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[SE/SE]; PI 429, Hamra Gård, S-147 41 Tumba (SE).
EKMAN, Torkel [SE/SE]; Lagga Gustavsberg, S-741 93
Knivsta (SE).

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(74) Agents: BERGLUND, Stefan et al.; Bjerkéns Patentbyrå
KB, Östermalmsgatan 58, S-114 50 Stockholm (SE).

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(71) Applicant (*for all designated States except US*):
DELAVAL HOLDING AB [SE/SE]; P.O. Box 39,
S-147 21 Tumba (SE).

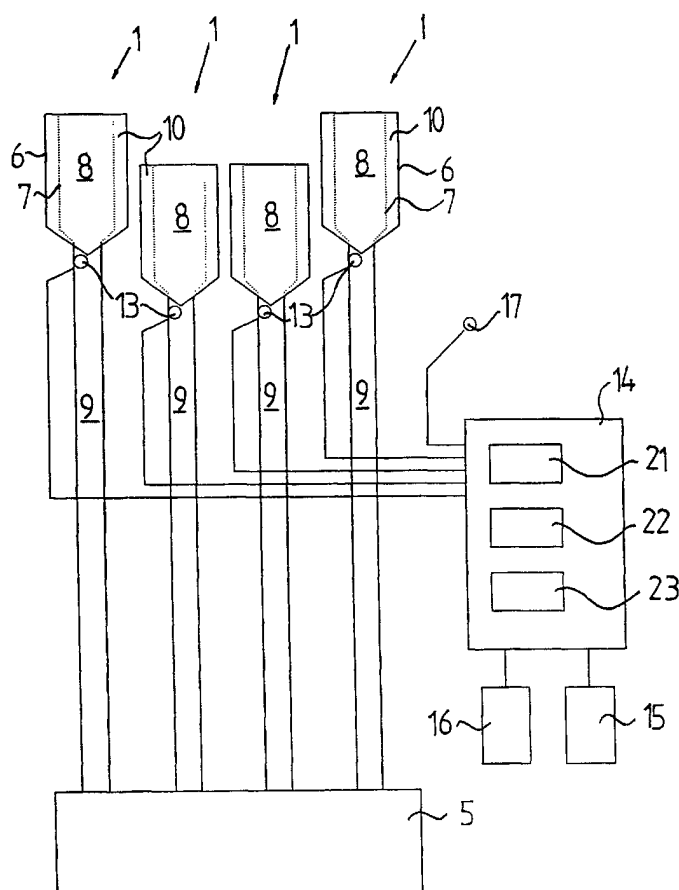
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(72) Inventors; and

(75) Inventors/Applicants (*for US only*): BJÖRK, Anders

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(54) Title: A DEVICE AND A METHOD FOR DETECTING AN ABNORMAL STATE OF AN ANIMAL



(57) Abstract: The invention refers to a device and a method for detecting an abnormal state of an udder part of an animal. The device includes a number of temperature sensors (13) for sensing the temperature related to a respective one of said udder parts. The temperature sensors are connected to a processing unit (14). First means (21) of the processing unit is arranged to compare the temperature sensed by one of the temperature sensors (13) with a comparison value including the temperature of at least one other part of the animal in order to determine if the temperature of said one udder part deviates from said comparison value. Second means (22) of the processing unit is arranged to determine if said deviation exceeds a certain level. Third means (23) of the processing unit is arranged to establish a possible existence of a local fever in said one udder part in response to said determination.

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A device and a method for detecting an abnormal state of an animal

10 BACKGROUND OF THE INVENTION AND PRIOR ART

The present invention refers to a device for detecting an abnormal state of an udder part of an animal, the device including a number of temperature sensors, each being
15 arranged to sense the temperature related to a respective one of said udder parts, and a processing unit to which the temperature sensors are connected. The invention also refers to a method for detecting an abnormal state of an udder part of an animal by means of a number of temperature sensors,
20 including sensing the temperature related to a respective one of said udder parts.

The present invention is concerned with any abnormal state giving rise to a fever which is detectable in the udder of
25 an animal. In particular, the invention is concerned with udder inflammation of animals, i.e. mastitis, which may be caused by an infection of micro-organisms, such as bacteria, but may also be the result of an injury, a trauma or hormonal imbalances. In all milk production, mastitis
30 constitutes a significant problem with respect to animal comfort, increased work load, reduced milk production capacity, etc.

In the past different methods and devices have been proposed
35 for identifying mastitis. Such methods and devices include, for instance, conductivity and temperature measurements on

the milk extracted from the udder. Such measurements require a rather complicated equipment and the result thereof is still not very reliable. It is also known to identify mastitis by means of laboratory tests, which although
5 reliable are rather inconvenient, since the result of such a test is not available immediately.

JP 8136535 discloses a device for detecting mastitis. The device includes a temperature sensor and a conductivity
10 sensor for each teat of an animal to be examined. It appears that both the conductivity and the temperature need to exceed a threshold value in order to determine that the animal is infected by mastitis. The known device appears not to enable such a determination merely based on temperature
15 measurements.

WO99/18774 discloses a device for analysing milk in order to determine the health of milk animals and/or the quality and composition of the milk. The device includes a number of
20 sensors, which for instance may comprise conductivity sensors and temperature sensors. The sensors are provided at a plurality of locations and this document exemplifies the short milk conduits, the claw etc. It is stated that by the known device not only the conductivity but also the
25 temperature of the milk from the individual udder quarters is measured and in case of an inflammation in an udder quarter, both sensors give a deviating value.

WO00/05943 discloses a device for detecting mastitis of the
30 udder of an animal by means of a comparison of the milk quantity from the different udder parts. This document indicates the possibility of detecting mastitis in an individual udder part.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a device and a method for detecting an abnormal state of the udder of an animal at an early stage. Furthermore, it is aimed at a detection device having an uncomplicated structure. Moreover, it is an object to obtain the result of the detection substantially immediately.

10 This object is obtained by the device initially defined, which is characterised in that the processing unit includes: first means arranged to compare the temperature sensed by one of the temperature sensors regarding one of the udder parts with at least one comparison value including the
15 temperature of at least one other part of the animal in order to determine if the temperature of said one udder part deviates from said comparison value,
second means arranged to determine if said deviation exceeds a certain level, and
20 third means arranged to establish a possible existence of a local fever in said at least one udder part in response to said determination.

By such a simple temperature measurement on an individual basis, and the comparison of the temperature obtained with a comparison value, it is possible to detect if any one of the udder parts has a temperature, which deviates from the comparison value. Such a temperature deviation exceeding a certain level may be a sufficient parameter to establish the
25 existence of a local disease such as mastitis in an individual udder part.

The inventors have realised that mastitis, i.e. any form of udder inflammation, at an initial stage results in a local response. The inflammatory process releases toxic substances due to which the local tissue around the inflammation
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responds by a local increase of the temperature, i.e. local fever. Consequently, the temperature of the udder part, which is inflamed, will be raised. Thus, the invention enables detection of inflammation in an easy and convenient manner at an early stage, i.e. before the inflammation results in a clinical mastitis. At such an early stage, it is possible to take appropriate measures to prevent the disease from infecting further udder parts or animals. Such a local inflammation may also be treated by a corresponding local, limited treatment of the animal. Furthermore, the invention makes it possible to separate the milk from the inflamed udder part and at the same time to take care of the milk from the healthy udder parts. Advantageously, said other part of the animal is formed by the other udder parts of the animal. Such a comparison value is easy to determine by, for instance, a substantially simultaneous sensing or measurement of the temperatures of the four udder parts of the animal. fever. Thereby, the temperature of the udder part, which is inflamed, will be higher than the temperature of the healthy udder parts.

Thus, since said comparison value may include merely the temperatures of any part of the animal, e.g. the other or remaining udder parts, and the detection may be made on a single occasion, it is possible to examine any animal in a simple and reliable manner without any preloaded data. It is not necessary to have the identity of the animal, nor any historical data about this animal. Said comparison value may include or consist of the average temperature of the temperatures of said other udder parts, wherein the first means is arranged to compare the average temperature with the temperature of said one udder part.

According to a further embodiment of the invention, said comparison value also includes historical temperatures of said one udder part. It is thus possible to compare the

actual temperature of one udder part with previous measurements of the temperature of said one udder part. If the actual temperature deviates from the previous measurements, this may be an indication of a local
5 inflammation.

It is to be noted that the reliability of the device may be enhanced if the temperature of said one udder part is compared with the temperatures of the other udder parts as
10 well as with previous temperatures of said one udder part.

According to a further embodiment of the invention, the device may include memory means arranged to store different values of the sensed temperatures. In such a way, the
15 previous temperatures of the udder parts may be stored and utilised to improve the comparison value.

According to a further embodiment of the invention, each temperature sensor is arranged to sense the temperature of
20 the milk from the respective udder part. The temperature of the milk from each teat reflects the temperature of the udder tissue producing the milk. By sensing the temperature of milk, the application and the structure of the temperature sensors may be realised in a simple manner. It
25 is also possible to provide each temperature sensor to sense the temperature by contacting the respective udder part, for instance a thermo-element which is brought to abutment with the skin of the respective udder part.

30 According to a further embodiment of the invention, the device is arranged to sense the temperatures during a milking operation by means of a milking machine having a milking member with a number of teatcups to be applied to a teat of the respective udder part of the animal, wherein
35 each temperature sensor is associated with a respective one of said teatcups. It is of course advantageous to make the

detection of a disease in connection with the milking operation in order to enable a decision whether the milk to be produced is to be separated or taken care of. Thereby, each teatcup may include a teatcup liner forming a channel
5 for receiving the teat and for conducting milk away from the teat, wherein each temperature sensor is provided at least in the proximity of said channel of the respective teatcup.

According to a further embodiment of the invention, the
10 device includes means arranged to provide a reference temperature. Thereby, the third means may be arranged to take into account the reference temperature when establishing said possible existence of a local fever or disease. For instance, the first means may be arranged to
15 compare the temperatures sensed by the temperature sensors with the reference temperature. In such a way, the reliability of the result obtained may be improved. The reference temperature may for instance include the body temperature of the animal. Such a body temperature may also
20 be obtained by the temperatures sensed from the udder parts. Thus, no further temperature sensor needs to be provided in order to obtain a reference temperature. Furthermore, the reference temperature may include the temperature of the environment surrounding the animal.

25 The animal may have an increased body temperature for instance due to physical activity, a general inflammation for any reason, heat, the temperature of the surrounding environment, etc. Such an increased body temperature may of
30 course influence the sensing of the temperatures of the individual udder parts. By the provision of such a reference temperature, it is thus possible to compensate for such an influence. It is to be noted that the device according to the invention also may be utilised to diagnose a general
35 fever of the animal.

The object is also obtained by the method initially defined, which is characterised in that it includes the steps of:

- 5 comparing the temperature sensed for one of the udder parts with a comparison value including the temperature of at least one other part of the animal in order to determine if the temperature of said one udder part deviates from said comparison value,
- determining if said deviation exceeds a certain level, and
- 10 establishing a possible existence of a local fever in said one udder part in response to said determination.

Preferred embodiments of the method are defined in the dependent claims 16-26.

15

BRIEF DESCRIPTION OF THE DRAWING

- The present invention is now to be explained more closely by means of embodiments, described by way of example, and with
- 20 reference to the drawing attached, in which
- Fig 1 discloses schematically an embodiment of a device according to the present invention.

25 DETAILED DESCRIPTION OF DIFFERENT EMBODIMENTS OF THE INVENTION

- Fig 1 discloses schematically a device for detecting a local fever or disease of an udder part of an animal in connection with a milking operation. The milking operation is to be
- 30 performed by means of a milking machine, which is indicated in Fig 1 by four teatcups 1, one for each teat of the animal to be milked. Moreover, the milking machine includes a milk-collecting member 5 for collecting the milk from the teatcups 1. Each teatcup 1 includes a teatcup shell 6 and a
- 35 teatcup liner 7 connecting the respective teatcup 1 to the milk-collecting member 5. Each teatcup liner 7 forms an

inner space 8 for receiving the teat of the animal and a milk conduit 9 extending from the inner space 8 to the milk-collecting member 5. The inner space 8 and the milk conduit 9 together form a channel from an outer end of the teatcup 1 to the milk-collecting member 5.

In a conventional manner, the inner space 8 and the milk conduit 9 are subjected to a sub-atmospheric pressure to draw milk from the udder part to the milk-collecting member 5. Moreover, a pulsation chamber 10 is formed between the teatcup shell 6 and the teatcup liner 7 in each teatcup 1. In a conventional manner, the pulsation chamber 10 is subjected to a pulsating vacuum.

The device for detecting a local fever includes four temperature sensors 13, one temperature sensor 13 for each teat of the animal to be milked. The temperature sensors 13 may be of any known kind, for instance thermoelements, temperature resistance sensors, IR-sensors, etc. In the embodiment disclosed in Fig 1, the temperature sensors 13 are arranged in the milk conduits 9 immediately beneath the teatcups 1. Consequently, the temperature sensors 13 disclosed are arranged to sense the temperature of the milk leaving the respective teats. It is to be noted that the temperature sensors 13 may be arranged at other positions than the one disclosed, for instance in the inner space 8 of the teatcups, all along the length of the milk conduit 9, etc. The temperature sensors 13 may be provided in the wall of the milk conduit 9, for instance moulded into the rubber material of the milk conduit 9. It may also be possible to arrange the temperature sensors 13 in the inner space 8 in such a manner that they sense the temperatures of the teat tissue rather than of the milk leaving the teat.

As appears from Fig 1, the temperature sensors 13 are connected to a processing unit 14. The processing unit 14

may be realised by digital technique in the form of a central processing unit, CPU, of a computer. The computer includes an internal memory 15, an external memory 16, for instance a hard disk, and further conventional computer components (not disclosed in the figure). In Fig 1, there is also disclosed a further temperature sensor 17 arranged to provide a reference temperature to be explained below.

The processing unit 14 includes first means 21 arranged to compare the temperature sensed by one of the temperature sensors 13 with at least one comparison value. According to one embodiment, the comparison value includes the temperatures sensed by the other temperature sensors 13. The first comparing means 21 is thus arranged to determine if the temperature of said one temperature sensor 13 deviates from the temperature of the other temperature sensors 13. Such a comparison may of course be made for each of the temperature sensors 13. In such a manner, it is possible to determine if the temperature of any of the temperature sensors 13, and thus of the milk from any of the udder parts, deviates from the temperatures of the other udder parts.

Furthermore, the processing unit 21 includes second means 22 arranged to determine if said deviation exceeds a certain level, and third means 23 arranged to establish a possible existence of a local fever in said at least one udder part in response to said determination. Consequently, according to this embodiment the processing unit 14 is arranged to establish if the temperature of any of the udder parts deviates more than a certain level from the temperature of the other udder parts, and thus if the animal suffers from a local disease in any of the udder parts.

The first means 21, the second means 22 and the third means 23 may be realised as software algorithms to be executed by

the processing unit 14 and stored as computer programs in the external memory 16 and the internal memory 15. It is to be noted that the means 21, 22 and 23 also may be realised by analogue technique including comparing circuits.

5

According to the example described above, the comparison value or values for said one udder part to be examined may be formed by the average temperature of the other udder parts, i.e. the remaining udder parts except said one udder
10 part. The comparison value may also include historical temperatures of said one udder part. Thereby, the external memory 16 may be arranged to store the temperatures sensed by the temperature sensors 13 on each milking occasion, at least a number of preceding milking occasions. By means of
15 these historical temperatures, it is possible to determine a normal temperature for each udder part, which usually would be the same for all udder parts of an individual animal. Such normal temperature may be included as a factor in the comparison value for the above-described establishing
20 process. In order to make the establishing of a possible local fever more reliable, the temperature of each udder part may, for instance, be compared by a first comparison value formed by the temperatures of the other udder parts and a second comparison value including said normal
25 temperature.

The temperature sensor 17 for determining a reference temperature may be arranged to sense the temperature of the surrounding environment. A high surrounding temperature may
30 influence the body temperature of the animal and thus the temperatures sensed by the temperature sensors 13. The reference temperature may also include the body temperature of the animal. Such body temperature may be sensed by the four temperature sensors 13 and formed by the average
35 temperatures of these sensors 13. It is also possible to sense the body temperature by a further temperature sensor,

for example the sensor 17, arranged to sense the temperature of any part of the animal at an arbitrary location of the animal. The body temperature of the animal may be raised due to, for instance, physical activity, a general inflammation or sickness, heat, etc. The reference temperature may include a correction factor taking into account, for instance, the position where the body temperature is sensed.

It is to be noted that the temperature sensed by the sensor 17 according to a further embodiment also may form the comparison value or at least a substantial part of the comparison value. Thus, the temperature of each of said one udder parts may be compared with the temperature sensed by the sensor 17 in order to determine a deviation indicating a local fever in any of the udder parts.

In the embodiment disclosed, the device is arranged to detect a possible local fever in connection with a milking operation. Thereby, the device is arranged in the milking machine and thus forms a part thereof. However, it is to be noted that the device also may be provided as a separate unit and that the detection of a local fever may be made at any time but not only during the milking operation.

The present invention is not restricted to the embodiments disclosed but may be varied and modified within the scope of the following claims.

Claims

1. A device for detecting an abnormal state of an udder part of an animal, the device including a number of temperature sensors (13), each being arranged to sense the temperature related to a respective one of said udder parts, and a processing unit (14) to which the temperature sensors are connected, characterised in that the processing unit includes:
- 10 first means (21) arranged to compare the temperature sensed by one of the temperature sensors (13) regarding one of the udder parts with at least one comparison value including the temperature of at least one other part of the animal in order to determine if the temperature of said one udder part
- 15 deviates from said comparison value,
second means (22) arranged to determine if said deviation exceeds a certain level, and
third means (23) arranged to establish a possible existence of a local fever in said one udder part in response to said
- 20 determination.
2. A device according to claim 1, characterised in that said other part of the animal is formed by the other udder parts of the animal.
- 25
3. A device according to claim 2, characterised in that said comparison value includes the average temperature of the temperatures of said other udder parts, wherein the first means (21) is arranged to compare the average
- 30 temperature with the temperature of said one udder part.
4. A device according to any one of claims 1 to 3, characterised in that said comparison value also includes historical temperatures of said one udder part.

5. A device according to any one of the preceding claims, characterised in that the device includes memory means (16) arranged to store different values of the sensed temperatures.

5

6. A device according to any one of the preceding claims, characterised in that each temperature sensor (13) is arranged to sense the temperature of the milk from the respective udder part.

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7. A device according to any one of the preceding claims, characterised in that each temperature sensor (13) is arranged to sense the temperature by contacting the respective udder part.

15

8. A device according to any one of the preceding claims, characterised in that the device is arranged to sense the temperatures during a milking operation by means of a milking machine having a milking member with a number of teatcups (1) to be applied to a teat of the respective udder part of the animal, wherein each temperature sensor (13) is associated with a respective one of said teatcups (1).

20

9. A device according to claim 8, characterised in that each teatcup (1) includes a teatcup liner (7) forming a channel (8, 9) for receiving the teat and for conducting milk away from the teat, wherein each temperature sensor (13) is provided at least in the proximity of said channel (8, 9) of the respective teatcup (1).

30

10. A device according to any one of the preceding claims, characterised in that the device includes means (13, 17) arranged to provide a reference temperature.

35

11. A device according to claim 10, characterised in that the third means (23) is arranged to take into account the

reference temperature when establishing said possible existence of a local disease.

12. A device according to claim 11, characterised in that
5 the first means (21) is arranged to compare the temperatures sensed by the temperature sensors (13) with the reference temperature.

13. A device according to any one of claims 10 to 12,
10 characterised in that the reference temperature includes the body temperature of the animal.

14. A device according to any one of claims 10 to 13,
15 characterised in that the reference temperature includes the temperature of the environment surrounding the animal.

15. A method for detecting a disease of an udder part of an animal by means of a number of temperature sensors, including sensing the temperature related to a respective
20 one of said udder parts,
characterised in that the method includes the steps of:

comparing the temperature sensed for one of the udder parts with a comparison value including the temperature of at least one other part of the animal in order to determine
25 if the temperature of said one udder part deviates from said comparison value,

determining if said deviation exceeds a certain level,
and

establishing a possible existence of a local fever in
30 said one udder part in response to said determination.

16. A method according to claim 15, characterised in that said other part of the animal is formed by the other udder parts of the animal.

17. A method according to claim 16, characterised by the step of forming said comparison value to include the average temperature of the temperatures of said other udder parts, and comparing the average temperature with the temperature
5 of said one udder part.

18. A method according to any one of claims 15 to 17, characterised in that said comparison value includes historical temperatures of said one udder part.

10 19. A method according to any one of claims 15 to 18, characterised by the step of sensing the temperature of the milk from the respective udder part.

15 20. A method according to any one of claims 15 to 18, characterised by the step of sensing the temperature by contacting the respective udder part.

20 21. A method according to any one of claims 15 to 20, characterised by the step of sensing the temperatures during a milking operation by means of a milking machine having a milking member with a number of teatcups to be applied to a teat of the respective udder part of the animal, wherein each temperature sensor is associated with a respective one
25 of said teatcups.

22. A method according to any one of claims 15 to 21, characterised by the step of providing a reference temperature.

30 23. A method according to claim 22, characterised in that the reference temperature is taken into account when establishing said possible existence of a local disease.

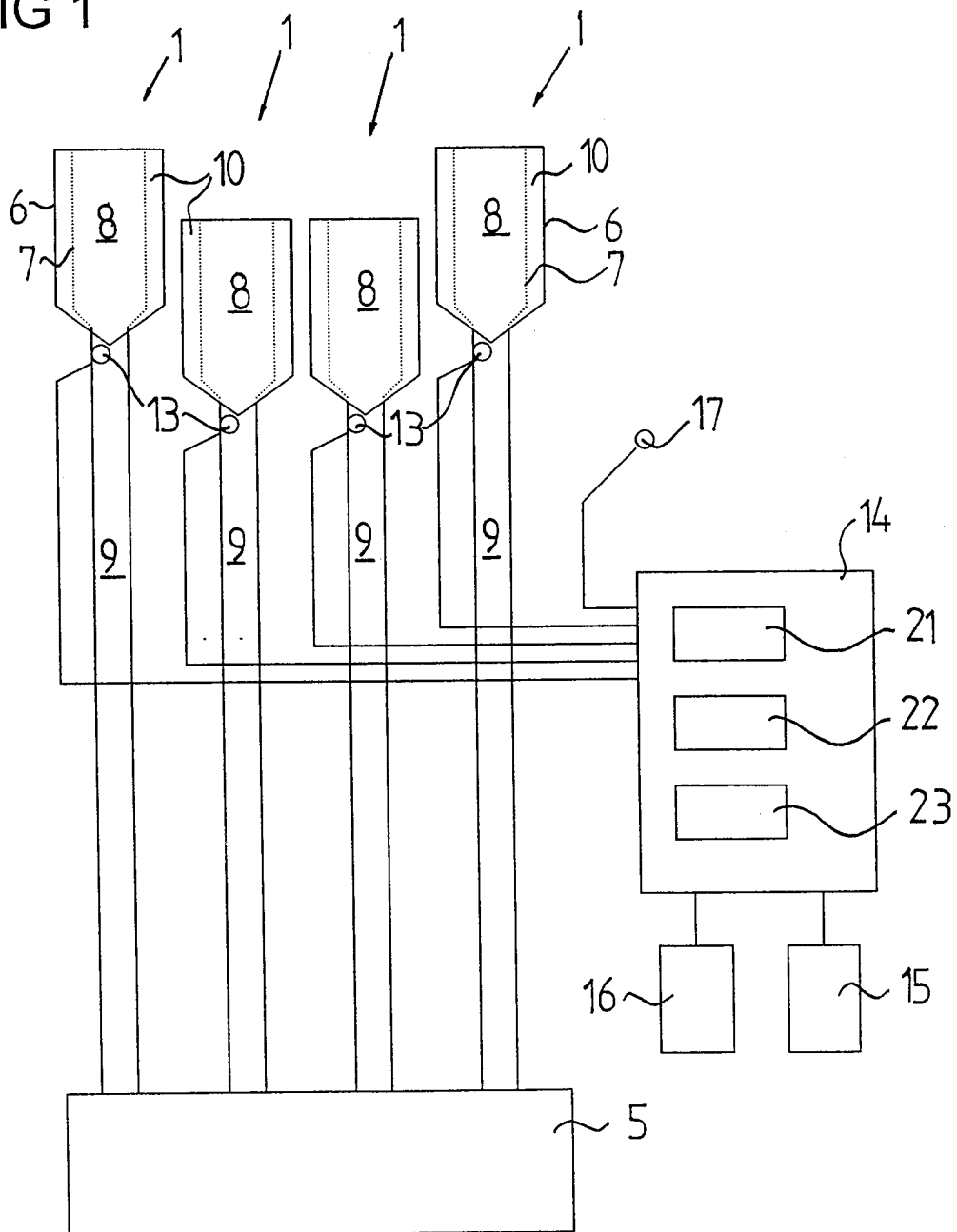
24. A method according to claim 23, characterised by the step of comparing the temperatures sensed by the temperature sensors with the reference temperature.

5 25. A method according to any one of claims 22 to 24, characterised in that the reference temperature includes the body temperature of the animal.

10 26. A method according to any one of claims 22 to 25, characterised in that the reference temperature includes the temperature of the environment surrounding the animal.

1/1

FIG 1



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/00485

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61B 5/00, A01J 7/00, A01J 5/00

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)

IPC7: A61B, A01J

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 0777962 A2 (C. VAN DER LELY N.V.), 11 June 1997 (11.06.97), description, column 10, line 44 - line 47, claims 1-2, abstract --	1-6,15
X	EP 0480542 A1 (C. VAN DEN LELY N.V.), 15 April 1992 (15.04.92), description, column 1, line 31 - line 44, claims 1-3 -- -----	1-6,15

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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专利名称(译)	一种用于检测动物的异常状态的装置和方法		
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[标]申请(专利权)人(译)	利拉伐控股有限公司		
申请(专利权)人(译)	DELAVAL HOLDING AB		
当前申请(专利权)人(译)	DELAVAL HOLDING AB		
[标]发明人	BJORK ANDERS EKMAN TORDEL		
发明人	BJÖRK, ANDERS EKMAN, TORDEL		
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摘要(译)

本发明涉及用于检测动物的乳房部分的异常状态的装置和方法。该装置包括多个温度传感器 (13) , 用于检测与所述乳房部分中的相应一个相关的温度。温度传感器连接到处理单元 (14) 。处理单元的第一装置 (21) 被布置成将由一个温度传感器 (13) 感测的温度与包括动物的至少一个其他部分的温度的比较值进行比较, 以便确定所述温度是否为所述温度。一个乳房部分偏离所述比较值。处理单元的第二装置 (22) 被布置成确定所述偏差是否超过特定水平。处理单元的第三装置 (23) 被设置成响应于所述确定在所述一个乳房部分中建立可能存在的局部发热。