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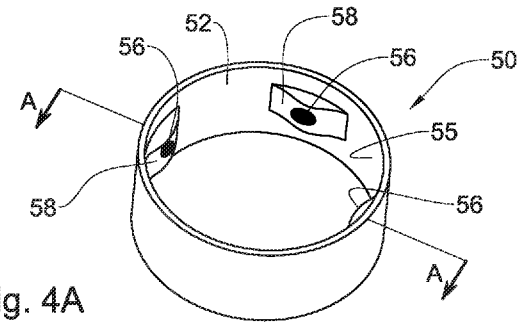

Fig. 4A

(57) Abstract: The subject matter of the present invention concerns a sensor for detecting at least one physiological parameter of an animal at its pre-determined limb, the sensor being configured for mounting on the limb so that its inner surface faces a skin surface of the limb. The sensor comprising: at least one PPG detector configured to obtain a photoplethysmogram signal of the limb, based on which the parameter can be detected; and a mounting member configured for mounting the sensor to the limb so as to allow its PPG detector to frictionally move along the skin surface of the limb and to thereby facilitate removal of dirt when disposed therebetween.

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A SENSOR FOR DETECTING A PHYSIOLOGICAL PARAMETER OF AN ANIMAL

TECHNOLOGICAL FIELD

The presently disclosed subject matter relates to a sensor for measuring a physiological parameter of an animal, in general and in particular, to a sensor for obtaining photoplethysmograph of an animal's limb.

BACKGROUND

Measuring heart rate in animals, such as cattle, plays a major role in managing their wellness, and facilitates maximizing productivity thereof. The primary technology used until today is ECG which requires that the sensor is attached to the animal's chest in close proximity to the heart. This limitation of the measurement location hinders monitoring the heart rate of animals as it is almost impractical to attach a monitor device to their chest.

"Techniques of Measuring Heart Rate in Cattle" by Marjan janžekovič, bogomir muršec and ignac janžekovič (Tehnički vjesnik, Vol.13 No.1,2 Lipanj 2006) discusses various methods of measuring the Heart Rate of animals.

PPG technology allows measurement of the heart rate and additional physiological parameters on various locations of the animal's body, particularly where the skin is thin enough to allow the light of the PPG sensor to penetrate therethrough and reach to the first tissue layer and analyze the blood properties thereof either by analyzing the light reflected thereby or the light transmitted therethrough.

US 20140243617 discloses a wearable apparatus for monitoring various physiological and environmental factors. Real-time, noninvasive health and environmental monitors include a plurality of compact sensors integrated within small, low-profile devices, such as earpiece modules. Physiological and environmental data is

collected and wirelessly transmitted into a wireless network, where the data is stored and/or processed.

GENERAL DESCRIPTION

There is provided in accordance with an aspect of the presently disclosed subject matter a sensor for detecting at least one physiological parameter of an animal at its pre-determined limb, the sensor being configured for mounting on the limb so that its inner surface faces a skin surface of the limb. The sensor comprising: at least one PPG detector configured to obtain a photoplethysmogram signal of the limb, based on which the parameter can be detected; and a mounting member configured for mounting the sensor to the limb so as to allow its PPG detector to frictionally move along the skin surface of the limb and to thereby facilitate removal of dirt when disposed therebetween.

The mounting member can be configured for mounting on the limb such that an inner surface thereof faces the skin surface. The PPG detector is integrated inside a sensing portion. The sensing portion can be defined on a protruding portion protruding from the inner surface such that movement of the mounting member with respect to the limb facilitates removal of dirt disposed between the skin surface and the sensing portion.

The sensing portion can include a light emitting source configured to emit light towards the limb and a light detector configured to detect a portion of the light reflected from the limb.

The sensing portion can include a light emitting source configured to emit light towards the limb and a light detector configured to detect a portion of the light transmitted through the limb.

The light source can be disposed on one side of the inner surface thereof, such that when mounted on the limb it faces one side thereof of the limb and the detector can be disposed on an opposing side of the inner surface, such that it faces a second side of the limb.

The sensing portion can be configured to frictionally move along the skin surface facilitating thereby removal of dirt disposed between the skin surface and the

sensing portion. The size and shape of the protruding portion can be configured in accordance with the shape of the limb on which it can be intended to be mounted.

The mounting member can be a bracelet member and the limb can be a leg member. The protruding portion can be configured to engage hair on the leg, such that movement thereof, with respect to the leg, causes the hair to brush off dirt from the sensing portion. The mounting member can include a shape adapted in accordance with the outer shape of the leg such that the sensing portion engages a skin surface thereon. The bracelet can include a rigid portion configured to firmly hold the sensing portion such that it engages the skin surface, and a flexible portion configured to allow mounting the bracelet on the limb.

The sensor can further include a weight affixed to the mounting member. The weight can be disposed opposite the PPG detector. The weight can be configured to tilt the mounting member such that a first side thereof, on which the weight can be mounted, can be urged downwardly, while a second side thereof, on which PPG detector can be defined, can be urged upwardly. The weight can be defined adjacent the PPG detector such that tilting of the mounting member, urges the weight together with the PPG detector downwardly, allowing thereby the PPG detector to engage the skin surface of the limb. The weight can be integrally formed with the mounting member.

The mounting member includes two or more sensing portions each having a PPG detector defined thereon. The two or more sensing portions are evenly disposed along an inner surface of the mounting member.

The sensor can further include a processing module configured for determining the sensing portion by which the PPG measurements of the limb are obtained. The processing module can be configured to identify one of the sensing portions which engages the skin surface. The processing module can be configured to determine which of the sensing portions engages the skin surface of the limb without dirt therebetween.

The sensor can further include a pressure sensor configured to detect which of the sensing portions engages the skin surface. The pressure sensor can be further configured to detect which of the sensing portions provide the best engagement with the skin surface.

The sensor can further include a processor configured for receiving the PPG measurements and calculate thereby the physiological parameter. The processor can be

integrally formed with the mounting member. The processor can be an add-on module configured to be coupled with the PPG detector.

The sensor can further include an accelerometer configured to detect movement of the animal. The sensor can further include a controller configured to activate the PPG detector in accordance with the data received from the accelerometer. The controller can be configured to activate the PPG detector when the accelerometer indicates that the animal can be unmoving.

There is provided in accordance with a further aspect of the presently disclosed subject matter a sensor for detecting at least one physiological parameter of an animal at its leg, the sensor being configured for mounting on said leg so that its inner surface faces a skin surface of said leg; the sensor comprising at least one PPG detector configured to obtain a photoplethysmogram of the leg, based on which said parameter can be detected; a mounting member configured for mounting said PPG detector to said leg such that said photoplethysmogram of the leg can be obtained.

There is provided in accordance with yet a further aspect of the presently disclosed subject matter a method for detecting heart rate of an animal. The method include movably mounting a sensing portion on a leg of the animal, the sensing portion having a photoplethysmogram detector facing a skin surface of the leg; displacing the sensing portion with respect to the leg such that dirt disposed between the skin surface and the sensing portion can be removed therefrom allowing thereby the photoplethysmogram detector to engage the skin surface; measuring plethysmogram of the leg; and determining the heart rate of the animal thereby.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1A is a top view of a sensor constructed as operative in accordance with an example of the presently disclosed subject matter;

Fig. 1B is a top sectional view of a sensor constructed as operative in accordance with another example of the presently disclosed subject matter;

Fig. 2 is a perspective view of a sensor constructed as operative in accordance with another example of the presently disclosed subject matter;

Fig. 3 is a side sectional view the sensor of Fig. 2, when mounted on a limb of an animal;

Fig. 4A is a perspective view of a sensor constructed as operative in accordance with yet another example of the presently disclosed subject matter;

Fig. 4B is a top sectional view of the sensor of Fig. 4A when mounted on a limb of an animal; and

Fig. 5 is a side view of a sensor of the presently disclosed subject matter when mounted on a leg of a calf.

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1A shows a sensor **10** for detecting at least one physiological parameter of an animal, such as cattle, at its pre-determined limb, for example a leg. The sensor **10** includes a mounting member **12,** here illustrated as a bracelet, configured for mounting on the limb such that an inner surface **14** thereof faces a skin surface of the limb. The sensor **10** further includes at least one sensing portion **15** having a photoplethysmogram detector configured to obtain photoplethysmogram (hereinafter PPG) signal of the limb. The PPG obtained is configured such that one or more physiological parameters of the animals can be detected thereby.

According to an example, the sensing portion **15** includes a light emitting source, such as a light-emitting diode (LED), configured to emit light towards the skin surface of the limb. The sensing portion **15** further includes a light detector, such as a photodiode, configured to detect a portion of the light reflected from the limb, obtaining thereby the PPG signal of the limb. The sensing portion **15** can thus detect the cardiac cycle of the animal, and due to the fact that the blood flow to the skin can be modulated by multiple other physiological systems, the PPG measurements can be utilized for monitoring breathing rate, rumination, and other physiological parameters of the animal, as known.

It is appreciated that according to an example the light detector is configured to detect light transmitted through the limb, as opposed to light reflected therefrom.

Accordingly, the sensor can include a bracelet having a light source disposed on one side of the inner surface thereof, such that when mounted on the animal's limb it faces one side of the limb. The detector, according to this example, is disposed on an opposing side of the inner surface of the bracelet, such that it faces a second side of the limb and it is configured to detected light transmitted from the light source through the limb, such that the PPG of the limb can be measured. It will be understood that this example is suitable in case a sufficient amount of light can be transmitted through the limb, for example when the sensor is mounted on an ear or nose.

The mounting member **12** is configured such that when the sensor is mounted on the animal's limb, for example the leg, the sensing portion **15** frictionally moves along a skin surface of the leg facilitating thereby removal of dirt disposed between the skin surface and the sensing portion **15**.

According to an example, the sensing portion **15** is defined on a protruding portion **20**, protruding from the inner surface **14** such that movement of the bracelet **12** with respect to the leg facilitates removing dirt disposed between the skin surface and the sensing portion **15**.

It is appreciated that the size and shape of the protruding portion **20** can be configured in accordance with the shape of the limb on which the sensor **10** is intended to be mounted. That is to say, if the limb is a cow leg, for example, the protruding portion **20** can engage the hair on the leg, such that movement of the bracelet **12** with respect to the leg, causes the hair to brush off dirt from the sensing portion **15**.

Similarly, the protruding portion **20** can include a shape adapted in accordance with the shape of the limb such that it engages a skin surface thereon. For example, if the limb includes depressions, such as between bones or other tissues, the protruding portion **20** can be configured to engage the depression such that movement thereof with respect to the depression facilitates removing dirt therefrom, thus allowing the sensing portion **15** to obtain the PPG measurements on a skin surface of the depression.

According to the illustrated example the bracelet **12** can include a rigid portion **16a**, and a flexible portion **16b**. The rigid portion **16a** can be configured to firmly hold the sensing portion **15** such that it engages a skin surface of the animal, and the flexible portion **16b** can be configured to allow mounting the bracelet on the animal's limb, such that the movement thereof does not irritate the skin surface.

In addition, the flexible portion **16b** can be configured to allow modifying the size of the bracelet **12** such that the sensor can be mounted on various limbs each having a different diameter or shape by reducing or increasing the diameter of the bracelet.

According to an example the flexible portion **16b** can be made of an elastic material such as rubber, etc., and can be configured such that when the bracelet **12** is mounted on the animal's limb, the bracelet **12** embraces the limb, and limits the movement thereof with respect to the limb. That is to say, the bracelet **12** can be configured to be mounted on a leg, such that the flexible portion **16b** holds the sensing portion **15** about a predetermined location on the leg, however allowing the sensing portion **15** to slightly move with respect to the leg, facilitating thereby the removal of dirt between the skin surface of the leg and the sensing portion thereof.

As shown in Fig. 1B the sensor **26** can include a rigid portion **27** having a sensing portion defined thereon. The rigid portion **27** includes a size and a shape configured in accordance with the shape of the limb **25** on which the sensor **10** is intended to be mounted, herein shown as the shape of the circumference of the leg. The sensor **26** can further include a flexible portion **29**, for example, a strap, configured to surround the leg **25** and to hold the rigid portion **27** such that it frictionally engages a skin surface of the leg **25** removing dirt disposed thereon.

Attention is directed to Fig. **2,** according to an example the sensor **30** can include a mounting member **32,** herein illustrated as a circular bracelet. According to the illustrated example the mounting member **32** is made of a rigid material, and includes an inner diameter configured to be mounted on a limb having a corresponding diameter. As explained hereinabove, in order to allow the mounting member **32** to frictionally move with respect to a skin surface of the limb, the diameter thereof can be configured slightly larger than the circumferential diameter of the limb.

According to the present example, the mounting member **32** includes a protruding portion **40** extending from the inner surface **34** of the mounting member **32** and having a sensing portion **35** defined thereon. The sensor **30** further includes a weight **38** affixed to the mounting member **32** substantially opposite the protruding portion **40** defined thereon. As shown in Fig. **3,** the weight **38** is configured to tilt the mounting member **32**, which, as indicated above, is in a form of a bracelet, such that the

first side thereof, on which the weight **38** is mounted, is urged downwardly, while a second side thereof, on which the sensing portion **35** is defined, is urged upwardly.

Since the diameter of the bracelet is slightly larger than the circumferential diameter of the limb, herein illustrated as a leg **37**, the bracelet can freely move up and down along the leg **37**, tilting thereof, however, urges the sensing portion **35** to engage a skin surface of the leg **37**.

It is appreciated that the weight **38** is configured such that while the animal is moving, and specifically when the leg **37** on which the sensor **30** is mounted is being displaced, the bracelet is frictionally moved along the leg **37**, resulting in removing dirt disposed between the leg **37** and the bracelet. When the animal is at rest, however, the bracelet is tilted under the gravitational forces exerted by the weight **38** mounted on one side thereof, such that sensing portion **35** engages the skin surface allowing the PPG measurement of the leg **37** to be obtained.

According to another example the sensing portion can be defined adjacent the weight, such that tilting of the mounting member, urges the weight together with the sensing portion downwardly, allowing thereby the sensing portion to engage a skin surface of the limb. It is appreciated that in the latter example, the weight of the sensing portion and/or the protruding portion can be configured to replace a weight member, such that the mere weight of the sensing portion urges the tilting thereof downwardly to engage a skin surface.

In the illustrated example, the weight **38** is integrally formed with the mounting member **32**, i.e. the bracelet, for example by forming a segment in which the mounting member **32** is slightly thicker, such that the weight thereof is larger than the weight of other segments of the mounting member **32**.

According to another example, the weight **38** can be made of a material different than the material of the mounting member **32** such as a material having higher specific weight than that of the mounting member. For example, the mounting member **32** can be made of a light weight thermoplastic material, such that mounting thereof on the animal's limb does not bear much weight thereon. The weight **38,** on the other hand, can be made of heavy metals or the like, such that a small amount thereof can exert a sufficient amount of gravitational forces so as to tilt the mounting member **32**. It is appreciated that the weight **38** can be integrally formed with the mounting member **32** and can be such that the segment of the mounting member **32** on which the weight **38** is

mounted is not thicker than other segments. This way, the segment of the weight does not include protruding portions which may irritate the animal's skin.

Reference is now made to Figs. 4A and 4B, according to a further example the sensor **50** it can include a mounting member **52**, herein illustrated as a rigid member in the form of a bracelet, having an inner surface **55** provided with a plurality of sensing portions **56** each being defined on a protruding portion **58**.

As explained hereinabove with regards to the previous examples, since the diameter of the bracelet is slightly larger than the circumferential diameter of the limb **59**, the leg in the illustrated example, the bracelet can freely move up and down along the limb **59**.

The protruding portions **58** and the sensing portions **56** thereon can be evenly disposed along the inner surface **54** such that each sensing portion **56** is defined on one side thereof. This way, when the bracelet tilts, such that one side thereof is urged downwardly, engaging thereby the limb **59** of the animal, one of the sensing portions **56** engages a skin surface of the limb **59**. It will be understood that as the animal moves, the bracelet can be displaced and, thus, when the bracelet is tilted again, the tilting can be in any direction. However, since the sensor includes a plurality of sensing portion **56** each of which is disposed at one side of the inner surface **54** of the mounting member **52**, a skin surface of the limb **59** is engaged by one of the sensing portions **56** in any tilting direction. Accordingly, the PPG measurements of the limb **59** can be obtained by at least one of the sensing portions **56**.

It will be appreciated by those skilled in the art that utilizing a plurality of sensing portions allows disposing the bracelet having a diameter relatively larger than that of the limb **59**, since in any tilting direction thereof at least one of the sensing portions engages a skin surface. Utilizing a bracelet having a larger diameter precludes excessive pressure on the limb **59**, provides some space between the bracelet and skin surface of the limb **59** allowing thereby air and water to enter therein.

It is further noted that in accordance with the present example, the sensor **50** can include a processing module for determining the sensing portion **56** by which the PPG measurements of the limb are obtained. That is to say, the module can be configured to identify one of the sensing portions **56** which engages a skin surface of the limb in the best manner, and which can thus provide the optimal PPG measurements thereof.

According to a further example, the processing module can be configured to

receive a signal forming all the sensing portions **56**, and to determine the PPG measurement of the limb, by detecting the sensing portion which provides the best signal. For example, the processing module can be configured to determine which of the sensing portions **56** engages a skin surface of the limb without dirt therebetween.

According to an example, the sensor further includes a pressure sensor configured to detect the segment of the inner surface which presses against a skin surface of the limb. The sensor **50** can include a pressure sensor integrated inside each of the sensing portions **56** or the protruding portion **58** such that when the sensing portion engages a skin surface of the animal's limb, the respective pressure sensor provides the processing module with a signal indicating which of the sensing portions **56** engages the skin surface and thus can provide the PPG measurement of the limb.

As shown in Fig. 5, the sensor **60**, which is substantially similar to the one described hereinabove with regards to Figs. 4A and 4B, can be mounted on a leg of an animal **65**, herein illustrated as a calf, by means of a mounting member **62**. One or more sensing portions (not shown) defined on the inner surface of the mounting member **62** are configured to obtain the PPG measurement of the leg of the calf. The sensor can further include a processor configured for receiving the PPG measurement from one of the sensing portions, and calculate thereby a predetermined physiological parameter of the calf, such as heart rate.

It is appreciated that the processor can be integrally formed with the sensing portion or the mounting member **62** of the sensor **60**. Alternatively, the processor can be provided as an add-on module, which can be coupled to the sensing portion and mounted on the mounting member, such that it can receive the PPG measurement from the sensing portion and calculate thereby a predetermined physiological parameter.

According to this example, various add-on processing modules can be coupled to the sensor, each being configured to calculate a specific physiological parameter. For example, if it is desired to obtain the heart rate of the animal, a corresponding processing module can be coupled to the sensor **60**. If, however, it is desired to calculate, based on the PPG measurements of the animal, another physiological parameter, such as respiratory rate, or other parameters, which can be calculated based on PPG measurements, the add-on processing modules can be replaced with an appropriate processing module.

According to a further example, the processor can be adapted with various algorithms such that it can calculate various predetermined physiological parameters, or can include an input device such that the user can determine the desired parameter to be calculated.

According to a further example, the sensor can include a wireless device configured to transmit the PPG measurements to a remote processor, which can be configured to calculate various physiological parameters of the animals thereby.

According to an example, the sensor can further include an accelerometer configured to detect the movement of the animal. The sensor can thus include a controller which is configured to activate the sensing portion to obtain the PPG measurements of the limb, in accordance with the data received from the accelerometer. For example, the controller can be configured to initiate PPG measurement only when the animal is at rest, such that the heart rate measurements calculated thereby reflects the heart rate of the animal at rest. Similarly, the controller can be configured to initiate PPG measurement when the animal is at rest as well as while the animal is moving. The PPG measurements, in the latter case, can be utilized for comparing the heart rate of the animal in various positions.

In addition, the accelerometer can be utilized for detecting when the animal is sleeping, for example by detecting when the animal is at rest over a predetermined period of time. This way, various physiological parameters of the animal can be calculated by the PPG measurements in various situations. According to another example, detecting when the animal is sleeping can be carried out by measuring the heart rate and detecting the heart rate pattern of the animal during sleep. The heart rate in this example can be further utilized for detecting cud-chewing, which may be involved with a heart rate having a specific pattern. The heart rate can be further utilized for detecting the Heart Rate Variability of the animal based on which various stress analyses can be carried out.

It is appreciated that the Heart Rate measurements can be utilized for obtaining further physiological data of the animal such as the metabolizable energy intake (MEI) thereof as well as the energy expenditure (EE) thereof. As known in the art these parameters can assist in monitoring changes in Dry Matter Intake (DMI), or in the Gross Energy (GE), monitoring the Negative Energy Balance (NEB) which typically occurs post calving.

It is appreciated that in accordance with the presently disclosed subject matter the heart rate can be frequently measured as the bracelet can be mounted on the animal's limb, such as the leg, for long periods of time, or for the entire life span of the animal. Thus, the heart rate can be measured numerous times, as required. Accordingly, remote calculation and monitoring of various parameters can be substantially continuously carried out.

In addition, the heart rate measurements can be used for detecting stress and pain in various situations, such as during transportation or following various changes in the animal's environment. Further the heart rate can be used for estimating and detecting calving time, injuries and diseases. Those skilled in the art to which the presently disclosed subject matter pertains will readily appreciate that numerous changes, variations, and modifications can be made without departing from the scope of the invention, *mutatis mutandis*.

CLAIMS:

1. A sensor for detecting at least one physiological parameter of an animal at its pre-determined limb, the sensor being configured for mounting on said limb so that its inner surface faces a skin surface of said limb; the sensor comprising:

- at least one PPG detector configured to obtain a photoplethysmogram signal of said limb, based on which said parameter can be detected;
- a mounting member configured for mounting said sensor to said limb so as to allow its PPG detector to frictionally move along said skin surface of the limb and to thereby facilitate removal of dirt when disposed therebetween.

2. The sensor according to claim 1 wherein said mounting member is configured for mounting on said limb such that an inner surface thereof faces said skin surface.

3. The sensor according to any one of the preceding claims wherein said PPG detector is integrated inside a sensing portion.

4. The sensor according to claim 3 wherein said sensing portion is defined on a protruding portion protruding from said inner surface such that movement of said mounting member with respect to said limb facilitates removing dirt disposed between said skin surface and said sensing portion.

5. The sensor according to claim 3 wherein said sensing portion includes a light emitting source configured to emit light towards said limb and a light detector configured to detect a portion of the light reflected from said limb.

6. The sensor according to claim 3 wherein said sensing portion includes a light emitting source configured to emit light towards said limb and a light detector configured to detect a portion of the light transmitted through said limb.

7. The sensor according to claim 6 wherein said light source is disposed on one side of said inner surface thereof, such that when mounted on said limb it faces one side thereof of the limb and said detector is disposed on an opposing side of said inner surface, such that it faces a second side of said limb.

8. The sensor according to any one of claims 5 to 7 wherein said sensing portion is configured to frictionally move along said skin surface facilitating thereby removal of dirt disposed between said skin surface and said sensing portion.

9. The sensor according to claim 4 wherein the size and shape of said protruding portion is configured in accordance with the shape of said limb on which it is intended to be mounted.

10. The sensor according to any one of the preceding claims wherein said mounting member is a bracelet member and said limb is a leg.

11. The sensor according to claim 10 when depending from claim 4 wherein said protruding portion is configured to engage hair on said leg, such that movement thereof with respect to the leg, causes the hair to brush off dirt from said sensing portion.

12. The sensor according to claim 10 wherein said mounting member includes a shape adapted in accordance with the outer shape of said leg such that said sensing portion engages a skin surface thereon.

13. The sensor according to claim 10 wherein said bracelet includes a rigid portion configured to firmly hold the sensing portion such that it engages said skin surface, and a flexible portion configured to allow mounting said bracelet on said limb.

14. The sensor according to any one of the preceding claims further comprising a weight affixed to said mounting member.

15. The sensor according to claim 14 wherein said weight is disposed opposite said PPG detector.

16. The sensor according to any one of claims 14 to 15 wherein said weight is configured to tilt said mounting member such that a first side thereof, on which said weight is mounted, is urged downwardly, while a second side thereof, on which PPG detector is defined, is urged upwardly.

17. The sensor according to any one of claims 14 to 15 wherein said weight is defined adjacent said PPG detector such that tilting of said mounting member, urges the weight together with the PPG detector downwardly, allowing thereby the PPG detector to engage said skin surface of the limb.

18. The sensor according to any one of claims 14 to 17 wherein said weight is integrally formed with said mounting member.

19. The sensor according to any one of the preceding claims wherein said mounting member includes two or more sensing portions each having a PPG detector defined thereon.

20. The sensor according to claim 19 wherein said two or more sensing portions are evenly disposed along an inner surface of said mounting member.

21. The sensor according to any one of claims 19 to 20 further comprising a processing module configured for determining the sensing portion by which the PPG measurements of the limb are obtained.

22. The sensor according to claim 21 wherein said processing module is configured to identify one of said sensing portions which engages said skin surface.

23. The sensor according to claim 21 wherein said processing module is configured to determine which of said sensing portions engages said skin surface of the limb without dirt therebetween.

24. The sensor according to any one of claims 19 to 23 further comprises a pressure sensor configured to detect which of said sensing portions engages said skin surface.

25. The sensor according to Claim 24 wherein said pressure sensor is further configured to detect which of said sensing portions provide the best engagement with said skin surface.

26. The sensor according to any one of the preceding claims further comprises a processor configured for receiving said PPG measurements and calculate thereby said physiological parameter.

27. The sensor according to claim 26 wherein said processor is integrally formed with said mounting member.

28. The sensor according to claim 26 wherein said processor is an add-on module configured to be coupled with said PPG detector.

29. The sensor according to any one of the preceding claims further comprises an accelerometer configured to detect movement of the animal.

30. The sensor according to claim 29 further comprises a controller configured to activate said PPG detector in accordance with the data received from said accelerometer.

31. The sensor according to claim 30 wherein said controller is configured to activate said PPG detector when said accelerometer indicates that the animal is not moving.

32. A sensor for detecting at least one physiological parameter of an animal at its leg, the sensor being configured for mounting on said leg so that its inner surface faces a skin surface of said leg; the sensor comprising at least one PPG detector configured to obtain a photoplethysmogram of the leg, based on which said parameter can be

detected; a mounting member configured for mounting said PPG detector to said leg such that said photoplethysmogram of the leg can be obtained.

33. A method for detecting heart rate of an animal, the method comprising:

movably mounting a sensing portion on a leg of the animal, said sensing portion having a photoplethysmogram detector facing a skin surface of said leg;

displacing said sensing portion with respect to said leg such that dirt disposed between said skin surface and said sensing portion is removed therefrom allowing thereby said photoplethysmogram detector to engage said skin surface;

measuring plethysmogram of said leg; and determining the heart rate of the animal thereby.

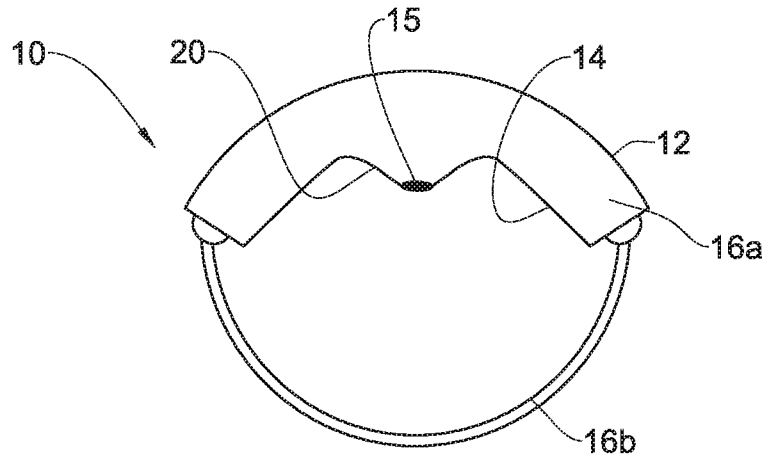

Fig. 1A

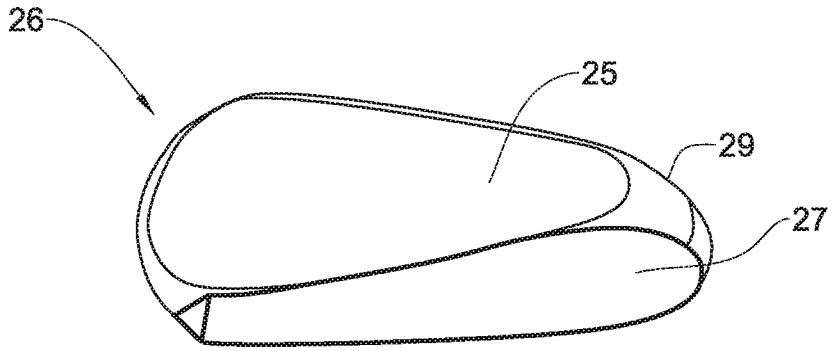

Fig. 1B

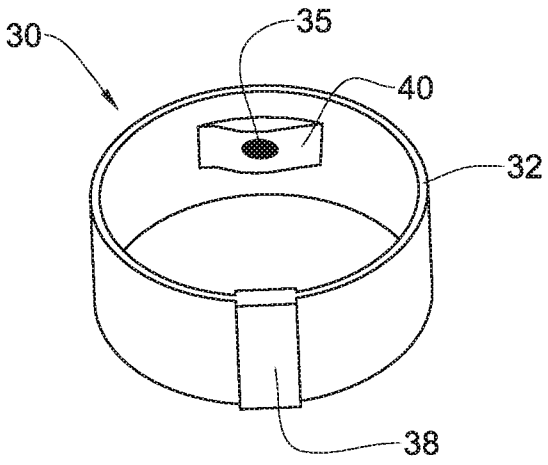

Fig. 2

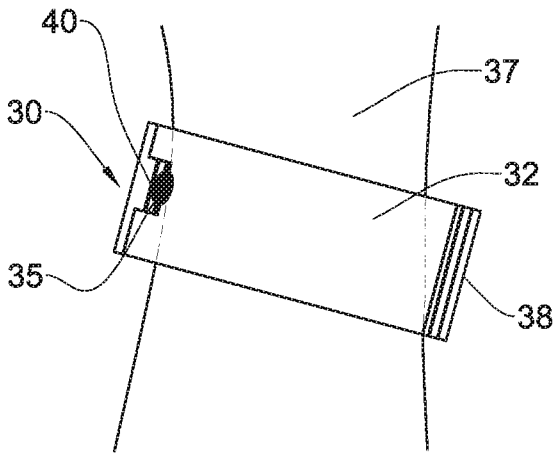

Fig. 3

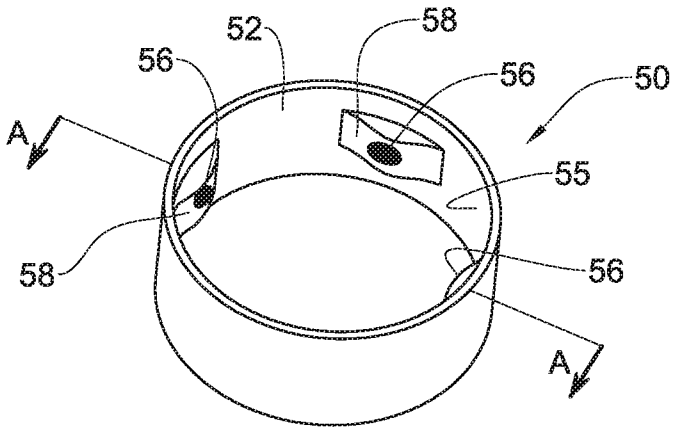

Fig. 4A

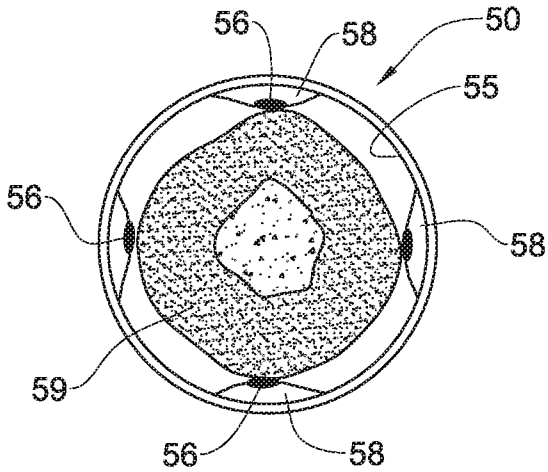

Fig. 4B

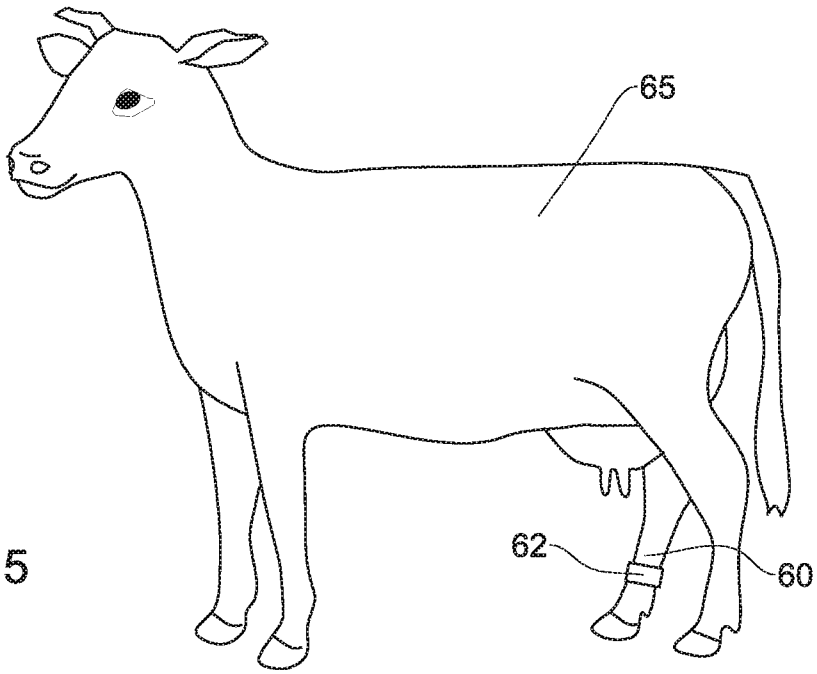

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2018/050445

A. CLASSIFICATION OF SUBJECT MATTER
IPC (2018.01) A61B 5/00, A61B 5/02

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (2018.01) A61B 5/00

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Databases consulted: Esp@cenet, Google Patents, Orbit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014135631 A1 FITBIT INC [US] 15 May 2014 (2014/05/15) whole document	1-33
A	EP 2613692 A2 CNSYSTEMS MEDIZINTECHNIK AG?[AT 17 Jul 2013 (2013/07/17) whole document	1-33
A	WO 2018019742 A1 KONINKLIJKE PHILIPS NV?[NL] 01 Feb 2018 (2018/02/01) whole document	1-33
A	US 2018070837 A1 KONINKLIJKE PHILIPS NV?[NL] 15 Mar 2018 (2018/03/15) whole document	1-33

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 Aug 2018	07 Aug 2018

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IL2018/050445

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
US 2014135631 A1	15 May 2014	NONE	
EP 2613692 A2	17 Jul 2013	NONE	
WO 2018019742 A1	01 Feb 2018	NONE	
US 2018070837 A1	15 Mar 2018	NONE	