 mm with the highest or peak thermal and infrared emission being within a diameter of about 5 mm or less, more likely within a diameter of about 3 mm or less, and most likely within a diameter of about 2 mm or less. It should also be understood that ABTT terminus **16** is not a perfect diameter, and may be somewhat oval, oblong, or irregular. The positioning of sensing portion **12** at main entry point **16** of the Abreu tunnel provides the optimum site for measuring physical and chemical parameters of the body as represented by the output of the tunnel. It should be understood that portion **26** may be fixed at any of the preferred angles described herein.

In order to position sensing portion **12** at the optimum location for measurement, sensing portion **12** as described herein as one of the exemplary embodiments is situated at a particular angle in relation to the ground, which will be illustrated with a subject being in a standing position and the body approximately perpendicular to the ground, as described herein. In this illustration, an exemplary angle **14**, which is measured from a line **34** extending perpendicular to the ground and extending parallel to the face, is equal to or less than 60 degrees, and is more preferably equal to or less than 45 degrees, as is shown in, for example, FIGS. **1** and **2**. It should be understood than an angle smaller than 45 degrees can be used, and such an angle would provide a beneficial interface angle with respect to the anatomic features of ABTT "target area" **16** since ABTT "target area" **16** tends to face or angle downwardly. It should also be understood that a sensor such as that shown in FIG. **16**, also is preferably oriented at an angle **36** to an axis **222** that is perpendicular to vertical axis or line **34**. An exemplary angle **36** is equal to or less than 10 degrees, a preferred exemplary angle **36** is equal to or less than 25 degrees, and a more preferred exemplary angle **36** is equal to or less than 55 degrees. An exemplary embodiment comprises sensor portion **12** that views ABTT terminus **16** from the bottom, i.e., sensor portion **12** looks or is angled upwardly, and from the side of a face **38**, or angled toward the center of face **38**, i.e., toward a nose **40**, achieving thus a preferred viewing angle, so for right ABTT **16**, the position of detector or sensing portion **12** is for viewing from the bottom and from the right side of face **38** from the perspective of the patient or subject being measured, and for the left ABTT (not shown), the position of detector or sensing portion **12** is for viewing from the bottom and from the left side of the face from the perspective of the patient or subject being measured.

In an exemplary embodiment, sensing portion **12** includes a non-contact infrared (IR) sensor **42**. Exemplary embodiments of IR sensor **42** and associated apparatus and different positions of IR sensor **42** are shown in FIGS. **40-44**, as well as an internal end position shown in FIG. **47**, a mid position shown in FIG. **46**, and external end position (shown in FIG. **44**). It should be understood that other sensors may be employed that measure temperature or other biological parameters of ABTT target region **16**, including those that require contact with the skin, such as thermistors, and those that do not require skin contact. The IR measurement is based on the Stefan-Boltzmann law of physics in which the total radiation is proportional to the fourth power of the absolute temperature, and the Wien Displacement law in which the product of the peak wavelength and the temperature are constant. The field of view of the non-contact infrared apparatus **10** of the disclosure is adapted to match the size and geometry of ABTT terminus area **16** on the skin, with an exemplary diameter (dimension) of a spot size viewed by infrared sensor **42** being equal to or less than 12 mm, and preferably equal to or less than 7 mm, another exemplary diameter being equal to or less than 5 mm, another exemplary diameter being equal to or less than 3 mm, and yet a further exemplary diameter being equal to or less than 2 mm. In an exemplary embodiment, the field of view of sensor **42** of apparatus **10** is approximately 9 degrees in order to measure a point that is preferably no greater than 3 mm in diameter. Any diameter greater than 3 mm potentially includes skin surrounding ABTT target area **16** that, because the skin surrounding ABTT target area **16** has a different surface temperature than ABTT terminus area **16**, would cause temperature measurements to be less accurate, and potentially require additional compensation or correction for increased accuracy.

Sensor portion **12** of apparatus **10** may include a wave guide **44**. Wave guide **44** is represented herein by the structure that receives the infrared radiation prior to the IR radiation reaching IR sensor **42**. Specialized wave guide **44** of the present disclosure guides IR radiation to reach IR sensor **42** properly, including the size of the area being measured and distance from the area being measured. Specialized wave guide **44** can take any shape or configuration, but in an exemplary embodiment is a cylinder or a barrel-like structure configured for optimizing collection of infrared radiation, and for ease of manufacture. FIGS. **45-48** show several views of an illustrative wave guide **44** of the

present invention. Exemplary embodiments of specialized wave guide **44** are described hereinbelow.

The field of view for a conventional IR sensor is approximately 90 degrees. This large field of view is acceptable for measuring body temperature on the forehead or in the ear canal. Such a large field of view is too large to take an accurate reading of the relatively small ABTT target area **16**. In order to obtain an IR sensor which has a field of view of the preferred full angle of 15 degrees or less, more preferably 12 degrees or less, and most preferably 9 degrees or less, sensing portion **12** according to one aspect of the disclosed embodiments may comprise IR sensor **42** located at a fixed end of a cylindrical "barrel" structure **46**, this barrel structure **46** being well insulated and including, in an exemplary embodiment, a longitudinal length **48** of 70 mm or less, preferably 30 mm or less, more preferably of 15 mm or less, and most preferably of 10 mm or less, as shown in FIG. **40**. In particular, an exemplary length **48** of the barrel is equal to or less than 90 mm, a preferred exemplary length **48** is equal to or less than 60 mm, a more preferred exemplary length **48** is equal to or less than 30 mm, an even more preferred exemplary length **48** is equal to or less than 20 mm, and a most preferably exemplary length **48** is equal to or less than 10 mm. An exemplary barrel or cylinder outside diameter **50** is equal to or less than 25 mm, is preferably equal to or less than 15 mm, is more preferably equal to or less than 10 mm, and is most preferably equal to or less than 5 mm. It should also be understood that body portion **20**, or any portion of sensing device or apparatus **10** housing electronics and one or more batteries may have any dimensions necessary to house those elements. It should also be understood that an exemplary embodiment wave guide **52**, as shown in FIG. **43**, can end in a conical structure **54**. Wave guide **52** includes a preferably cylindrical structure **56** which terminates as conical structure **54**. The dimensions of conical end or structure **54** have to fit with the crowded anatomy of ABTT terminus **16**. IR sensor **42** is disposed at first end **18** of sensing portion **12**, which may also be described as probe **12**. The preferred dimensions of the cone of conical structure **54**, i.e., the distance from first cone end **58** of the cone, which may also be described as device end **58**, to second cone end **60** resting on the skin or in a non-contact location adjacent to the skin, which may also be described as skin surface end **60**, requires specialized dimensions to fit with the anatomy surrounding ABTT terminus **16**. An exemplary cone length **62** of the cone is equal to or less than 20 mm, is preferably equal to or less than 15 mm, is more preferably equal to or less than 10 mm, is even more preferably equal to or less than 6 mm, and yet most preferably equal to or less than 3 mm. An exemplary outside diameter **64** of conical structure **54** at second cone end **60** is equal to or less than 25 mm, is preferably equal to or less than 15 mm, is more preferably equal to or less than 11 mm, and is even more preferably equal to or less than 8 mm, and is most preferably equal to or less than 5 mm. In another exemplary embodiment shown in FIG. **44**, a conical structure **66** is encased in a cylindrical structure **68**. In yet another embodiment, the conical end is replaced by a kidney (or beam) shaped structure (not shown), so as to conform better to the anatomic region between the eye and the eyebrow.

In an alternate embodiment, as depicted in FIG. **41**, an IR sensing portion **112** may comprise a barrel structure **114** including an exemplary longitudinal length **116** of 10 mm, with IR sensor **42** located near a first end **118**, which is similar to first end **18** of the exemplary embodiment shown in FIG. **1**, which is at the fixed or attachment end of barrel **114**. Barrel **114** includes one or more internal baffles **120** that may be equally spaced and arranged longitudinally therein along the longitudinal length **116** of barrel **114**. Baffles **120** may be formed of materials that do not absorb infrared radiation. One benefit of baffles **120** is to provide a field of view that helps to limit data gathering to ABTT terminus **16**.

In another exemplary embodiment, shown in FIG. **42**, an IR sensing portion **212** comprises a barrel structure **214**, including a longitudinal length **216** of preferably 10 mm with a suitable lens assembly **218** positioned to focus IR light onto IR sensor **42**. According to this aspect of the disclosed embodiments, the IR energy emitted by ABTT terminus **16** produces a field of view of 9 degrees, with the area being measured having a diameter of approximately 3 mm. Preferred exemplary longitudinal lengths **116** and **216** of the barrels **114** and **214** are equal to or less than 70 mm, more preferred exemplary longitudinal lengths **116** and **216** are equal to or less than 50 mm, even more preferred exemplary longitudinal lengths **116** and **216** are equal to or less than 30 mm, yet more preferred exemplary longitudinal lengths **116** and **216** are equal to or less than 20 mm, and most preferred exemplary lengths **116** and **216** are equal to or less than 10 mm.

The sensing portions disclosed herein may also comprise one or more wires, cables, and other electric connectors or circuitry adapted to join IR sensor **42** with a suitable supply of power, such as a battery or power source, or to enable signals generated or transmitted by IR sensor **42** to be communicated to a controller, processor, non-transitory memory, PC board, wireless transmitter, or other suitable circuitry or apparatus that may be located in, for example, body portion **20** of sensing device **10**, including devices and apparatuses configured to transmit, such as wireless transmitters and/or connection devices and apparatus configured to connect to the internet or a computer network (not shown) via a wireless receiving device including a cell phone, computer, watch, and the like.

This infrared-based system, as provided in the present disclosure, is preferably (but not limited to) being integrated as part of a portable or hand-held unit completely disconnected from a human or animal body. It should be understood, however, that the infrared-based system of the present disclosure can be integrated in a support structure in contact with a body, such as, for example, a sticker, bandages, adhesives, medial canthal pad, eyeglasses, goggles, masks, helmets, headbands, head-mounted gear, neck-mounted gear, or other such structures that may be designed to support the ABTT infrared measuring device. Sensing apparatus **10** of the present disclosure may be held by an operator that aims sensing apparatus **10** at ABTT area **16** to perform measurement. Apparatus **10** may also be integrated into a support that is not connected to a body or held by an operator, such as a swing or mount (not shown).

Hand-held sensing device or apparatus **10** should be positioned at a predetermined distance to obtain accurate measurements. To ensure that measurements are being taken at a consistent distance, it is proposed to use optical distance measurement. The optical distance measurement device or apparatus may comprise an alignment mechanism or beam which is connected to viewing portion **30** or other display to inform an operator when the optimal alignment distance has been obtained. It is also understood that optical distance measurement apparatus may be connected to second free end **22**. In another exemplary embodiment, the optical distance measurement may comprise an alignment apparatus that is connected to a circuit board or processor (not shown) that will cause the device to automatically take a measurement when the optimal distance has been obtained, thus

reducing or eliminating the chance for operator error during measurement using the infrared device. Other distance measurements such as optical by reflectance, ultrasound, lasers, and the like can also be used.

Embodiments of the sensing apparatus as described in this disclosure may further include an extension or tip shaped to be comfortably positioned at ABTT terminus site **16** for measuring temperature and biological parameters without discomfort to the subject or patient. The extension in contact with the skin at ABTT terminus **16** is shaped in accordance with the anatomic landmarks and the geometry and size of ABTT terminus site **16**. IR radiation sensor **42** is positioned in the extension, and in an exemplary embodiment, sensor **42** is spaced away from the skin. However, sensor **42** may also rest directly on the skin of ABTT terminus **16**. Sensor **42** may also be positioned within the volume of second free end **22**, but spaced a distance from the skin of ABTT terminus **16** during measurement. Another exemplary embodiment specialized wave guide for receiving radiation emitted from ABTT site **16** is disclosed FIG. **52** and indicated generally at **162**. Wave guide **162** includes IR sensor **42** disposed at a first end **160** of a probe **168**, which is the end intended to be positioned on or adjacent the skin of ABTT terminus **16**. An exemplary distance **164** of IR sensor **42** from the end of probe **162** to the location of IR sensor **42** inside the probe is equal to or less than 30 mm, is preferably equal to or less than 15 mm, is more preferably equal to or less than 10 mm, and is most preferably equal to or less than 5 mm. An exemplary outside diameter **166** of the open end of the probe is equal to or less than 12 mm, is preferably equal to or less than 8 mm, is more preferably equal to or less than 6 mm, and is most preferably equal to or less than 4 mm. An exemplary diameter **168** of the active region of IR sensor **42** is equal to or less than 8 mm, is preferably equal to or less than 5 mm, is more preferably equal to or less than 3 mm, and is most preferably equal to or less than 2 mm. Probe **162** houses IR sensor **42** and associated electrical connections between IR sensor **42** and signal processing circuitry (not shown). First end **160** of probe **162** is preferably an open end to permit IR transmission to IR sensor **42**. However, first end **160** may incorporate a window or lens that readily transmits IR energy. It should be understood that probe **162** may incorporate a disposable probe cover **172** that can be replaced to avoid cross-contamination among patients.

The entire sensing portion, including the extension, may be disposable, to help prevent the spread of germs or diseases that may be transmitted through contact with an eye or related fluids. In an alternate embodiment, the IR sensing portion itself, the extension, or both may be covered by a sheath or sleeve of a disposable, sterile material. A variety of wave guides, as disclosed herein, can be used in accordance with the geometry of ABTT terminus **16** and the principles of the disclosure.

In the present disclosure, infrared sensor **42** is used in the sensing portion of the device to measure body temperature through ABTT terminus area **16**. In alternate embodiments, reflectance spectroscopy, ultrasound, Raman spectroscopy, and the like may be used in the device to determine biological parameters, such as temperature or measurement of analytes, including glucose, cholesterol, ethanol, sodium, potassium, urea, creatinine, liver enzymes, heart enzymes, and the like, measurement of antibodies, and the like, from ABTT target area **16**.

FIGS. **63** and **64** show another sensing device or apparatus in accordance with an exemplary embodiment of the present disclosure and indicated generally at **340**. Sensing device **340** includes a sensing portion **342** that is at a first angle **344** when viewed from a front or end of sensing device **340**, as shown in FIG. **63**, and a second angle **346** when viewed from a top of sensing device **340**, as shown in FIG. **64**. Exemplary embodiments of first angle **344** can be the same as for predetermined angle **14**. Exemplary embodiments of second angle **346** can be the same as angle **36** shown in FIG. **16**. One benefit to the configuration of FIGS. **63** and **64** is that sensing portion **342** is angled to optimally mate with ABTT terminus **16**, which can make it easier for some subjects or patients to orient sensing device **340** with respect to ABTT terminus **16** when making a measurement of ABTT terminus **16**.

Sensing device **340** includes other features that may be incorporated in other sensing device embodiments described herein. Sensing device **340** is configured to rotate from the orientation shown in FIG. **63** by two times angle **346** to enable sensing device **340** to measure either right or left ABTT terminus **16**. In an exemplary embodiment, rotation of sensing portion **342** from the left to the right may be accomplished by a rotating interface **348**. Rotating interface **348** may be positioned in a fixed orientation by engagement of a detent **350** with an engaging apparatus, device, or mechanism **352**, which may be operated or actuated by an actuation device or button **354**. Each detent **350** is located to establish second angle **346** in a left, or counter clockwise rotation from a vertical direction along axis **34**, or to establish second angle **346** in right, or clockwise rotation from a vertical direction along axis **34**.

Sensing device **340** further includes an extension **356** that is configured to mate with the unique area around ABTT terminus **16** to aid in positioning sensing portion **342** for measurement. Extension **356** is configured to be removable such that extension **356** can be configured in a right version and a left version to mate with right ABTT terminus **16** and left ABTT terminus **16**. In an exemplary embodiment, extension **356** is formed of a dark colored, semi-rigid plastic, which may be sterilized or may be disposable. It should be understood that extension **356**, or a similarly configured extension **356**, can be attached to any of the sensing devices disclosed herein.

It should be understood, as shown in FIG. **63**A, that second free end **22** of sensing portion **342** can preferably include an essentially convex or round surface **357** configured to mate with the unique essentially concave area of ABTT terminus **16** to aid in scanning the area of ABTT terminus **16** by moving second free end **22** around the center of ABTT terminus **16**. Convex end **357** preferably includes an opening **359** configured to receive radiation **361** emitted from ABTT terminus **16**. It should be understood that this disclosure includes a method for determining the center of ABTT terminus **16** or hot spot, including a first step of moving second free end **22** in apposition to the skin of ABTT terminus **16** along the "scanning area," the scanning area including the region along the side of the nose and the area of the medial half of the upper eyelid between the eye and the eyebrow, a second step of determining the highest temperature, and a third step of reporting the detected highest temperature. It should be understood that the method may include a non-contact method for scanning the "scanning area".

To accomplish the method, second free end **22** is configured to have a maximum diameter equal to or less than 15 mm. In another embodiment, second free end **22** is configured to have a maximum diameter equal to or less than 12 mm. In yet another embodiment, second free end **22** is configured to have a maximum diameter equal to or less than

7 mm. In a further embodiment, second free end **22** is configured to have a maximum diameter equal to or less than 5 mm.

FIGS. **63**B to **63**F show exemplary scanning methods and preferred areas being scanned. FIG. **63**B shows the most frequent location for ABTT terminus **16** and two preferred boundaries of an area **363** and an area **375** to be scanned or covered by a sensor, by contact or non-contact with a sensor. Larger area **363** demarcated by dashed lines includes the following boundaries: a nose **365**, an eyebrow **367**, which includes eyebrow **367** but not the forehead, a lateral end of an upper eyelid **369**, and a superior portion of an eyeball **371**, including the caruncle and tear duct **373**. Smaller scanning area **375** is demarcated by solid lines has the following boundaries: nose **365**, eyebrow **367**, including eyebrow **367**, but not the forehead, the mid half of upper eyelid **377**, and a free edge of an eyelid **379**.

Considering the most likely position of ABTT terminus **16**, scanning a smaller area reduces time for detecting the main point or hot spot of ABTT terminus **16**. FIG. **63**C shows a first exemplary method, including a preferred spiral motion for scanning, initiating at a center around ABTT terminus **16** and moving to a periphery as per arrows **381** and **381***a*. FIG. **63**D can represent a second exemplary method or step that includes a spiral motion starting at the periphery and moving to ABTT terminus **16** as shown by arrows **383** and **383***a*. FIG. **63**E shows a third exemplary method for scanning area **363**, including a left to right horizontal motion toward the nose as per arrow **385** for left ABTT terminus **16**, followed by a right to left motion as per arrow **385***a*. FIG. **63**F can represent fourth exemplary method or a second step to the step of FIG. **63**E that includes an up and down motion for scanning area **363**, starting at a lower edge adjacent to the nose as per arrow **387** and moving upwards, followed by a downward motion as per arrow **387***a*. It should be understood that a method that focuses on the most frequent location of ABTT terminus **16**, may include focusing on ABBT terminus **16** with short right and left motion, and short right and left motion that includes a preferred area measuring from the center of the ABTT terminus a diameter equal to or less than 25 mm, preferably a diameter equal to or less than 15 mm, and most preferably a diameter equal to or less than 10 mm.

FIG. **63**G shows another exemplary scanning area **393** that is demarcated by solid lines, and that has an essentially triangular shape and the following boundaries: nose **365**, eyebrow **367**, including eyebrow **367** but not the forehead, and a line that starts at the lateral end of an eyebrow **389** and a lateral corner of an eye **391** terminating at nose **365**.

FIG. **63**H shows an exemplary scanning area for an animal to identify the equivalent of the ABTT terminus in humans, represented in FIG. **63**H by a canine species. A scanning area **395** demarcated by solid lines has an essentially triangular shape and the following boundaries: an upper portion of a nose **399**, an edge of an upper eyelid **403**, and an edge of an lower eyelid **401**, including the transition area **397** previously described (encompassing an anterior corner of an eye and lacrimal duct area.

FIG. **63**I shows another exemplary scanning area configured with a smaller dimension **405** in accordance with the present disclosure, demarcated by dashed lines that have the following boundaries: an upper portion of nose **399**, a mid portion of an eyeball **407** at a level of an edge of an upper eyelid **409**, and an edge of a lower eyelid **411**, including the transition area and a medial eye corner, but not a lateral eye corner **413**. Scanning area **415** is preferable for scanning the ITP for primates, including chimpanzees, and preferably includes both a transition area **417** at a medial corner and a lateral eye corner **419**, as shown in FIG. **63**J. Motions similar to the motions shown in FIGS. **63**C-**63**F can be used for scanning areas **395**, **405**, and **415**.

Sensing device **340** further includes a transmitter **358** configured to receive data from a sensor such as those described herein. Transmitter **358** then transmits the data to a receiving device **360**, such as a cell phone, computer, tablet, etc., which displays the received data. Sensing device **340** may be configured to transmit complete video information to receiving device **360**, or receiving device **360** may include an application or program formatted to display information received from sensing device **340**.

FIG. **65** is a side view of another sensing device or apparatus in accordance with an exemplary embodiment of the present disclosure and indicated generally at **362**. Sensing device **362** includes a sensing portion **364** that is rotatable about a rotating interface **366** that is positionable at predetermined angles, similar to the configuration of FIGS. **63** and **64**. Rotating interface **366** can include detents **368** configured to receive an engaging apparatus **370**, which may be operated by an actuation device, apparatus, or mechanism **372**. Sensing apparatus **362** further includes a viewing or display apparatus **374** that includes a first display **376** configured to be in a location readily viewable by a subject or patient **380**, and a second display **378** configured to be in a location readily viewable by an operator **382**, which can be a nurse, doctor, technician, care giver, or other person conducting a measurement on subject **380**. It should be understood that in an exemplary embodiment, display apparatus **374** may be configured to include only one display such as first display **376** that can be rotated to allow first display **376** to be viewed by either patient **380** or operator **382**.

The dual display configuration of apparatus **374** is beneficial for multiple reasons. When sensing device **362** is used on a child, for example, first display **376** may present a short subject, such as an animation, humorous event, action event, or the like, while the operator, which may be a parent in this example, receives information about the child's condition. The displayed image for the child helps to reduce tension of the child and may even encourage the child to accept the device in exchange for seeing the short subject. Of course, first display **376** and second display **378** may also present the same information, or may present a display selected by subject or patient **380** while operator **382** views data output of sensing device **362**.

In an exemplary embodiment, an IR sensor may be an array of infrared sensitive pixels configured as a camera, such as the IR sensor shown in FIG. **66** and indicated generally at **384**. FIG. **66**B also shows a stylized output of IR sensor **384**, which may be analyzed in a controller to determine, for example, a peak temperature **386** of ABTT terminus **16**, and an average temperature **388** of ABTT terminus **16**. In an exemplary embodiment, peak temperature **386** is the highest temperature indicated by a limited number or one pixel element **390** of IR sensor **384**. Also in an exemplary embodiment, average temperature **388** of ABTT terminus **16** can be determined as a region of temperatures within a particular temperature band of the peak temperature, such as a percentage of peak temperature **386**, or a band measured in degrees, such as 0.1 degrees of the peak temperature. IR sensor **384** can also be configured to provide a map **392** of temperatures around ABTT terminus **16**, which can then be analyzed for abnormalities.

As previously discussed, a sensing device or apparatus may include an extension that is configured to be attached to

an end of a sensing portion to separate the sensing portion from a patient or subject and that permits sterilization or disposal of the extension. An exemplary extension in accordance with the present disclosure is shown in FIGS. **67** and **68** and indicated generally at **394**. Extension **394** is configured to be securely attached or positioned on a sensing portion, such as sensing portion **396** shown in FIGS. **67** and **68**. Extension **394** includes open area **499** and may include an interior chamfer **398** to aid sliding extension **394** over a corner **400** of sensing portion **396**. In an exemplary embodiment, extension **394** is configured to include a ring-like configuration **433** and is formed of a dark, semi-rigid or rigid plastic, with dark including dark gray, dark blue, dark red, black, etc. In an exemplary embodiment, extension **394** is configured as an annulus or ring. A benefit of extension **394** is that it is readily removable for sterilization or disposal.

Though sensing devices and apparatuses to measure ABTT terminus **16** have generally been shown as including a handle, buttons, and the like, a sensing device may be small device configured to mate with, for example, a cell phone, tablet, or other small electronic device, such as sensing device shown in FIG. **69** and indicated generally at **402**. Sensing device **402** can include, in an exemplary embodiment, IR imaging array **384**. In an exemplary embodiment, sensing device **402** includes a plug **404** for mating with a cell phone or other compatible device. In an exemplary embodiment, sensing device **402** is configured to include an IR led **406** to provide illumination for IR receiver or imaging array **384** to improve the image provided on imaging array **384** to help locate ABTT terminus **16**.

FIG. **70** shows another sensing device in accordance with an exemplary embodiment of the present disclosure and indicated generally at **408**. Sensing device **408** is similar to sensing device **402**, but uses a wireless transmitter or transceiver **410** in place of or in addition to plug **404**.

FIGS. **71-75** show exemplary configurations of the output of the sensing devices and apparatus of the present disclosure, including, as an example, sensing devices **402** and **410**. In the exemplary embodiment of FIG. **71**, an electronic device **412** includes a display **414**. The software for display of data from a sensing device in this embodiment is free or very low cost, but appears with advertisements to help subsidize the cost of the software or the sensing device, or both. After the advertisement portion is complete, which can be configured to play during measurement or data acquisition and analysis, the results of the measurement can be displayed, for example, as shown in FIG. **72**.

An upgraded version of display software, such as is shown in FIG. **73**, can be configured to provide additional information to a user, such as, for example, risk of infection, risk of stroke, etc. Such upgraded software may be provided at an additional cost, as an incentive to purchase a more sophisticated sensing device, or free.

Software may be further upgraded as shown in FIGS. **74** and **75** to provide data for both ABTT terminuses **16**, to provide analysis and/or diagnostics, as shown in display area **416** of electronic device **412**, including displayed data, such as map **392** in FIG. **66**B, and may be without advertisements. As with the embodiment shown in FIG. **73**, this embodiment may be provided at an additional cost, as an incentive to purchase a more sophisticated sensing device, or free, for example, as a promotional device.

Sensing device **10** in accordance with an exemplary embodiment of the present disclosure includes handle portion **24**. Handle portion **24**, which may also be described as an arm portion **24**, may be used by an operator or user for holding sensing device **10**. In an exemplary embodiment, as shown in FIGS. **1-17**, arm or handle portion **24** is connected to body portion by adjustable connection mechanism **26**, and thus handle portion **24** is adjustably positioned with and adjustably connected to body portion **20** wherein a plurality of orientations of handle portion **24** may be obtained. The adjustable nature of arm or handle portion **24** allows for a plurality of device holding configurations. Exemplary embodiment sensing apparatus **10** including handle portion **24** is configured so that an operator may either take a temperature measurement of another person, or of himself or herself.

In a first scenario, a doctor or other medical practitioner may use sensing apparatus **10** for measuring the body temperature of a patient or subject. For a single sensing device **10** to have the dual uses described herein, one aspect of the disclosed embodiments is that adjustable arm portion **24** allows for better balance of sensing device **10** during measurement. In one embodiment, arm portion **24** is connected to body portion **20** using adjustable connection mechanism **26**, which may include a hinge, screw fastener, and/or other suitable adjustable method of connection which allows the arm position to be rotated from a straight or 180 degree configuration related to body portion **20**, as shown in FIG. **1**, to a 90 degree vertical orientation, as shown in FIG. **2**.

The 180 degree orientation of FIG. **2** enables an operator to use IR sensing device **10** on himself, so that sensing device **10** is optimally balanced and stable during use. The operator may comfortably use sensing device **10** with his arm extended, so as to achieve the ideal angle for reaching ABTT target area **16** with sensing device **10**. Alternatively, the 90 degree orientation of FIG. **2** provides better stability and balance for an operator to take measurements of another person. The 90 degree orientation also allows for better arm positioning for the operator during use, as the elbow can be easily kept near the body without affecting balance. This orientation enables sensing device **10** to be used in a clinical setting, such as a doctor's office-type setting, where space may be limited.

In alternate embodiments, arm portion **24** may also be positioned to any suitable vertical orientation between 90 and 180 degrees. As is presented in FIGS. **2-6**, arm portion **24** may also be joined to body portion **20** by adjustable connection mechanism **26** that allows arm portion **24** to be rotated 90 degrees to the left or right, allowing handle portion **24** to rest at a 90 degree orientation in the horizontal plane with body portion **20**, as shown in FIGS. **3** and **5**, contrasted with the aforementioned vertical orientation of handle portion **24** shown in FIGS. **1**, **4** and **6**. In alternate embodiments, adjustable connection mechanism **26** may allow for 360 degrees of rotation, so that when handle portion **24** is at the 90 degree orientation in relation to body portion **20**, it may be rotated in a full 360 degrees around body portion **20**. As shown in FIGS. **11** and **12**, adjustable connection mechanism **26** may also allow handle portion **24** to be rotated around body portion **20** when handle portion **24** is oriented 180 degrees in relation to body portion **20**. The many adjustable orientations of arm portion **24** related to body portion **20** allows an operator to position arm portion **24** so that it is most comfortable for use and, most importantly, adjusted for the anatomy of ABTT terminus area **16**, thereby allowing optimal measurements.

Alternate embodiments may be found in FIGS. **13-39**, in which an arm portion is immovably fastened to a body portion so that the handle orientation is fixed and may not be adjusted. FIGS. **13-15** show an example of a sensing device **200** where an arm portion **202** is immovably fixed in an

approximately 90 degree orientation with respect to a body portion **204**. This orientation would be ideal for a device used in a setting such as a doctor's office, where an operator administers a measurement of another person. FIGS. **18-22** show a sensing device **230** where an arm or handle portion **232** is immovably fixed in an approximately 180 degree orientation with respect to a body portion **234**. This orientation is ideal for sensing devices for home use or similar settings where an operator takes temperature measurements on himself.

It may be challenging for some users to find ABTT terminus **16** easily. Accordingly, in an exemplary embodiment, as shown in FIGS. **13-15**, a nose interface **208** may be attached to a portion of sensing device **200**. Nose interface **208** may be positioned on a sensing portion **210** of sensing device **200**. Nose interface **208** may include a cavity **220** configured to interface with a human nose. Nose interface **208** may be adjustable for varying nose sizes and shapes, and nose interface **208** will typically be formed of a soft or padded material, such as plastic or foam. Nose interface **208** may also be adjustable in orientation with respect to sensing portion **210** to refine the orientation of sensing portion **210** with respect to ABTT terminus **16**. Nose interface **208** may be permanently fixed or removable and disposable.

It should be understood that the handle or arm portions disclosed in the various embodiments may be comprised of any suitable material, such as wood, metal, metal alloys, plastic, or other synthetic substances. The arm portion may also be covered in a rubber, plastic, or other natural or synthetic gripping surface, that can be removable or non-removable, disposable, reusable, or the like. The arm portion may also be configured to have an ergonomic shape, with finger grips, with a slight bulge, curvature, or rounding of the free end. The arm portion may also be appropriately weighted to provide for better balance and control.

In an exemplary embodiment, sensing device **10** includes switch **28** located on an outer portion of sensing device **10** for activating the measurement function and other functions of the device. In one exemplary embodiment, as shown in FIG. **1**, switch **28** may be located on an underside **70** of body portion **20** of sensing device **10**, on an outer surface of body portion **20** of sensing device **10**. This configuration is ideal for a sensing device configuration that comprises an adjustable handle feature, as switch **28** is not affected by the changing orientation of arm portion **24**. It should be understood that in another exemplary embodiment the switch can be configured as a trigger switch **29** as shown in FIG. **2**. In an alternate embodiment, as shown in FIGS. **13** and **14**, when arm portion **202** is immovably fixed in the 90 degree orientation in relation to body portion **204**, switch **28** may be located alongside arm portion **204**. This orientation is ideal for use when a measurement is being administered by an operator on another person. In this "trigger-like" configuration, sensing device **200** may be activated by a simple action of the forefinger, for example. In yet another embodiment, as is shown in FIGS. **18** and **20**, when arm portion **232** is immovably fixed in the 180 degree orientation with respect to body portion **234**, switch **28** may be located on an upper side **206** of arm portion **202**. This configuration allows for easier administration of an operator on himself using a forefinger when gripping arm portion **202**. In FIGS. **23** and **24**, this 180 degree orientation is also shown with switch **28** positioned on an underside **242** of an arm portion **244** of a sensing device **240**. This configuration would allow self-administration with sensing device **240** being activated by an action of the thumb, for example. It should be understood that any combination of switches can be used, as well as multiple switches.

In an exemplary embodiment, switch **28** is of a hard key-type, which is physically activated by the operator. In alternate embodiments, switch **28** may be activated using one or more soft-keys, a touch screen, voice commands, remote control, or other activation configurations, including wireless or wired activation via a cell phone, watch, tablet, or any computing device.

In an exemplary embodiment, switch **28** is configured to activate temperature measurement or other measurements such as concentration of substances or any analytes by activating the IR sensing portion, such as sensing portion **12**. In alternate embodiments, switch **28** may also be used to turn the sensing device on/off, or to activate the display, storage, or transmission of information created by the sensing device.

When a measurement is being taken using the ABTT IR sensing device as described herein, many times a viewer, or the person whose temperature is being measured, will have a fright reaction to the sensing portion, which, because of the location of ABTT terminus **16**, is directed to a position very close to the eye during measurement. When an object appears to be heading toward the eye, it is often a first instinct to flinch, recoil, or otherwise move the head from the object in question. To alleviate some of the fright reaction associated with the use of the ABTT infrared sensing device, an exemplary ABTT sensing device is configured to include viewing portion **30**, which assists in diverting the attention of the patient or subject away from sensing portion **12**, to reduce a flinch, recoil, or other head movement during the approach of sensing portion **12** and while measurements are being taken. Viewing portion **30** may include, for example, patient friendly animation, an amusing short subject, videos, pictures, etc.

Exemplary embodiments of the sensing device or apparatus disclosed herein often include a viewing portion, such as viewing portion **30** shown in FIG. **1**. Viewing portion **30** can be represented by a slide screen, a digital viewer, a standard display, or the like. Viewing portion **30** may include, as shown in at least FIG. **1**, an upper portion **72** and a lower portion **74**. Lower portion **74** is positioned on and attached to body portion **20** of sensing device **10**, and may be positioned on and attached to body upper portion **32**. Upper portion **72** is positioned on and attached to lower portion **74**, and is configured to extend into a patient or subject's field of view. It should be understood that the sensing device or apparatus can include a video camera or photo camera (not shown) for filming ABTT terminus **16** and facilitate positioning the apparatus in the proper location to interface with ABTT terminus **16**, with the acquired images being displayed on viewing portion **30**, or alternatively on the screen of separate device such as a cell phone, computer, watch, and the like.

It should be understood that the word "slide screen" as used in this disclosure may refer to any apparatus or device for viewing an image or words, including any screen such as electronic, digital, LED, OLED, LCD, plasma, and the like.

A slide screen is defined herein as a relatively small component, which in an exemplary embodiment has a rectangular or square shape, and which may be either movably or immovably fixed to body portion **20** of sensing device or apparatus **10** for measuring body temperature or any biologic parameter through the ABTT by measurements made at the ABTT terminus **16**. Lower portion **74** of the slide screen or viewing portion **30** is fixed to upper side **32**

of body portion **20** of sensing device or apparatus **10**, and is made of a rigid material so that a free or unsupported end **76** of slide screen or viewing portion **30** extends into the patient or subject's field of view or vision when sensing device or apparatus **10** is in use. A rigid material may be, for example, plastic, rigid paper, or other synthetic materials. It should be noted that a person looking at viewing portion or slide screen **30** may be a patient, subject, doctor or other medical practitioner, or other individual taking a measurement, and any person looking at viewing portion or slide screen **30** may be described as a viewing person or viewer. Because viewing portion **30** may be configured to display an image in two, opposite directions, a viewer on the same side as sensing portion **12** may be described as a patient or subject viewer, and a viewer on the opposite side of viewing portion **30** may be described as a testing or monitoring person, such as, for example, a nurse.

As is shown in FIGS. **1-29**, viewing portion **30** comprises upper, horizontally oriented rectangular or square portion **72**, and lower, vertically oriented portion **74**. In an alternative embodiment shown in FIGS. **30-34**, sensing device **128** includes a viewing portion **130** and a body portion **134**. Viewing portion **130** includes a square side or upper portion **132**, which is attached to body portion **134** by lower or attachment portion **136**. In another alternative embodiment shown in FIGS. **35-39**, a sensing device or apparatus **150** includes a body portion **152** and a viewing portion **154** positioned and/or attached to body portion **152**. Viewing portion or slide screen **154** includes an upper or side portion **156** that is shown as a thin, smaller rectangle, and a lower or attachment portion **158** configured to attach upper portion **156** to body portion **152**. It should be understood that slide screen or viewing portion **154** may be any one of a plurality of shapes and sizes so long as slide screen **154** extends into the field of view of a viewer, which may be a patient, subject, tester, or monitor.

Slide screen or viewing portion **30** shown in FIGS. **1-29** is positioned, mounted, or attached to a lateral center of a body portion of the sensing device, such as body portion **20** of sensing device **10**, near to the arm portion of the device, such as arm portion **24** of sensing device **10**. As such, when the sensing device is in use, as is shown in FIGS. **1**, **2**, **11**, **12**, **13**, **15**, **16**, **18**, **20**, **21**, **23**, and **25**, slide screen **30** is positioned directly in the line of sight of the patient or subject and may be seen with both eyes. In an exemplary embodiment, slide screen or viewing portion **30** is mounted or attached to a specific, fixed position on the body portion of the sensing device, for example body portion **20** of sensing device **10**. In another embodiment, the slide screen may be moved horizontally along the axis of the body portion, closer or farther from the viewer, to better facilitate the viewer's ability to focus on the slide screen display. The slide screen may include a variety of lenses for facilitating focusing of an image if the slide screen is located relatively closely to the eye, for example, at less than 15 cm from the eye.

An exemplary distance of viewer portion **30** from second free end **22** to body **20** adjacent to device **26** is 10 cm, the distance of viewer portion **30** from second free end **22** to body **20** adjacent to device **26** is preferably 15 cm, and the distance of viewer portion **30** from second free end **22** to body **20** adjacent to device **26** is more preferably 25 cm, and the distance of viewer portion **30** from second free end **22** to body **20** adjacent to device **26** is most preferably 40 cm. In FIG. **27**A, viewer portion **30** is configured to include a rotating mechanism **25**. Viewer **30** is configured to be mounted or positioned on handle **24**. In an exemplary embodiment, handle **24** is configured to include a housing **27** for storage of viewer **30**. The position of viewer **30** in handle **24** allows a better distance for a patient to see viewer **30**, as shown in FIG. **27**A.

In the alternate embodiments shown in FIGS. **30-39**, the lower or attachment portion **136** or **158** is mounted, positioned, or attached to one side of body portion **134** or **152**, respectively, as opposed to other embodiments where the lower or attachment portion is mounted, positioned, or attached on an upper surface of the body portion. The slide screen or viewing portion may be positioned on either side of the body portion of the sensing device. The slide screen or viewing portion may also be configured to be easily repositioned or moved between sides to meet the viewer's preference and depending on which ABTT target area is being measured; i.e., the left ABTT terminus or the right ABTT terminus.

In an exemplary embodiment of the disclosure, the slide screen portion will have a design in the form of images or text displayed thereon to divert the viewer's attention from the sensing portion of the device. In this embodiment, the images or text may be a printed, drawn, or projected image; for example, a cartoon, quote, photograph or other still image, video clip, or an advertisement may be displayed. It should be understood that any combination of images and text may be incorporated that would distract a patient or subject being measured from the sensing portion of the sensing device. Such images or text may be stored in non-volatile memory, may be received wirelessly from another device, such as a computer, satellite receiver, cable box, or the like, or may be received wirelessly from the internet or a cellular system.

In a case where the slide screen design is an advertisement, for example, it may be necessary to remove the current slide or image and replace it with another with a more current advertisement. In an exemplary embodiment, the slide screen or viewing portion may be mounted or configured using a type of sliding mechanism that allows the slide screen to be removable, as well as a fastener such as a pin or clip. In a preferred embodiment, the lower portion of the slide screen comprises circuitry (not shown) designed to connect with a receiving portion (not shown) of the body portion of the sensing device that, when the viewing portion is mounted to the body portion of the sensing device, allows the viewing portion to be activated. In an exemplary embodiment, switch **28** of the sensing device may also be linked to the connection of the slide screen so that the sensing device may not be activated without a slide screen appropriately positioned or mounted in place.

In an exemplary embodiment, the slide screen or viewing portion can have a radio frequency ID (RFID) tag, a chip, an electrical pad, or other apparatus for connecting the slide screen or viewing portion with the electrical circuitry (not shown) of the sensing device, thereby activating the sensing device for measurement. In a variation of this exemplary embodiment, it would be necessary for the operator to purchase a new slide screen or viewing portion occasionally to continue taking measurements with the sensing device. The slide screen or viewing portion can include non-volatile memory or time monitoring apparatus to allow an expiration to be used to determine the life of a particular slide screen or viewing portion, i.e., determine the time period or interval in which a particular slide screen or viewing portion can activate the sensing device for measurement. In another exemplary embodiment, a clock (not shown) to allow a specific period of time for use of the device can be used. In addition, the internal clock or a counter as part of the internal

circuitry (not shown) of the sensing device can be used to determine the life of the sensing device and/or the number of measurements available. Note that this exemplary embodiment can be used for any previous embodiment of a thermometer or other measuring device, in addition to embodiments that include a slide screen or viewing portion. In a further exemplary embodiment, the slide screen or the body portion of the sensing device may comprise a controller or processor (not shown) and a separate display configured to notify the operator when a threshold period of time has been exceeded and the current slide must be replaced.

In an alternate embodiment, the slide screen may be comprised of a display that may be, for example, an LCD screen where images in the form of video are displayed. In this embodiment, the slide screen or body portion of the device may comprise, in addition to the necessary circuitry and controller or processor (not shown), an internet connection or wireless transmission capabilities, as well as a speaker, an audio jack, an earphone connection, or other component for providing the viewer with audio content. In such embodiments, the slide screen would not need to be removable as new content could be uploaded without the need to physically remove and replace the slide screen.

In an alternate embodiment, the slide screen or viewing portion may configured to display content, either in the form of still images or video images, on both sides so that the viewer and the operator are both exposed to content. The slide screen or viewing portion may display the same information on both sides, or it may display different content to each of the viewer and operator. For example, on a device that is used in a doctor's office, an advertisement targeted towards consumers may be displayed on the portion of the display facing the viewer. On the other, opposite side, facing the operator, display may present a thermal display to help locate ABTT terminus **16**, or an advertisement that may be, for example, a pharmaceutical advertisement targeting medical professionals. It should be understood that, in accordance with the above description, the slide screen with dual displays may be constructed of any appropriate material and may be of any appropriate shape and size. In an alternate embodiment, the slide screen may have two displays for video content, such as LCD displays and the like, which are each in the same component, but which are facing in opposite directions. This dual-sided display could be connected to display the same content on both sides. Alternatively, the dual-sided displays could be independent, separately connected, or disconnected to enable displaying two independent images.

In an alternate embodiment, the slide screen component, digital viewer, or display, instead of being mounted onto a handheld device as described above, may be mounted onto another support structure for measuring, continuously monitoring, or treating biological parameters using ABTT terminus **16**. Non-limiting examples of such support structures are clips, eyeglasses, goggles, masks, helmets, caps, headbands, and other wearable or non-wearable support structures, including table-top or wall mounted. It should be understood that the apparatus disclosed herein can be used for treatment, and in such embodiments the sensing portion is replaced by a treating portion such as including an apparatus, device, or mechanism to deliver heat or cold to ABTT terminus **20**, or any other type of electrical or electromagnetic energy.

In home use, or in other situations where an ABTT sensing device is used or transported where a mirror is not readily available, it would be convenient to provide such a mirror to enable a person to take their own measurements. A mirror may be incorporated into a transport container, shown in FIGS. **49-51** and indicated generally at **300**. Transport container **300** includes a storage compartment **302** configured to hold the ABTT sensing device, and a lid portion **304**. Lid portion **304** includes a first end **306**, which is movably fixed or attached to storage compartment **302** by a hinge or magnetic apparatus to allow for about 270 degrees of rotation about a pivot axis **310** positioned on first end **306**; a second end **308**, which includes a ledge portion **312** that is configured to rotate at least 45 degrees about a ledge pivot axis **314** located at second end **308** of lid portion **304**, and a mirror portion **316** fixed to lid portion **304**.

Transport container or box **300** is configured to provide safe storage of a sensing device or apparatus in a home use setting and is configured to provide a container for transportation so the ABTT sensing device could be readily available for temperature measurements away from home in settings such as, for example, travel, sporting events, competitions, and outdoor activities. Storage compartment **302** of transport container **300** may include an insert (not shown) designed to fit the size and shape of the ABTT sensing device exactly, so that the sensing device does not shift around during movement. This insert could be made of any suitable material that is soft and protective, such as plastic which is covered in felt or cloth, a foam, a gel, or a cushion material that has been shaped to hold specific portions of the ABTT sensing device. It should be understood that any suitable material may be used for both the composition of the box itself and for the composition of the interior of the storage compartment inside, including any insert or padding. In an exemplary embodiment, mirrored lid portion **304** is designed to enable a user to see their face easily, so as to assist a user in guiding the device towards ABTT target area **16** with ease and accuracy. Since the ABTT sensing device or apparatus is a handheld device, the sensing device may not always be operated when a mirror is easily accessible. In such situations as a sporting event or outdoor activity, as described hereinabove, a mirror may be difficult to find. As shown in FIGS. **49-51**, transport container **300** is configured and arranged so that lid portion **304** may be rotated approximately 270 degrees around lid pivot axis **310** so that lid portion **304** creates an approximately 90 degree angle with respect to a bottom portion **318** of transport container **300**, thus acting as a supporting arm. The stability of transport container **300** is achieved by including complimentary magnetic fasteners or other suitable fasteners, such as hinges, in storage compartment **302** and in lid portion **304**. This configuration allows mirror **316** to be displayed stably so a user may then, without having to hold or support storage container **300** by hand, easily see ABTT target area **16** to guide a sensing portion for measurements using the sensing device. Once a measurement has been taken, the ABTT sensing device or apparatus may be returned to storage compartment **302**, and lid portion **304** may then be returned to its original position to serve as a cover for storage compartment **302**.

As is described hereinabove, the sensing portion of the apparatus comprises a sensor for gathering brain temperature measurement data or any biological parameter data. This sensor is, in turn, connected to various devices, apparatuses, or mechanism configured to transmit, convert, report, and store data, such as input and output coupling circuits, display circuits, processors, converters, connectors, and non-transitory memory (not shown). In an exemplary embodiment, these components are located in the body portion of the sensing device, such as body portion **20** of sensing device **10**, are connected using the appropriate

circuitry and wires to the sensing portion of the sensing apparatus, such as sensing portion **12** of sensing device **10**. In alternate embodiments, the system components may be located in the sensing portion itself, or may be suitably located in another portion of the device. The components of the system are connected to a power source, such as a battery or other such internal power source (not shown). It should be understood that a variety of external power sources, such as electromagnetic coupling, can be used, including an ultra-capacitor charged externally through electromagnetic induction coupling and cells that can be recharged by an external oscillator.

In order to report and display temperature measurements, the sensing apparatus must be configured to transmit the finalized measurement value to the user. The transmission directly to the user, without the use of a receiver, may be in the form of a simple light or sound alarm (not shown), which is configured to alert when a specific temperature threshold has been obtained or surpassed. It should be understood that such an alarm may also use a combination of one or more lights and sound. The sound may be a noise such as a buzzer, beep, or other tone, or may be a reproduction of a human voice or other such sound. Measurement data may also be displayed as a numerical value on a digital or LCD screen built into the sensing apparatus, such as viewing portion **30** of sensing device **10**. In such an embodiment, the system would comprise a display output module to convey the temperature value to the display. Such output module may include a software portion to providing proper formatting of the data, and a hardware portion for configuring the information for display. Aside from displaying a numerical value, data may be displayed in the form of charts, spectra, or other visual data presentation arrangements.

Also included in the present disclosure is an apparatus for remotely transmitting temperature and/or biological parameter data. Such an apparatus includes an output transmitter module and a receiver module (not shown). The transmission of data may be executed using passive radio transmission, active radio transmission, or communication by fixed cable. Ultrasonic micro-circuits may also be used for transmission, for which the signal may be transmitted using modulated sound signals, particularly under water because sound is less attenuated by water than are radio waves. In alternate embodiments, the output transmission module may be configured to transmit data via a wireless cellular network or internet network, phone network, or the like.

The present invention also provides a method for detecting body temperature, including the steps of providing a temperature detector positioned near ABTT terminus **16** during temperature detection, and determining the temperature based on the infrared radiation detected or sensed at ABTT terminus area **16**. In another embodiment, the method is based on the anatomy of the ABTT terminus **16** on the surface of the skin. The method includes scanning of the area between the eye and the eyebrow, and in particular, using an arc shape movement of the probe or sensing portion, which follows the curvature of the eyelid from the tear punctum all the way up into the middle of the eyelid following the area of skin between the eye and the eye brow. Such scanning can extend into other areas of the face, head, and neck from the main starting point between the eye and the eyebrow and alternatively including the tear punctum and conjunctival area. The method includes a step of positioning a sensor, such as sensing portion **12** including IR sensor **42**, between the eye and eyebrow, and making lateral, vertical, or circular movements between the eye and the eyebrow, with a controller or processor in the sensing device adapted to identify the highest temperature and report this high temperature. It should be understood that ABTT terminus **16** may have as a boundary, as shown in FIG. **62**, a nose **322**, in addition to an eye **324**, and an eyebrow **326**, and that an ABTT scanning area **328** may include an area surrounded by those boundaries. Preferably, ABTT scanning area **328** includes, as shown in FIG. **62**, an area surrounded by nose **322** and a medial third **330** of the area between the eye and eyebrow. In an exemplary embodiment, scanning area **328** is an area surrounding ABTT terminus **16** of 10 centimeters in diameter that can be measured for comparison to ABTT terminus **16**. In another exemplary embodiment, scanning area **328** is an area surrounding ABTT terminus **16** of 8 centimeters in diameter that can be measured for comparison to the ABTT terminus **16**. In yet another exemplary embodiment, scanning area **328** is an area surrounding ABTT terminus **16** of 6 centimeters in diameter that can be measured for comparison to ABTT terminus **16**. In yet a further exemplary embodiment, scanning area **328** is an area surrounding ABTT terminus **16** of 3 centimeters in diameter that can be measured for comparison to ABTT terminus **16**. It should be understood that the area scanned preferably includes areas of a truncated circle up to the eyebrow and below the eyebrow.

A series of sounds can be used to provide feedback to identify ABTT terminus **16**. The lack of sound is an indication that the highest temperature between the eye and eyebrow has been found, in a typical situation where ABTT terminus **16** has a higher temperature than the surrounding skin, or an indication where the lowest temperature between the eye and eyebrow has been found, in the less common situation where ABTT terminus **16** has a lower temperature than the surrounding skin. One light or a series of lights (e.g., an LED) in the sensing device would also stop illuminating when the hottest temperature of the area between the eye and the eyebrow was found. The steps include positioning a temperature sensor (contact or non-contact) for resting on the skin or viewing the skin without contacting the skin, the skin corresponding to the skin between the eye and the eyebrow that correspond to ABTT terminus **16**. A next step includes making a motion with the IR sensor to cover the area between the eye and the brow, the motion preferably following the curvature of the groove between the eye and the eyebrow, more preferably in the medial portion (or nasal portion) of the area between the eye and the eyebrow, and adjacent to the nose. Scanning may also include automatically the scanning diameters described herein. It should also be understood that the area between the eyes can be used, and also that both left and right ABTT terminuses **20** can be scanned or measured. A subsequent step includes detecting the highest temperature between the eye and the eyebrow (except in situations where the surrounding skin is warmer than ABTT terminus **16**), and then reporting the highest (or lowest) temperature between the eye and the eyebrow.

A sensing device or apparatus may operate in a variety of modes of operation. One such operational sequence is described in FIGS. **53-59**. FIG. **53** shows a sensing process, generally indicated at **250**. Sensing process **250** begins with a start process **252**, where various registers may be reset to zero or default values, systems are provided with power, and other initializing functions for a sensing device, such as sensing device **10**, are performed. Once start process **252** is finished, control passes from start process **252** to a display ad sequence **254**.

In display ad sequence **254**, a display or viewing portion, such as display or viewing portion **30**, may display a "measuring" screen, such as is shown in FIG. **54**, followed

by a series of advertisements, such as those shown in FIGS. **55-58**. During the display of one or more advertisements, a portion of display **30** may indicate that the sensing device is measuring temperature, for example, by indicating "measuring" somewhere on viewing portion **30**. Once the ad sequence is started, control passes from display ad sequence **254** to a receive sensor data process **256**.

In receive sensor data process **256**, data is received from an IR sensor, such as IR sensor **42** positioned in sensing portion **12**. The data is stored in a memory location (not shown) for later processing. Once data is received from IR sensor **42**, control passes from receive sensor data process **256** to an analyze sensor data process **258**, where the data received from IR sensor **42** is analyzed to determine one or more features of the signal from IR sensor **42**, such as temperature or any biological parameter such as glucose. Control then passes from analyze sensor data process **258** to a perform field of view (FOV) compensation process **260**.

In FOV compensation process **260**, the data from IR sensor **42** is analyzed to compensate for non-ABTT terminus data. Such analysis may be by simple geometric subtraction of temperatures below a peak value, integration of peak temperature areas, curve fitting, or other analysis. In some embodiments, the sensing device is measuring relative temperature with time, and such compensation may be unnecessary, and may be de-selected via optional controls not shown. Once data from IR sensor **42** has been analyzed, control passes to a test data process **262**.

In test data process **262**, the validity of the compensated data is tested. If the data is not valid, e.g., the indicated temperature is outside anticipated predetermined limits, control passes to an adjust compensation parameters process **264**. If the indicated temperature data is valid, then control passes to a temperature limit process **266**.

In adjust compensation parameters process **264**, compensation parameters are modified prior to performing FOV compensation process **260** again. Once compensation parameters are adjusted, process **250** continues at FOV compensation process **260** as previously described.

Returning to temperature limit process **266**, it is determined whether the temperature exceeds a predetermined limit. In an exemplary embodiment, the predetermined temperature may be 104 degrees F. If the predetermined temperature limit is reached or exceeded, control passes from temperature limit process **266** to a display temperature and guidance process **270**. Otherwise, control passes from temperature limit process **266** to a complete ad sequence process **268**.

In ad sequence process **268**, the previously displayed ad sequence transitioned from the display shown in FIG. **57** to a display shown in FIG. **58**, wherein sensor data, shown in FIG. **58** as a temperature, is displayed on a portion of the advertisement from FIG. **57**. In the example of FIG. **58**, the temperature is displayed on an enlarged portion of a license plate of a vehicle shown in FIG. **57**. A similar transition may be from signage associated with a commercial or retail store, packaging of a product, or other images associated with an advertiser. Furthermore, as shown in FIG. **58**, the temperature is "brought to you" by an advertiser. In an exemplary embodiment, temperature data is configured to be shown in a random manner in relation to the time of the advertisement and in relation as to how the temperature value will be displayed. In a car advertisement, for example, the numerical information or data, e.g., temperature data, can be substituted for the number of a license plate. In another exemplary embodiment, a grocery store advertisement may show the numerical value, data, or information, e.g., temperature data, by replacing a price of a product with the numerical value, data, or information.

The benefit of the interactive advertisements shown in FIGS. **57** and **58** is that the payments from the advertisers can help subsidize the cost of the sensing device, making exemplary sensing devices described herein more affordable for home use and for clinical use, such as doctor's offices and hospitals. In the event that a user is uninterested in advertisements, an option may be presented to purchase a code for the specific sensing device to eliminate the advertisements, with each sensing device including its own, unique code, to prevent hacking of a code in one device and transporting the hack to all other devices. It should be understood that the apparatus includes an input apparatus, device, or mechanism such as keypad, touch screen, voice, and the like for entering a code.

Returning to display temperature and guidance process **270**, if the measurement temperature is outside predetermined limits that may constitute a need for medical guidance, for example a call to a doctor or nurse, a trip to the doctor, or a trip to the emergency room, as soon as the temperature data is available, the display shown in FIG. **59** is presented, with guidance that assistance from a medical practitioner should be considered. A sponsoring message may also be presented in the display of FIG. **59**, but will be subservient, i.e., smaller or de-emphasized, as compared to the temperature, which may be in color, such as red, and may flash, along with a suggestion to seek medical attention or advice.

Once process **268** or process **270** are finished, and after a suitable, predetermined interval, such as an interval in the range of 10 seconds to 60 seconds, control passes to an end process **272**, where viewing portion **30** may power off, IR sensor **42** may power off, and other portions of the sensing device may power down to conserve power, which may be battery power or other power.

While various embodiments of the disclosure have been shown and described, it is understood that these embodiments are not limited thereto. The embodiments may be changed, modified, and further applied by those skilled in the art. Therefore, these embodiments are not limited to the detail shown and described previously herein, but also include all such changes and modifications. It should also be understood that any part of series of parts of any embodiment can be used in another embodiment, and all of those combinations are within the scope of the disclosure.

I claim:

1. A sensing device configured to interface with a human Abreu brain thermal tunnel (ABTT) terminus, the sensing device comprising:

a body portion including a first end and a second end;

a handle portion pivotally mounted on the second end of the body portion;

a sensing portion including an infrared sensor mounted on a free end of the sensing portion, an opposite end of said sensing portion being rotatably mounted on the first end of the body portion, the free end being rotatably moveable with respect to the body portion to receive infrared energy from the ABTT terminus, and the sensing portion including a field of view to capture at least the infrared energy from a center portion of the ABTT terminus; and

a viewing portion mounted on the body portion, the viewing portion including a display configured to extend from the body portion, the display also being configured to display data related to the infrared energy captured by the infrared sensor, and the display con-

figured to present an advertisement while the infrared sensor receives infrared energy prior to the display of any data related to the infrared energy captured by the infrared sensor.

2. The sensing device of claim **1**, wherein the display transitions from presenting the advertisement to presenting the advertisement and data related to the infrared energy captured by the infrared sensor.

3. The sensing device of claim **2**, wherein when the display transitions from presenting the advertisement to presenting the advertisement and data related to the infrared energy captured by the infrared sensor, the data related to the infrared energy captured by the infrared sensor is displayed on a portion of the advertisement.

4. The sensing device of claim **3**, wherein the data related to the infrared energy captured by the infrared sensor is temperature data, and the temperature data is presented on an enlarged portion of a license plate displayed on the display during the advertisement.

5. The sensing device of claim **3**, wherein data related to the infrared energy captured by the infrared sensor is temperature data, and the temperature data is presented on a sign of a commercial or retail business displayed on the display during the advertisement.

6. The sensing device of claim **1**, wherein when a measurement determined from the infrared energy exceeds a predetermined value, the display presents a message suggesting that medical advice be obtained in place of the advertisement.

7. The sensing device of claim **6**, wherein a message indicating a sponsor is presented in a portion of the display.

8. A sensing device configured to interface with a human Abreu brain thermal tunnel (ABTT) terminus, the sensing device comprising:

a body portion including a first end and a second end;

a handle portion positioned on the second end of the body portion;

a sensing portion including an infrared sensor, said sensing portion being movably mounted on the body portion, the sensing portion including a first end and a second end, the sensing portion being movably mounted on the body portion by said first end of the sensing portion, and the sensing portion being configured to allow positioning of the second end of the sensing portion to receive infrared energy from the ABTT terminus, and the sensing portion including a field of view to capture at least the infrared energy from a center portion of the ABTT terminus; and

a display mounted on the body portion, the display being configured to display data related to the infrared energy captured by the infrared sensor, and the display configured to present an advertisement to a user while the infrared sensor receives infrared energy prior to the display of any data related to the infrared energy captured by the infrared sensor.

9. The sensing device of claim **8**, wherein the display transitions from presenting the advertisement to presenting the advertisement and data related to the infrared energy captured by the infrared sensor.

10. The sensing device of claim **9**, wherein when the display transitions from presenting the advertisement to presenting the advertisement and data related to the infrared energy captured by the infrared sensor, the data related to the infrared energy captured by the infrared sensor is displayed on a portion of the advertisement.

11. The sensing device of claim **10**, wherein the data related to the infrared energy captured by the infrared sensor is temperature data, and the temperature data is presented on an enlarged portion of a license plate displayed on the display during the advertisement.

12. The sensing device of claim **10**, wherein data related to the infrared energy captured by the infrared sensor is temperature data, and the temperature data is presented on a sign of a commercial or retail business displayed on the display during the advertisement.

13. The sensing device of claim **8**, wherein when a measurement determined from the infrared energy exceeds a predetermined value, the display presents a message suggesting that medical advice be obtained in place of the advertisement.

14. The sensing device of claim **13**, wherein a message indicating a sponsor is presented in a portion of the display.

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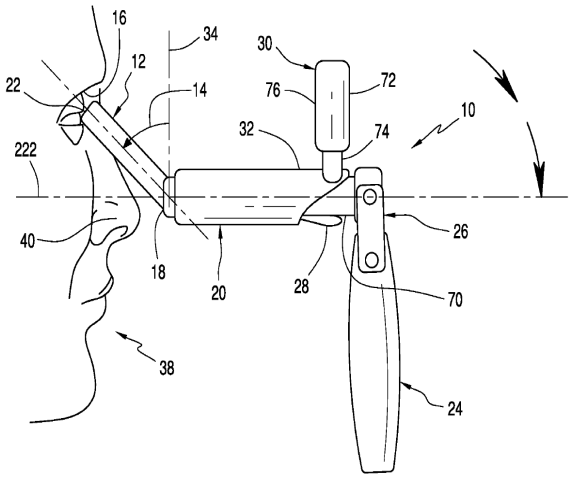
专利名称(译)	用于测量Abreu脑热隧道的红外输出的装置		
公开(公告)号	US10383525	公开(公告)日	2019-08-20
申请号	US15/972605	申请日	2018-05-07
申请(专利权)人(译)	GEELUX HOLDINGS，LTD.		
当前申请(专利权)人(译)	GEELUX HOLDINGS，LTD.		
[标]发明人	ABREU MARCIO MARC		
发明人	ABREU, MARCIO MARC		
IPC分类号	A61B5/01 G01J5/04 G01J5/02 A61B5/00 G06Q30/02 G01J5/00 A61B5/04 A61B5/05		
CPC分类号	A61B5/01 A61B5/4064 A61B5/6814 A61B5/6819 A61B5/6835 A61B5/742 G01J5/0025 G01J5/0205 G01J5/0265 G01J5/04 G01J5/047 G06Q30/0271 A61B5/0064 A61B5/7445 A61B5/015 A61B5/04008 A61B5/05 A61B5/441		
代理机构(译)	史蒂倍克与BRACKETT PC		
优先权	61/926155 2014-01-10 US		
其他公开文献	US20180325381A1		
外部链接	Espacenet		

摘要(译)

描述了一种用于通过Abreu脑热隧道（ABTT）测量脑温数据的医疗设备。大脑温度测量是疾病和健康的关键和普遍指标，是唯一不能被情绪状态人为改变的重要标志。目前，脑温很难测量。然而，本公开描述了一种容易定位Abreu脑热隧道的装置，并且被配置为提供大脑的非接触温度读数。所公开的装置的实施例使个人能够测量他们自己的温度并使医疗专业人员能够测量其他人的温度。