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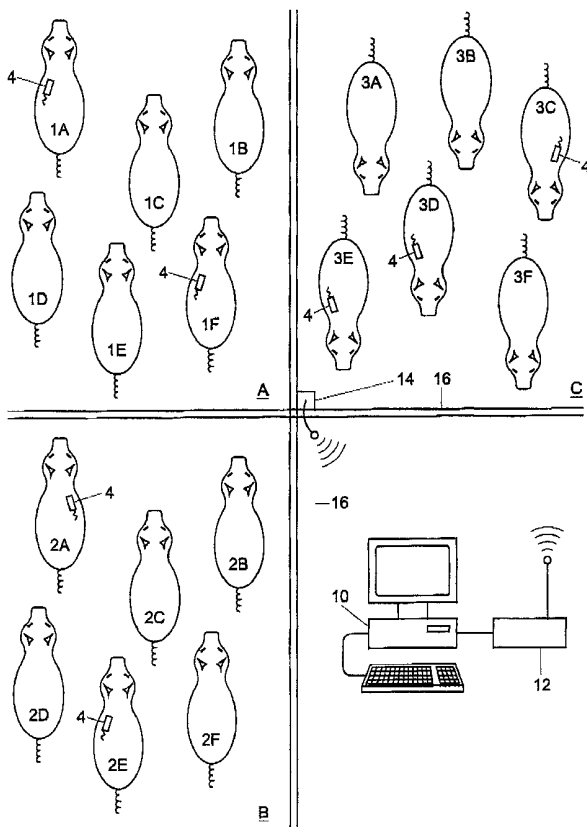
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(54) Title: METHOD AND ASSEMBLY FOR MONITORING THE STATE OF HEALTH OF ANIMALS IN A POPULATION



(57) Abstract: A method for monitoring production  
animals, wherein a number of animals from a population  
is provided with transmitting means (4), which are  
provided with measuring means for measuring at least one  
bodily function and are arranged to emit a signal on the  
basis thereof, wherein receiver means (14) are installed in  
the vicinity of the population, with which receiver means  
the signals emitted by the respective transmitting means  
are received and are passed to an arithmetic unit (12,10),  
which arithmetic unit includes an algorithm with which  
data concerning the state of health of the animals in the  
population are determined from the received signals by  
comparison with previously inputted standard values.



WO 02/060244 A1



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Title: Method and assembly for monitoring the state of health of animals in a population

The present invention relates to a method for monitoring production animals. More in particular, the invention relates to a method for monitoring the state of health of production animals in a population by using sensor technique in combination with wireless transmission  
5 techniques.

It is of important relevance to cattle-breeders that they should be in a position to accurately monitor the state of health of their production animals so as to be able to recognize in good time changes therein, in particular deteriorations, so that measures can be taken. Thus, suffering to  
10 the animals can be prevented or at least be minimized, production loss can be avoided, and spreading of diseases can be checked.

It is conventional to cattle-breeders, who often keep their production animals in sheds or sties, to visually follow their animals so as to be able to obtain an indication about the state of health from changes in the behavior  
15 of the animals. Periodically, health inspections are carried out, for instance by measuring a number of standard values, such as body temperature, blood composition, and the like. From these data obtained from the individual production animals in the population a judgment can be given about the state of health of the relevant population.

20 This known method has the advantage that it is relatively simple, but it has a number of significant drawbacks. Thus, the value of the visual inspection substantially depends on the expertise of the cattle-breeder, at least the observer. Furthermore, such visual inspections can only be carried out periodically, that is to say when the observer gets a view of the animals  
25 of the relevant population. The above-mentioned health inspections will be carried out even much less frequently, since the expenses thereof are

relatively high and such inspections are further unpleasant to the animals, which will cause stress and hence production loss.

The invention has for its object a method of the type described in the opening paragraph, wherein the above drawbacks are avoided while  
5 retaining the advantages thereof. To that end, the method according to the invention is characterized by the measures of claim 1.

The provision of animals in a population with transmitting means, which are additionally provided with measuring means for at least one bodily function, has the advantage that at any desired moment the at least  
10 one relevant bodily function of each relevant animal can be checked, without causing stress to the relevant animal. In fact, the relevant animal will not be troubled by the reading out. The resulting signals can then be processed in the arithmetic unit, so that at any desired moment information can be obtained about the state of health of the relevant animals.  
15 Preferably, use is made of active transponders, that is to say transponders capable of providing informative signals by means of transmitting means, which offers the possibility that the transponders can be read out over a relatively great distance and can be activated at any desired moment, while they need not emit signals continuously or periodically. Other transmitting  
20 means may of course also be used, such as passive transponders or transmitters suitable for use in, for instance, radiotelemetry, optical telemetry, cavity monitoring, or the like. The receiving means may be arranged, for instance, near a ceiling or a wall of a shed or sty in which the animals are. The arithmetic unit is preferably placed at a distance and can,  
25 for instance, be installed in an office room.

In this description the transmitting means will always be referred to as transponders, without being restricted thereto.

In a special advantageous embodiment a method according to the invention is further characterized by the measures of claim 2.

The provision of only a limited number of animals with a transponder has the advantage that only a limited number of animals needs to be followed, while, furthermore, the expenses are reduced, because only a limited number of transponders needs to be placed, which also has the advantage that placement may trouble only a limited number of animals. The number of animals provided within a population with such a transponder is determined on the basis of, for instance, epidemiological and statistical data and models. Surprisingly, it has been found that on the basis of known manners of spreading of diseases within populations of production animals and known indicators for occurrence of such a disease prophecies can be accurately made about the state of health of the animals in the population on the basis of the health of a limited number of the animals from that population. Moreover, the provision of only a limited number of animals with a transponder has the advantage that in, for instance, a slaughter line only a limited number of transponders need to be removed.

In a further advantageous embodiment a method according to the invention is further characterized by the measures of claim 3.

The use of knowledge about the transmission of infecting agents, at least epidemiological knowledge about transmission of diseases between animals, has the advantage that on the basis of these and statistical data from measuring values of one or a few animals prophecies can be made about the health of the population in which the relevant animal is, and precautions can be taken. Thus, for instance, a rapid rise or fall of the body temperature, a changing heartbeat, or the like, possibly coupled to, for instance, a changing eating behavior, motion behavior, and the like, of the relevant animal can be interpreted as going with a syndrome, which syndrome goes with, for instance, an infectious disease, after which the population can be examined further, can be vaccinated, separated into animals that may or may not be sick or susceptible to sickness, and the like.

Preferably, in an arithmetic unit as used in a method according to the invention limiting values are adjusted for the measured bodily functions, at least the signals generated on the basis thereof, in which arithmetic unit the algorithm is adjusted such that when exceeding such a limiting value an attention signal is emitted. This enables rapid reactions to undesirable deviations from the relevant bodily functions of at least the animals functioning as indicator animals and provided with a transponder according to the invention.

A method according to the invention is preferably characterized by the measures of claim 6.

The use of probability calculation for analyzing the signals has the advantage that significant changes in the state of health of the animals in the relevant population can be easily recognized with a fair degree of certainty. Moreover, an animal caretaker himself need not approach the animals. Memory means are preferably provided, with which historical data can be recorded, which can be used in the analysis of incoming signals and/or in the determination of desired limiting values, which enables adjusting the mentioned limiting values, for instance, depending on seasons, hour of the day, or the like.

In a special advantageous embodiment a method according to the invention is further characterized by the measures of claim 9.

In such a method an allowable degree of deviation from a standard value is adjusted, in excess of which an attention signal is transmitted to a medical service or such an aid, which can then read out and diagnose data concerning the population.

A method according to the invention can be carried out in an at least partly autonomously functioning system. In this system, for instance, a signal from a transponder is always passed to a central reporting station, for instance a health center, as well as to the cattle-breeder. This prevents fraud. In fact, even when the cattle-breeder moves an animal, for instance

because of sickness, this will be detected by the central reporting station, just as the deviation as an indication of a deteriorating health. Preferably, means are also provided with which it can be detected that the system is manipulated, such as in case of disturbance of the signals, disconnection of the transponders, and the like. From the central reporting station presence checks for animals and apparatus can be carried out regularly or irregularly.

Furthermore, the invention relates to an assembly of at least a number of transponders with transmitting means, a receiver for signals emitted by the transmitting means, and an arithmetic unit with an algorithm, characterized by the features of claim 10.

Such an assembly is particularly suitable for use in a method according to the invention. With such an assembly information can be obtained from a distance about the state of health of animals, of animals in which the transponders are placed as well as of animals in the direct surroundings thereof. The animals equipped with the transponder will also be designated as indicator animals.

Preferably, the or each transponder with the measuring means is arranged for implantation under the skin of an animal.

Preferably, an assembly according to the invention is further characterized by the features of claim 10.

The provision of transmitting and receiving means designed for wireless communication over a distance up to about 50 m has the advantage of a relatively great freedom for positioning the receiving means, for instance near a roof of a shed or sty, while interference between the different transmitting and receiving means is avoided. Moreover, this enables the use of transmitting means having a relatively low energy level, which means that the transponders require relatively little energy and, furthermore, have substantially no influence on the health of the animals.

More advantageous is an even shorter distance, for instance 30 m, in particular 20 m.

The invention further relates to an arithmetic unit characterized by the features of claim 13.

5           Such an arithmetic unit is particularly suitable for use in a method or assembly according to the invention.

Furthermore, the invention relates to the use of active transponders with measuring means characterized by the features of claim 14.

10           Precisely such a use of active transponders has the advantage that data about at least one bodily function of animals in a population can be easily obtained, on the basis of which data pronouncements can be given on the health of all, at least a larger number of animals in the mentioned population.

15           The other subclaims give further advantageous embodiments of the invention.

In explanation of the invention, exemplary embodiments of a method, assembly, arithmetic unit and use according to the invention will be specified with reference to the accompanying drawings, in which:

20           Fig. 1 diagrammatically shows three populations of animals, separated from each other, provided with transponders, a receiver, and an arithmetic unit coupled therewith;

Fig. 2 shows, in exploded (above) and composed (below) condition, a transponder for use according to the invention;

25           Fig. 3 shows an alternative embodiment of a transponder for use according to the invention; and

Fig. 4 shows a block diagram of a temperature/heartbeat transponder with a block diagram of the heartbeat hybrid.

30           In this description similar or corresponding parts have similar, at least corresponding reference numerals.



Fig. 1 shows, in top view, three populations A, B, C of animals, in the exemplary embodiment shown pigs. It will be clear, however, that the invention may also include other animals, for instance production animals, such as cows, sheep, and the like, riding animals, such as horses, or pets, such as dogs and cats. In the exemplary embodiment shown, each population A-C comprises six pigs 1A-1F, 2A-2F, 3A-3F. In the first population A two animals, namely pigs 1A and 1F, are equipped with a transponder 4, and so are two animals, namely pigs 2A and 2E, in the second population B. In the third population C three animals 3C, 3D, 3E are equipped with such a transponder 4. For each population it can be determined by way of experiment what number of animals, for instance expressed in terms of percentage, has to be provided with such a transponder 4 to obtain desired information in a manner to be specified.

In explanation, Figs. 2-4 diagrammatically show embodiments of such transponders. Such transponders are known per se and described by, for instance, Mans B. Jansen, Peter J. Nijenhuis, and Arjan Cats in a publication by TF DL DLO and IMAG-DLO, The Netherlands, entitled "Recent developments on implantable transmitters with the AMTI61 integrated circuit as a universal 6-channel biomedical telemetry transmitter". It will be clear that these transponders are mentioned by way of example only. In principle, any implantable transmitter or transmitter otherwise fixable in or on an animal, such as an active or passive transponder, transmitter, or the like, which is remotely readable, may be used within the invention.

The transponders 4 preferably used according to the invention are active transponders, which can provide informative signals by means of transmitting means 6. Moreover, these transponders are provided with measuring means 8, for instance a heartbeat meter, a temperature sensor or a blood pressure sensor, with which each time at least one bodily function of the relevant animal can be measured and can be emitted via the

transmitting means 6 as informative signal. By using an active transponder, the at least one relevant bodily function of each animal equipped with a transponder can be checked at any desired moment, without causing stress to the relevant animal. To that end, in an apparatus according to the present invention an arithmetic unit 10 is connected with a first transmitter/receiver 12, for instance installed in an office room, and a second transmitter/receiver 14, arranged near, but at some distance from the relevant populations A-C, for instance near a ceiling of a piggery, in which the populations A-C are housed, separated from each other by means of fences 16. Each transponder 4 is preferably equipped with an at least temporary memory, in which data concerning the or each measured bodily function can be stored periodically or continuously, at least prior to reading out, at least transmitting the desired informative signal to the first transmitting/receiving means 12 via the second transmitting/receiving means 14. Preferably, each transponder 4 is individually recognizable and controllable, for instance with an identification signal and/or a specific frequency, such that by means of the first and second transmitting/receiving means 12, 14 transponders can be controlled and read out individually at any desired moment, at least the memories thereof can be read out or on-line information can be requested about the relevant bodily functions. To that end, an arithmetic unit 10 can be easily programmed.

Equipping, as shown in Fig. 1, only a limited number of animals, for instance 1 out of each group of 2 or 3 animals or even fewer animals within a relevant population, with a transponder has the advantage that only a limited number of animals needs to be monitored, which is cost-saving and, in addition, more restful to the animals. In fact, placement of the transponders may cause stress to the relevant animal. A further advantage thereof is that in case of, for instance, slaughter of the animals the transponder 4 needs to be removed only from a number of animals. Preferably, a lowest possible number of animals are provided with a

transponder. A minimum number of animals can be determined on the basis of, for instance, epidemiological and statistical data and models, for instance depending on the bodily functions to be measured and diseases, deviations, or the like, to be expected or to be diagnosed. Such a selection can be made  
5 by those skilled in the art on the basis of generally available knowledge.

An apparatus of Fig. 1 is used, for instance, as follows.

On the basis of above-mentioned epidemiological and statistical data and models it is determined which bodily functions of how many animals have to be measured. Optionally, different animals may be  
10 equipped with different transponders 4, for instance in the third population C three animals 3C, 3D with a transponder 4 for measuring body temperature and a third animal 3E with a transponder for measuring the heartbeat, which may be advantageous, for instance when interference between both magnitudes could be expected. However, measuring means for  
15 different bodily functions may also be combined in a transponder 4, as shown, for instance, in Figs. 3 and 4. The animals equipped with transponder(s) 4 are used as indicator animals. By means of an algorithm in the arithmetic unit a number of limiting values is adjusted for the bodily functions to be measured, which arithmetic unit is arranged to provide an  
20 attention signal in case of exceeding of falling below such a limiting value. This has the advantage of enabling rapid reactions in case of undesired deviations of the relevant bodily functions of at least the animals functioning as indicator animals, which are provided with a transponder according to the invention. Surprisingly, it has been found that even  
25 equipment of a very limited number of animals with a transponder 4 can give a good picture of the state of health of a total population A-C.

The apparatus, in particular the first and/or second transmitter/receivers 12, 14, may be coupled to a central reporting unit, for instance a reporting center of a supervisory body. Data concerning the  
30 indicator animals and hence about the population are then immediately

passed to this reporting center, so that it can be checked whether the animals are not undesirably manipulated. Thus, for instance, it can be detected whether sick, at least infected animals are not removed from a population without reporting this, after which the other animals from the population could, for instance, be sold without reporting the risk of infection, for instance during an incubation time. Fraud with sick or (possibly) infected animals is thus prevented, in particular when this system is coupled to a central registration and data storage system.

Preferably, use is made of probability calculation to analyze the signals for detecting significant changes in the state of health of animals in the relevant population. Historical data can be recorded in memory means, optionally in the transponder, but preferably in the arithmetic unit, such that they can be used in the analysis of incoming signals and/or when determining desired limiting values, for instance time-dependently. Thus, developments of different individual animals and of populations can also be recorded and checked. If the probability calculation indicates that there is a significant risk of an undesired state of health, then this can be checked by a veterinarian.

Fig. 2 shows an exploded transponder 4 with removed housing (above) and a composed transponder with transparent housing 18 (below). Included in the housing 18 are a printed circuit board 20, containing at least part of the transmitting means 6, memory means, and the like. Connected therewith is a transmitting coil 22 and a (lithium) battery 24. In composed condition such a transponder has, for instance, a length of a few centimeters or, preferably, less and a diameter of about one and a half centimeters or, preferably, less. It has been calculated that such a transponder can remain active for, for instance, one and a half to two years. At one end of the housing a temperature sensor 26 is provided, connected with the printed circuit board 20, with which temperatures can be measured with, for instance, a precision of plus or minus 0.1°C. Of course, any desired

sensor can be connected with such a printed circuit board 20 and housing 18 in a comparable manner. The housing 18 is closed to the outside and made of a material that can be used and is allowed for use in a body of an animal (FDA approved).

5            Fig. 3 shows an alternative embodiment of a transponder for use within the invention, which comprises both a temperature and a heartbeat measuring device. To that end, a number of ECG electrodes 28 are connected with the housing 18. Fitted to the housing 18, on the outside, is a strip of felt, such as, for instance, Dacron felt 30, with which after  
10    implantation in an animal the transponder 4 is prevented from moving through the body of the animal. Of course, such a transponder may also be fixed in a body of an animal in a different manner.

          Fig. 4 shows a block diagram of a transponder 4 for use in the invention. This is a general diagram. This transponder 4 comprises a  
15    control logic 40, to which is coupled at least one sensor 42, for instance a temperature sensor. Moreover, a clock 44, in particular a quartz clock, is coupled to the control logic. The control logic is coupled to a transmitter 46 and an antenna 48 connected therewith. Optionally, a receiver 50 may be inserted between the antenna 48 and the control logic 40. The control logic  
20    40 may contain memory means.

          During use the control logic 40 receives the measuring values from the temperature sensor 42, whether or not to order, at fixed times. At fixed times the quartz clock 44 gives the control logic 40 the order to engage the transmitter 46 and to pass the measured temperature values received to the  
25    transmitter 46, which, in turn, passes the transmitter signal via an antenna coupling unit 52 to the antenna 48. In the case of an active transponder the receiver 50 will be added, via which an instruction can be given to the control logic 40 in the form of an external wireless order, which reaches the receiver via the antenna 48 and the antenna coupling unit 52. This wireless  
30    order is generated by a suitable external transmitting device.

The invention is by no means limited to the exemplary embodiments given in the specification and shown in the drawings. Many variations thereof are possible within the framework of the invention as defined by the claims.

5           Thus, within the invention each animal within a population can be equipped with a transmitting means, at least a transponder of a type described, while, moreover, animals may be equipped with two or more transponders. Even for such uses pronouncements can be given on the basis of, inter alia, epidemiological and statistical data about syndromes of a  
10 population and developments to be expected therein. Furthermore, first transmitting and receiving means can be used, with which transponders can be directly controlled and read out without intervention of second (or further) transmitting and receiving means. It will be clear that several second transmitting and receiving means may also be used, if the desired  
15 range calls for this. In the embodiment shown transponders are indicated near the neck of the pigs. It will be clear that any desired position of the transponders in or on the animals can be selected, for instance depending on the desired bodily functions to be measured. Any desired number of populations can be monitored with a method and an apparatus according to  
20 the invention. Where in this text transponder is mentioned, it should be understood that any type of transmitter as described therein may be used. These and many variations are deemed to fall within the framework of the invention as defined by the claims.

## CLAIMS

1. A method for monitoring production animals, wherein a number of animals from a population is provided with transmitting means, which are provided with measuring means for measuring at least one bodily function and are arranged to emit a signal on the basis thereof, wherein receiver  
5 means are installed in the vicinity of the population, with which receiver means the signals emitted by the respective transmitting means are received and are passed to an arithmetic unit, which arithmetic unit includes an algorithm with which data concerning the state of health of the animals in the population are determined from the received signals by  
10 comparison with previously inputted standard values.
2. A method according to claim 1, wherein only a limited number of animals from a population is equipped with said transmitting means, which number is preferably determined on the basis of at least epidemiological and/or statistical data.
- 15 3. A method according to claim 2, wherein at least use is made of epidemiological knowledge about transmission of infectious agents.
4. A method according to claim 1 or 2, wherein transponders, in particular active transponders, are used as transmitting means.
5. A method according to any one of claims 1 – 4, wherein in the  
20 arithmetic unit limiting values are adjusted with which at least part of the signals from the transmitting means is compared, wherein when exceeding these limiting values an attention signal is emitted.
6. A method according to any one of the preceding claims, wherein at least on the basis of probability calculation, the received signals, and the  
25 number of animals in the relevant population it is determined whether significant changes in the state of health of the animals in the relevant population occur, at least have occurred.

7. A method according to any one of the preceding claims, wherein the arithmetic unit is provided with memory means for recording historical data with respect to the relevant population, in particular with respect to the bodily function corresponding to the signals measured with the transmitting means, in particular transponders, which recorded data are inputted in the algorithm and are involved in the determination of the standard values.

8. A method according to any one of the preceding claims, wherein at least the body temperature of the relevant animals equipped with said transmitting means is measured, as well as changes therein, wherein at least on the basis of relative changes in the body temperatures the state of health of the animals is determined, at least attention signals are emitted.

9. A method according to any one of the preceding claims, wherein at a pre-adjusted degree of deviation with respect to the, at least one standard value the arithmetic unit transmits an attention signal to a medical service or such an aid, which aid can then read out the arithmetic unit to obtain data required for diagnosis.

10. An assembly of at least a number of devices, in particular transponders with transmitting means, a receiving means for signals emitted by the transmitting means, an arithmetic unit, and an algorithm included in the arithmetic unit, arranged to provide, at least on the basis of signals emitted by the transmitting means, information about the state of health of the animals on or in which animals said transmitting means are placed and about animals in the direct surroundings.

11. An assembly according to claim 10, wherein the transmitting means with the measuring means are arranged for implantation under the skin of an animal.

12. An assembly according to claim 10 or 11, wherein the transmitting means and the receiving means are designed for wireless communication over a distance up to about 50 m, more in particular about 30 m, and preferably about 20 m.



13. An arithmetic unit, provided with an algorithm arranged to provide, at least on the basis of measured values of at least one bodily function of a number of animals from a population, information about the state of health of all animals in the relevant population.
- 5 14. The use of transmitting means with measuring means for measuring at least one bodily function of an animal for collecting, on the basis of signals emitted by such transmitting means placed in a number of animals from a population, data concerning the state of health of the whole relevant population.
- 10 15. The use according to claim 14, wherein active transponders are used.

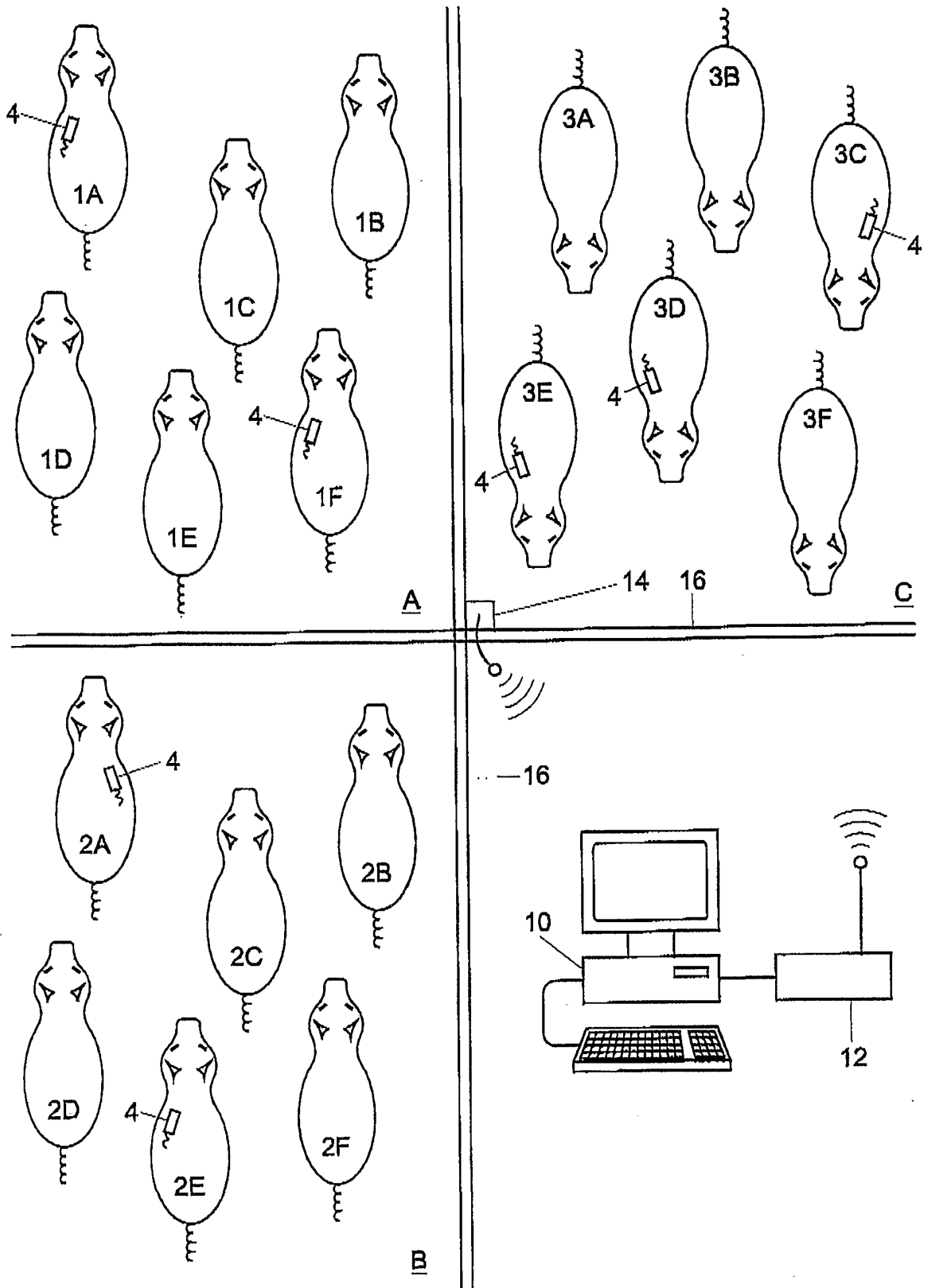


Fig. 1

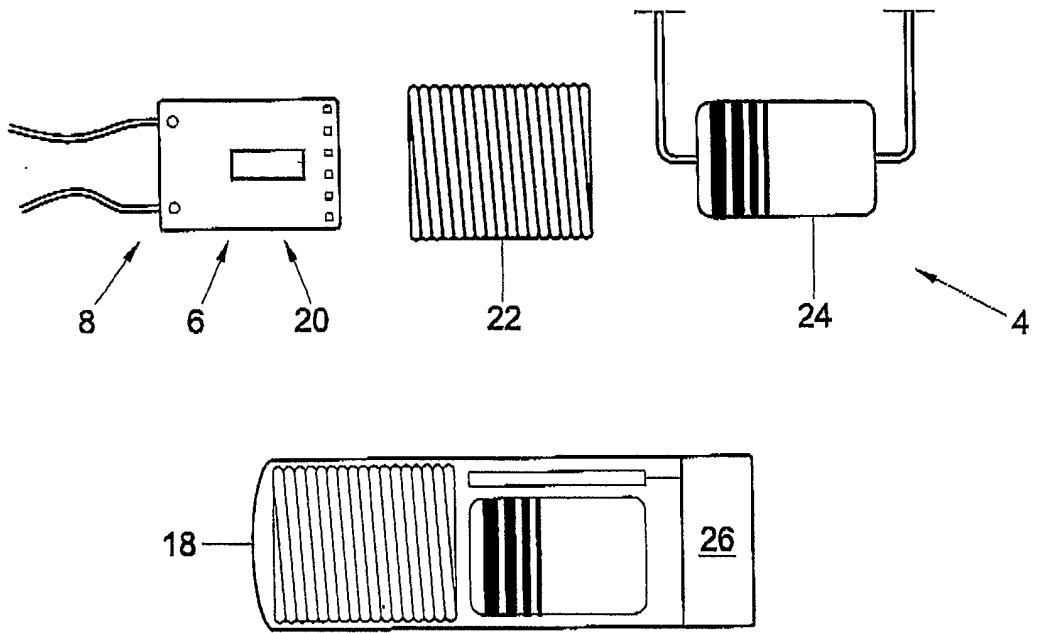


Fig. 2

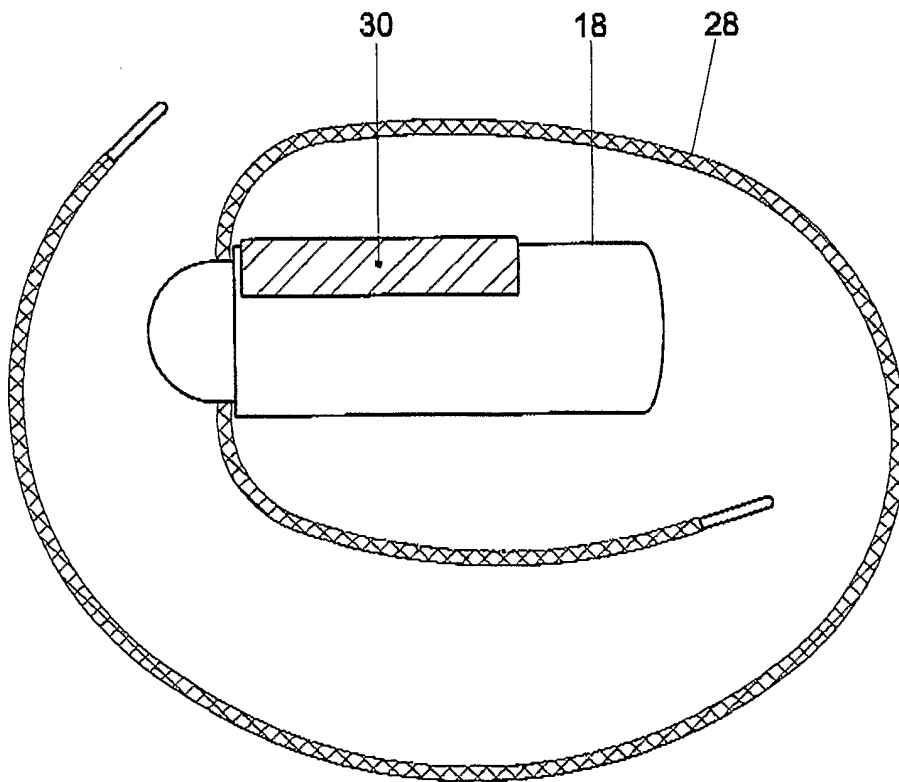


Fig. 3

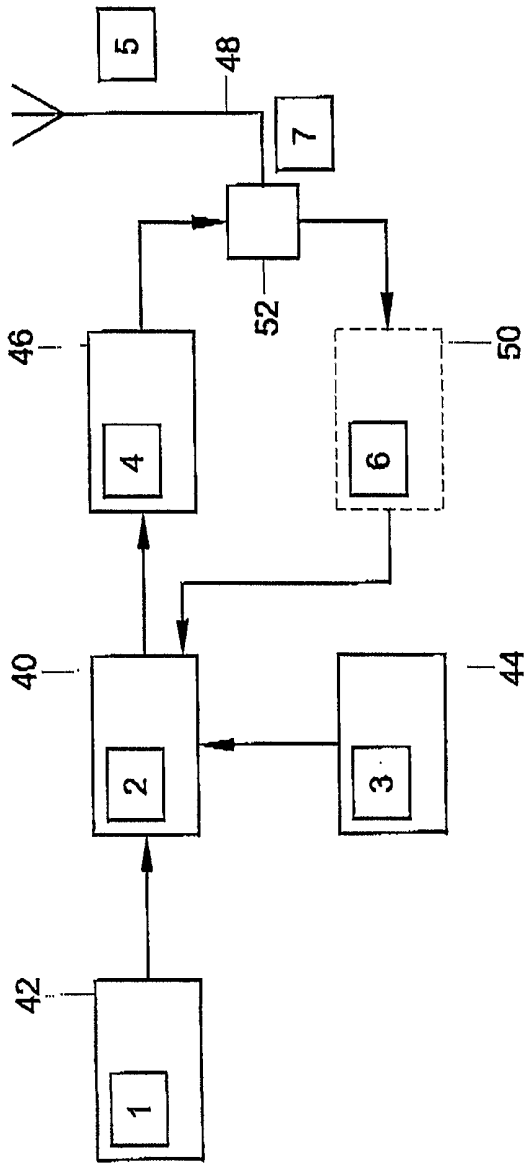


Fig. 4

## INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 A01K29/00 A61B5/00

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)  
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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 practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 104 294 A (ANDERSSON) 15 August 2000 (2000-08-15)  the whole document	1,4,5, 7-10, 12-15
X	EP 0 549 081 A (STICHTING INSTITUUT VOOR MECHANISATIE ARBEID EN GEBOUWEN) 30 June 1993 (1993-06-30) the whole document	1,4-15
X	US 5 794 625 A (MCCARLEY) 18 August 1998 (1998-08-18)  the whole document	1,4,5, 7-10, 12-15

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents:

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Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6104294	A	15-08-2000	AU 717436 B2	23-03-2000
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