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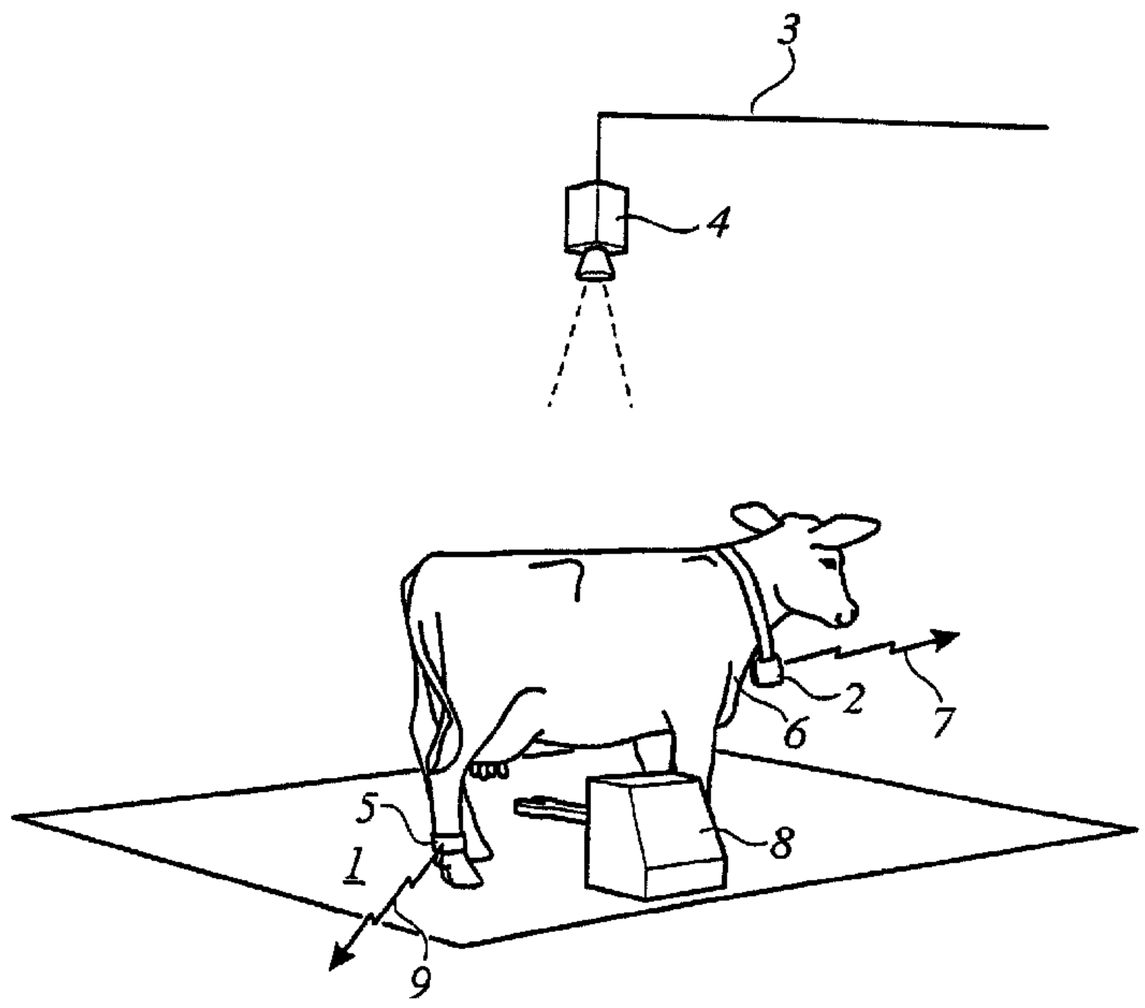
(54) **DISPOSITIF ET PROCEDE DE SURVEILLANCE DE L'ACTIVITE D'UN ANIMAL**

(54) **AN APPARATUS AND A METHOD FOR MONITORING THE MOTION ACTIVITY OF AN ANIMAL**



(57) An apparatus for monitoring the motion activity of an animal comprising sensor means (2, 4, 5) for sensing at least one motion state of the animal and transmission means (3, 7, 9) for transmitting of information to an evaluation station (21) and operatively connected to the sensor means. According to the invention the sensor means includes at least one intensity measuring device (4), the output signals of which represent the animal movements in terms of amplitude, transients and/or rising time and are supplied to said evaluation station (21) comprising a processor (25) for determination of various states of the animal.

ABSTRACT

An apparatus for monitoring the motion activity of an animal comprising sensor means (2, 4, 5) for sensing at least one motion state of the animal and transmission means (3, 7, 9) for transmitting of information to an evaluation station (21) and operatively connected to the sensor means. According to the invention the sensor means includes at least one intensity measuring device (4), the output signals of which represent the animal movements in terms of amplitude, transients and/or rising time and are supplied to said evaluation station (21) comprising a processor (25) for determination of various states of the animal.

An apparatus and a method for monitoring the motion activity of an animal

TECHNICAL FIELD

The present invention relates to an apparatus for monitoring the motion activity of an animal comprising:
sensor means for sensing at least one motion state of the animal;
transmission means for transmitting of information to an evaluation station and operatively connected to the sensor means.

It also relates to a method for monitoring the motion activity of an animal involving sensing of at least one motion state of the animal, and transmitting of information to an evaluation station for processing the information obtained.

BACKGROUND OF THE INVENTION

Such an apparatus and such a method are known from EP-A-0 786 203, which describes a motion activity system for determination of the physical condition of domestic animals, such as milking animals, by registering their movements within a predetermined area, such as a milk box. The known system including an activity sensor carried by the animal monitored, is based on recording the number of movements registered for one or more steps in a computer. The registered number of movements is compared in the computer to corresponding informations for various animals. On basis of the result of the comparison the computer is able to indicate the animals whose number of movements deviates from an average value regarding the number of these movements. Then the indication of deviation is interpreted as a symptom of an abnormal physical condition of the animal, e.g. injuries, diseases, heat, and the like.

The known system based on registration of the number of movements is rather complicated and the results are often misleading.

Another activity measurement unit is described in WO 97/24027 which also is intended to be carried by a domestic animal. It is based on the evaluation of electric pulses generated when the animal moves. The evaluation is made on a time basis in such a way that when the number of pulses within a predetermined time period exceeds a certain threshold, information is transmitted to an evaluation station. The frequency of the informations transmitted is collected and used for diagnosing various states of the animal.

Thus, also the unit known from the WO 97/24027 is based on registration of the number of activities/movements which, although being reported to the evaluation system in a favourable energy saving way, it can be somewhat difficult with regard to obtain fast results with reference to the actual movements of the animal.
Still another motion activity system is to be found in US-A-5 183 056 and in EP-A-0 423 394 describing an inductive motion sensor. The known sensor is based on a spherical magnetic member movable within an ellipsoid cavity surrounded by an electrical coil. The movement of the magnetic member in the cavity generates various electric signals from the coil depending on the actual position of the magnetic member within the cavity. The motion activity system is mainly used for heart pacemakers and also as an anti-theft sensor.

The known systems mentioned above have to be attached in a rather firm way to the body of the object to be monitored. If the object is an animal free to move within the predetermined area, the signals generated by the systems have to be transmitted by a radio transmitter for evaluation at an evaluation station. This radio transmission also adds to the costs of the systems, each one being in itself rather complicated.

For identification of individual domestic animals it is well-known in art to make use of a transponder unit attached to the animal. Such transponder identificators are described e.g. in US-A-4 510 495, US-A-4 247 758, US-A-4 618 861 and in WO 95/32616.

Such transponders are presenting identification information only, but they give in no way any information on the animal movements.

Therefore, it is an object of the invention to overcome the drawbacks with the known systems mentioned above for having a more reliable monitoring system being mainly a basic stationary arranged system generating activity informations easy to evaluate at an evaluation station for obtaining of fast and true diagnoses of various states of the animal monitored.

SUMMARY OF THE INVENTION

This object has been achieved by an apparatus of the initially defined kind, which is characterised in that a sensor means includes an intensity measuring device, the output signals of which represent the animal movements in terms of amplitude, transients and/or rising time and are supplied to said evaluation station comprising a processor for determination of various states of the animal.

It has also being achieved by a method of the initially defined kind, which is characterised in that sensed motion states are indications on the movement intensity of the animal in terms of signal amplitude, transients, and/or rising time, said signals being processed at said evaluation station for determination of various states of the animal.

The object is based on a direct monitoring of the animal within a predetermined animal area by a mainly stationary, basic monitoring system evaluating the amplitude, transients and/or rising time of the signals generated. Hereby, a safer and faster system for diagnosing of various states, such as general disturbances, restless, heat, etc. of the animal is obtained.

Suitably, said intensity measuring device is an image capturing device observing the animal movements, the images captured by said device being supplied to said evaluation station in form of electrical output signals. Hereby, the information obtained are easy to transfer to and to evaluate at the evaluation station.

Preferably, said intensity measuring device includes a combination of an inductive motion activity sensor worn by the animal being observed and an image capturing device observing the animal movements, the output signals from said activity sensor and said image capturing device being processed at said evaluation station for said determination of the various states of the animal, said states being considered true if both said signal generation means simultaneously indicate pronounced signal values. Hereby, the informations obtained from said two intensity measuring sources, i.e. from said inductive sensor and from said image capturing device, are compared to each other resulting in a safe determination of the animal status when both the sources generate coincident signals.

Suitably, image capturing device is a basic, mainly stationary device including a video camera, an IR camera or a digital camera. Hereby, electrical signals are generated in an analogues or digital form to be directly usable by said evaluation station preferably including electronics processor means.

Preferably, comparator means are comparing the obtained output signals to reference signals stored in a memory for evaluation of intense animal movement indicating particular states of the animal if crossing predetermined threshold values. Hereby, a reference is obtained to normal conditions of the actual animal.

Suitably, said intensity measuring device is combined with an identification means worn by the animal, said identification means being in information connection with said evaluation station for identification of the animal actually monitored. Hereby, the animal just monitored can be identified, which is important when comparing stored individual animal data to data obtained from the captured images.

Preferably, said identification means is a transponder being in wireless connection with a transponder receiver, said transponder receiver being electrically connected to said evaluation station. Hereby, a fast direct transmission is obtained for more simple information on the individual animal.

Preferably, output signals from said processor are used as control signals for a milking robot. Hereby, the generated signals, indicative for the animal state, may be directly used for actuation of an animal handling devise, such as a milking robot.

With the apparatus and the method according to the present invention it is possible to register all the movements taken by the animal monitored by the basic image capturing device. Thus, from the signal generated one may have informations about the animal's momentanous "mental condition" just by interpretation of the amplitude and/or frequency and/or rising time and/or transients of the signal. Thus a signal rich of transients may be interpreted as an animal heat. A high frequency signal indicates often an anxious or restless animal while a signal with fast rising time deflections may be an indication of an excited animal. On the other hand, a calm and regular running signal having no transients etc. will indicate a harmonious animal.

The signal evaluated at the evaluation station may be used as a health indicator as such, but it can also be used as a control input for an automatic milking robot or the like.

DRAWING SUMMARY

The invention will now be described in more detail with reference to accompanying drawings, in which

Figure 1 illustrates in a simplified manner the image capturing area monitored according to the invention,

Figure 2 illustrates a block diagram for a preferred embodiment of the invention and

Figure 3 illustrates a diagram showing the processed output of the image capturing device registered on a tape presenting samples on different signal indications and interpretations thereof.

DETAILED DESCRIPTION

Figure 1 illustrates in a simplified manner the image capturing area 1 being monitored by a stationary basic monitoring device 4 shown in form of a camera device. Said camera device 4 generates image signals supplied to an evaluation station 21 (Figure 2) preferably through electric cables 3. An animal 6 to be monitored is wearing a transponder 2 wireless 7 connected to a transponder receiver 22 (Figure 2) for supplying individual animal identification data to the evaluation station.

Preferably, but not necessarily, an inductive motion activity sensor 5 is also worn by the animal 6. Also said activity sensor 5 is in wireless communication 9 with the evaluation station through a receiver 23 (Figure 2) for supplying of signals representing animal movements comparable to those obtained from the camera device 4. The inductive device 5, including its wireless transmitter, is attached to the animal body at a suitable position, e.g. on one of its legs as shown.

The evaluated signals at the evaluation station may be used as a control input to a milking robot 8 shown in Figure 1.

Fig. 1b shows a robot stall with a milking robot 8, a monitoring device 4 and a gate 10 to the robot stall. The milking robot 8 contains teat cups 13, a valve 11 connected to the teat cups 13 and a pulsator 12 also connected to the teat cups 13. The monitoring device 4 is connected to an evaluation station 21 and the gate 10, the teat cups 13, the valve 11 and the pulsator 12 are connected to a control station 14 connected to the evaluation station 21.

The evaluation station 21 receives signals from the monitoring device 4. The signals are evaluated and then transferred to the control station for controlling of the milking robot 8. If the evaluated signal establishes that an abnormal situation has arisen, e.g. that the animal being milked is in a state of panic, the milking operation can be interrupted by control from the control station 14, e.g. by closing the valve

11, stopping the pulsator 12 and detaching the teat cups 13. After this either the gate 10 to the stall is opened up to let the animal out or the milking robot waits for the animal to calm down and then tries to milk again.

The evaluated signals could also control the feeding of the animal.

Figure 2 illustrates a block diagram for a preferred embodiment of the invention including a camera device as well as an inductive motion sensor 5. To identify the animal actually monitored also a transponder 2 is used.

As mentioned above with respect to Figure 1 the camera device 4 is the basic monitoring device supplying signals of captured images of the whole animal monitored, or parts thereof. Said signals are supplied through cables 3 to the evaluation station 21. Said supplied signals are processed by the evaluation station 21 for determination of various states of the animal monitored. The evaluation is carried out by investigation of the signals with respect to their amplitude, frequency, transients, and/or rising time as will be discussed further below with respect to Figure 3.

Thus, basically the camera device 4 may be the only signal source for implementation of the present invention. However, to obtain a more reliable determination of the signal design generated the camera device source is combined with the inductive motion sensor 5 mentioned above. Thus, in a comparator means 24 the information signals obtained from said two intensity measuring sources, i.e. from said inductive sensor 5 and from said camera device 4, are compared to each other resulting in a safe determination of the animal status when both the sources generate coincident signals.

To be able to compare the actual state of the animal to normal values for the animal being stored in a memory device 26, the transponder signals from the transponder receiver 22 suitably activates said memory device 26. Then, stored individual data

for the actual animal is supplied to the comparator means 24 for individual evaluation.

Resulting evaluation signals are processed in a processor means 25 for different purposes as is indicated in Figure 2. Thus, the processor means 25 generates control signals for a milking robot 8. Other processor generated signals are supplied to a printer device 27 and to a personal computer 28 being programmed to visually describe the resulting animal state.

Figure 3 illustrates a tape registration, e.g. obtained from the printer 27 shown in Figure 2. The registration print shown in Figure 3 is an intensity versus time diagram compressed for illustration purpose only, making it possible to illustrate some possible indications obtainable by the system according to the present invention.

Thus, the first section 31 of the intensity/time diagram shows a calm and regular progress of the signal having a normal amplitude/intensity and a long rising time. Such a signal stands for a harmonious animal.

The second section 32 shown in Figure 3 is a signal characterised by a high amplitude/intensity and a rather fast rising time. This signal indicates an animal being excited.

The third section 33 of the diagram print is showing a more high frequent signal indicating an anxious or restless animal.

Finally, the fourth section 34 of the diagram shows once more a somewhat regular signal progress similar to the one of section 31, but being rich of transients. Such a signal is interpreted as an animal heat.

It should be noted that the camera 4 may be arranged above the animal, as shown in figure 1 or on a robot arm of the robot 8.

The described apparatus and method according to the invention are applicable to all domestic animals, but is preferably related to animals to be milked, such as cows, sheep, goats, buffaloes and horses.

The Swedish Patent Office
PCT International Application

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CLAIMS

1. An apparatus for monitoring the motion activity of an animal (6) comprising: sensor means (2, 4, 5) for sensing at least one motion state of the animal, said sensor means includes at least one intensity measuring device (4, 5) the output signals of which represent the animal movements;
transmission means (3, 7, 9) for transmission of the output signals from the intensity measuring device (4,5) to an evaluation station (21) for determination of various states of the animal, the transmission means being connected the sensor means, said apparatus being **characterised in that** said output signals from the intensity measuring device (4, 5) represent the animal movements in terms of amplitude, transients and/or rising time and in that said intensity measuring device (4,5) includes an image capturing device (4) observing the animal movements, the images captured by said device being supplied to said evaluation station (21) in form of electrical output signals.

2. An apparatus according to claim 1, wherein said intensity measuring device (4, 5) includes a combination of an inductive motion activity sensor (5) worn by the animal (6) being observed and the image capturing device (4) observing the animal movements, the output signals from said activity sensor (5) and said image capturing (4) device being processed at said evaluation station (21) for said determination of the various states of the animal, said states being considered true if both said signal generation means simultaneously indicate pronounced signal values.

3. An apparatus according to claim 1 or 2, wherein image capturing device (4) is a basic, mainly stationary device including a video camera, an IR camera or a digital camera.

4. An apparatus according to anyone of the preceding claims, wherein comparator means (24) are comparing the obtained output signals to reference signals stored in

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a memory (26) for evaluation of intense animal movement indicating particular states of the animal if crossing predetermined threshold values.

5. An apparatus according to anyone of the preceding claims, wherein said intensity measuring device (5) is combined with an identification means (2) worn by the animal, said identification means being in information connection with said evaluation station (21) for identification of the animal (6) actually monitored.

6. An apparatus according to claim 5, wherein said identification means (2) is a transponder being in wireless connection with a transponder receiver (22), said transponder receiver being electrically connected to said evaluation station (21).

7. An apparatus according to anyone of the preceding claims, wherein output signals from said processor are used as control signals for a milking robot (8).

8. A method for monitoring the motion activity of an animal (6) involving sensing of at least one motion state of the animal, and transmitting of information to an evaluation station (21) for processing the information obtained and determining different states of the animal, said method being **characterised in that** said sensed motion states indicate the movement intensity of the animal in terms of signal amplitude, transients, and/or rising time, and in that said indicating of the movement intensity of the animal includes signal generation by an image capturing device (4) observing the animal's movements, the images captured by said device being supplied to said evaluation station (21) in form of electrical signals.

9. A method according to claim 8, involving a combination of signal generation by an inductive motion activity sensor (5) worn by the animal (6) monitored, and signal generation by the image capturing device (4) observing the animal's movements, the output signals from said activity sensor and said image capturing device being processed at said evaluation station (21) for said determination of various states of the animal, said states being considered true if both said signal generation means simultaneously indicate pronounced signal values.

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10. A method according to anyone of the claims 8 to 9, involving a transponder signal from a transponder (2) worn by the animal (6) for identification of the animal actually monitored.

11. A method according to claim 10, wherein said transponder signal is activating reference data individually stored at said evaluation station (21) for every animal (6) being able to monitor.

12. A method according to anyone of the claims 8 to 11, involving comparation of the generated output signals to stored reference signals for evaluation of intense movements indicating serious states of the animal if crossing predetermined threshold values.

13. A method according to anyone of the claims 8 to 12, involving interpreting of the signals processed at said evaluation station (21) for obtaining control signals being used in connection with a milking robot (8).

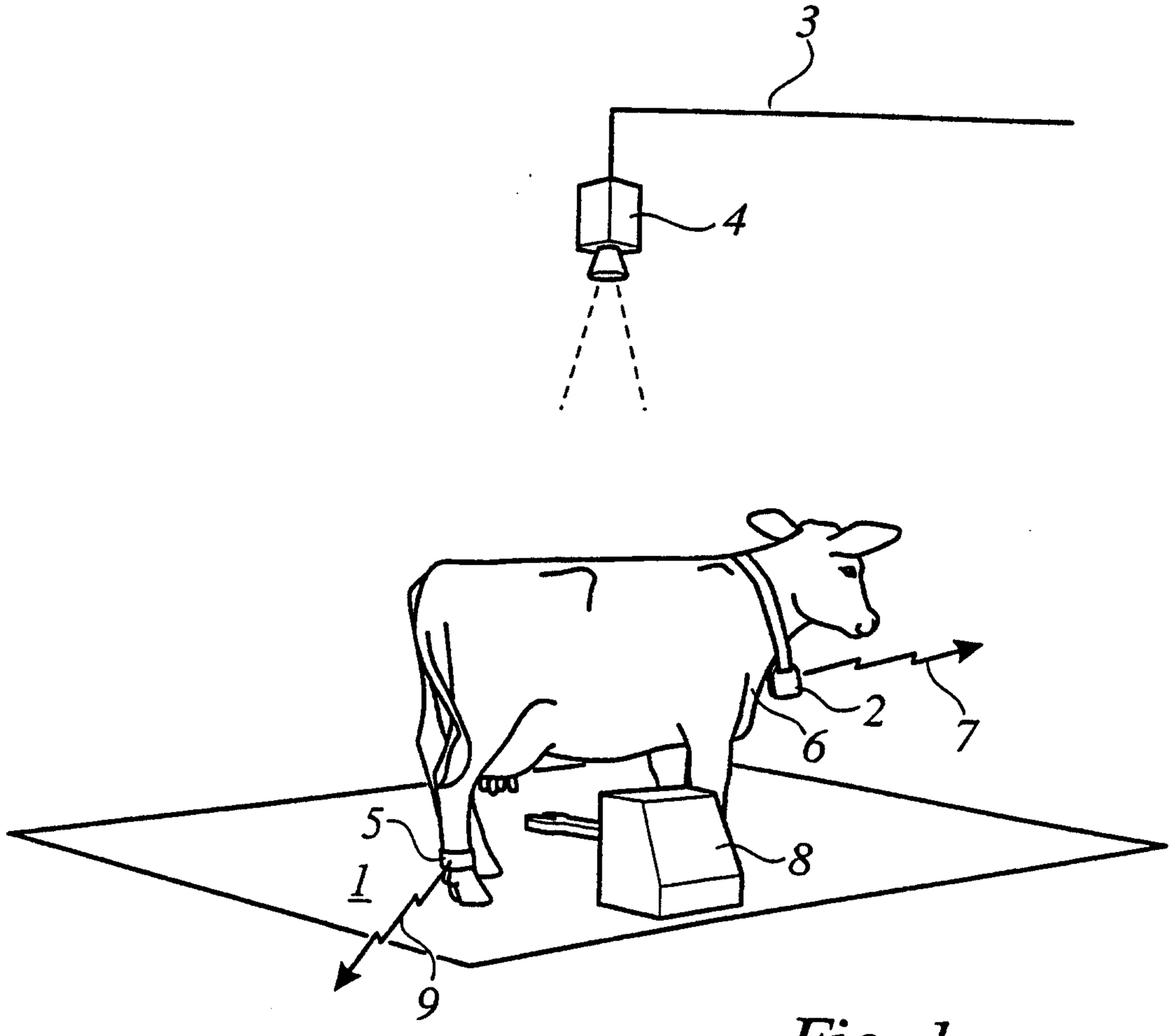

Fig. 1

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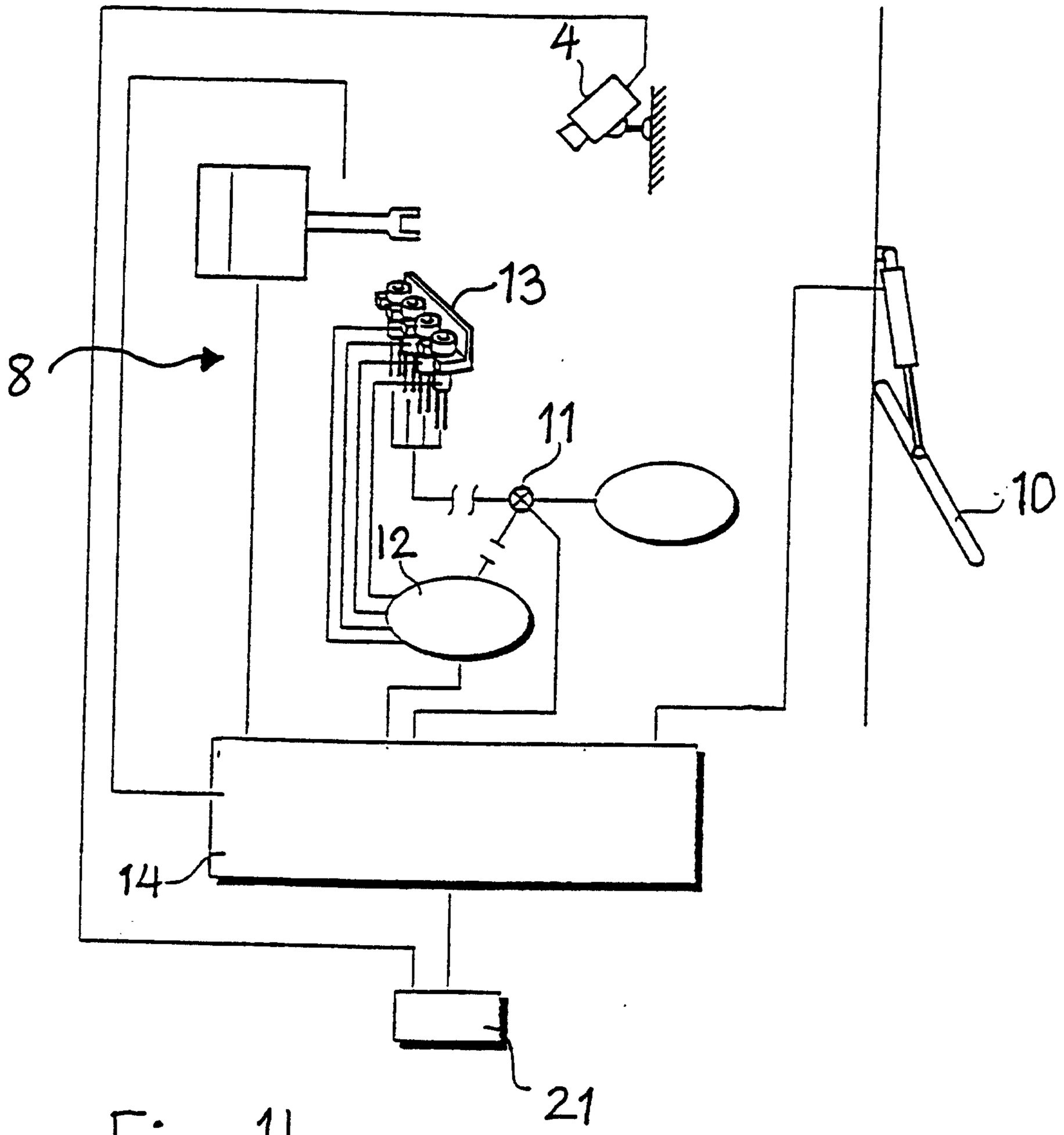

Fig. 1b

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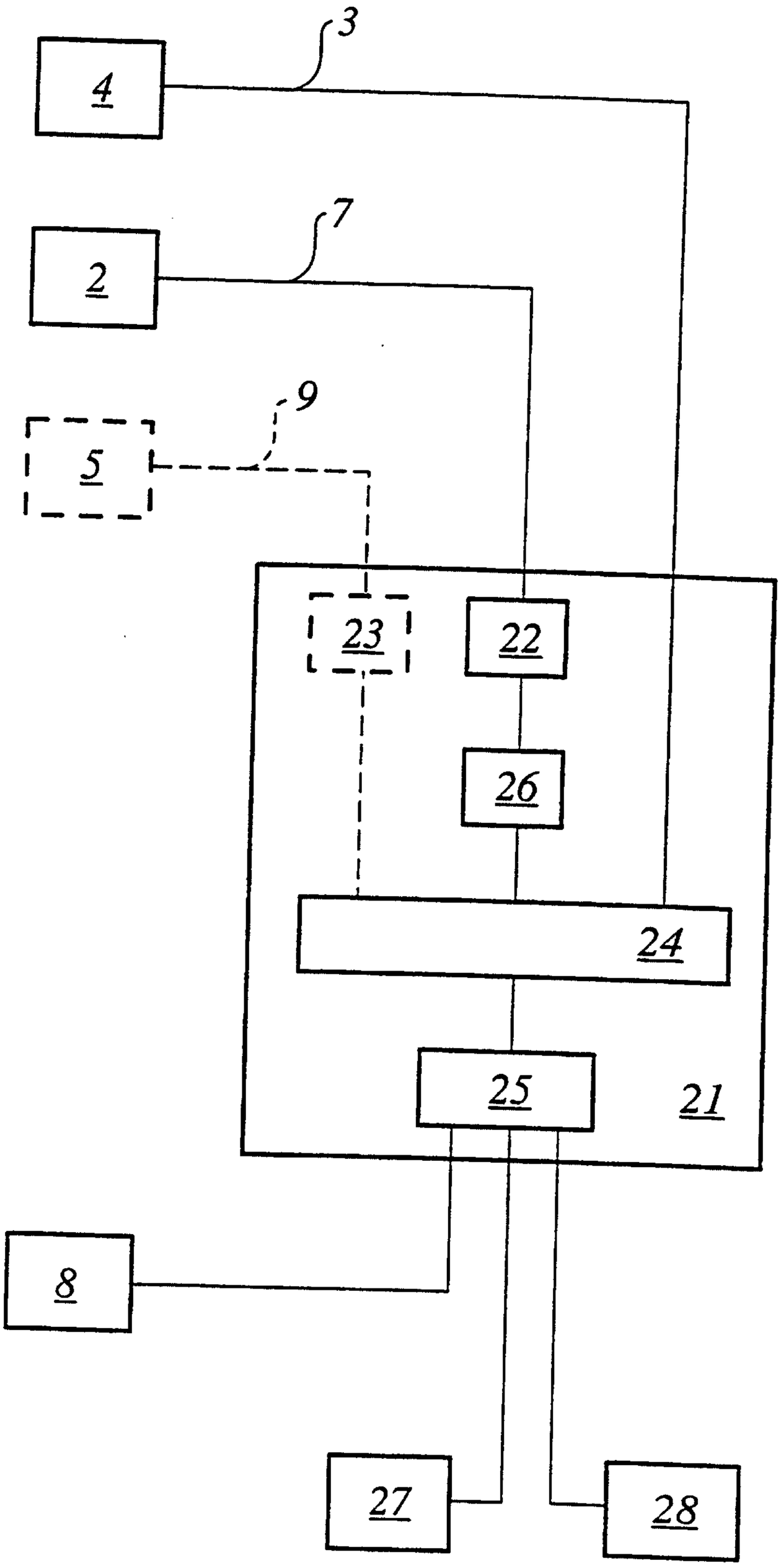

Fig. 2

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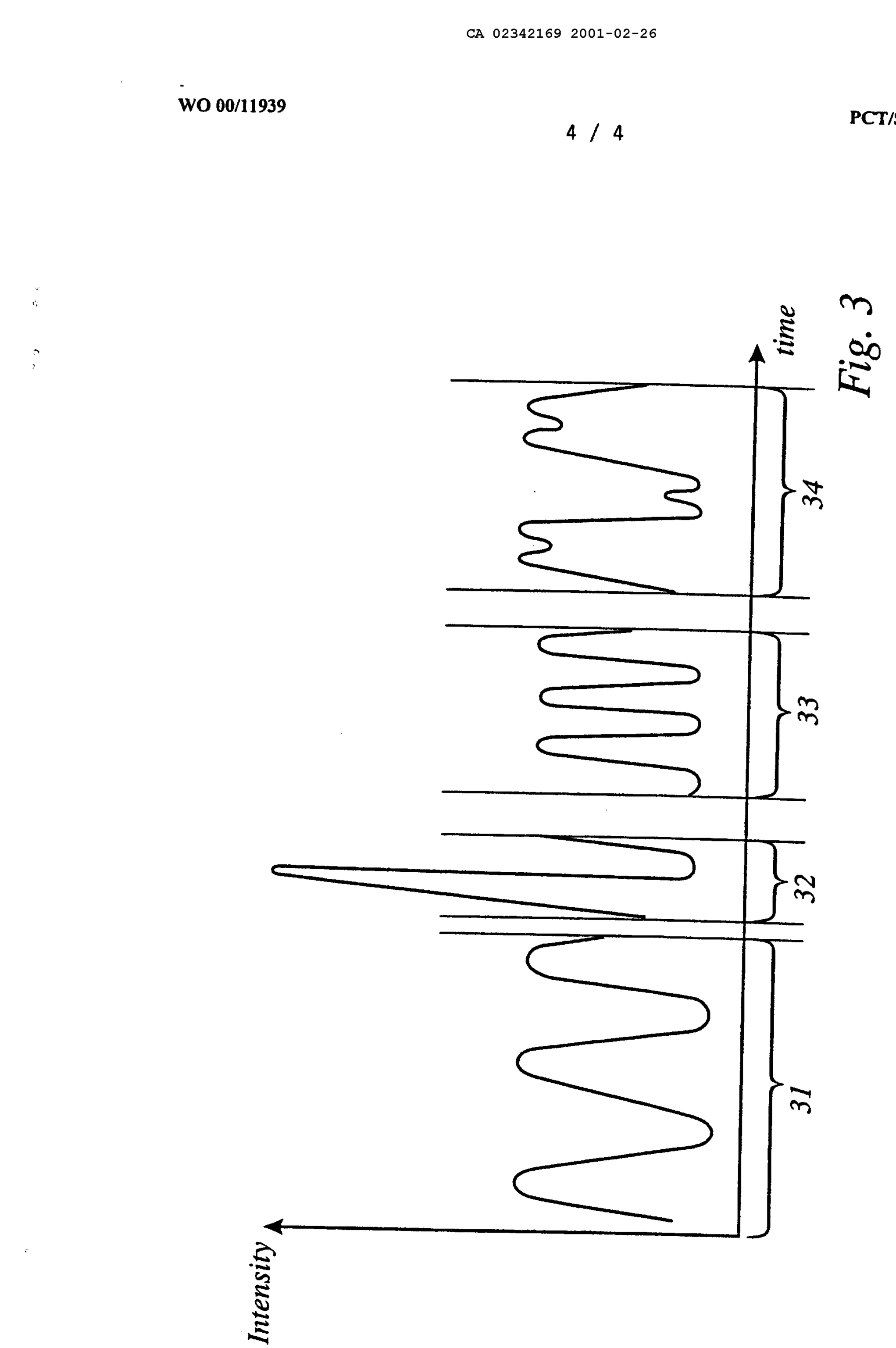

Fig. 3

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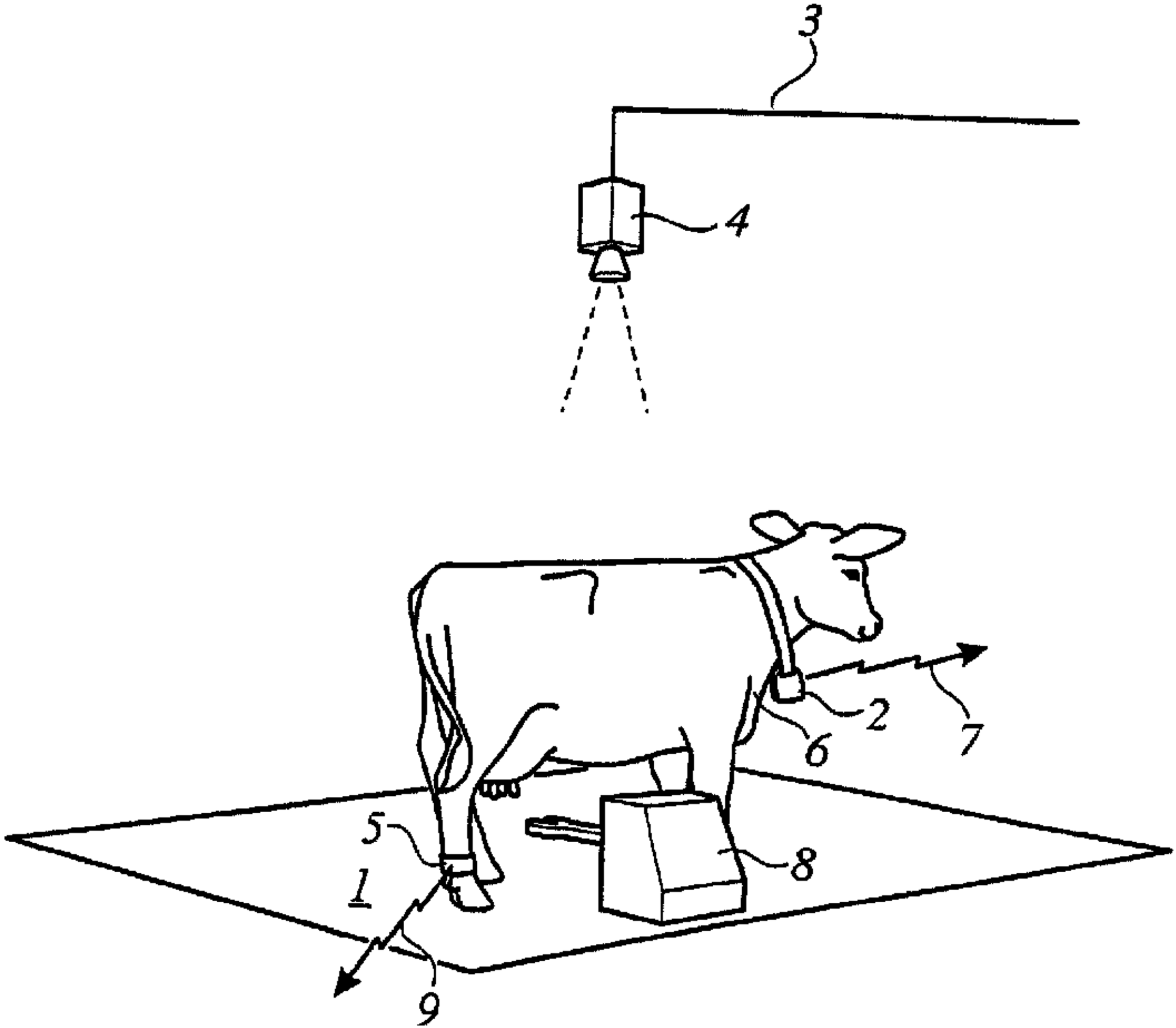
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