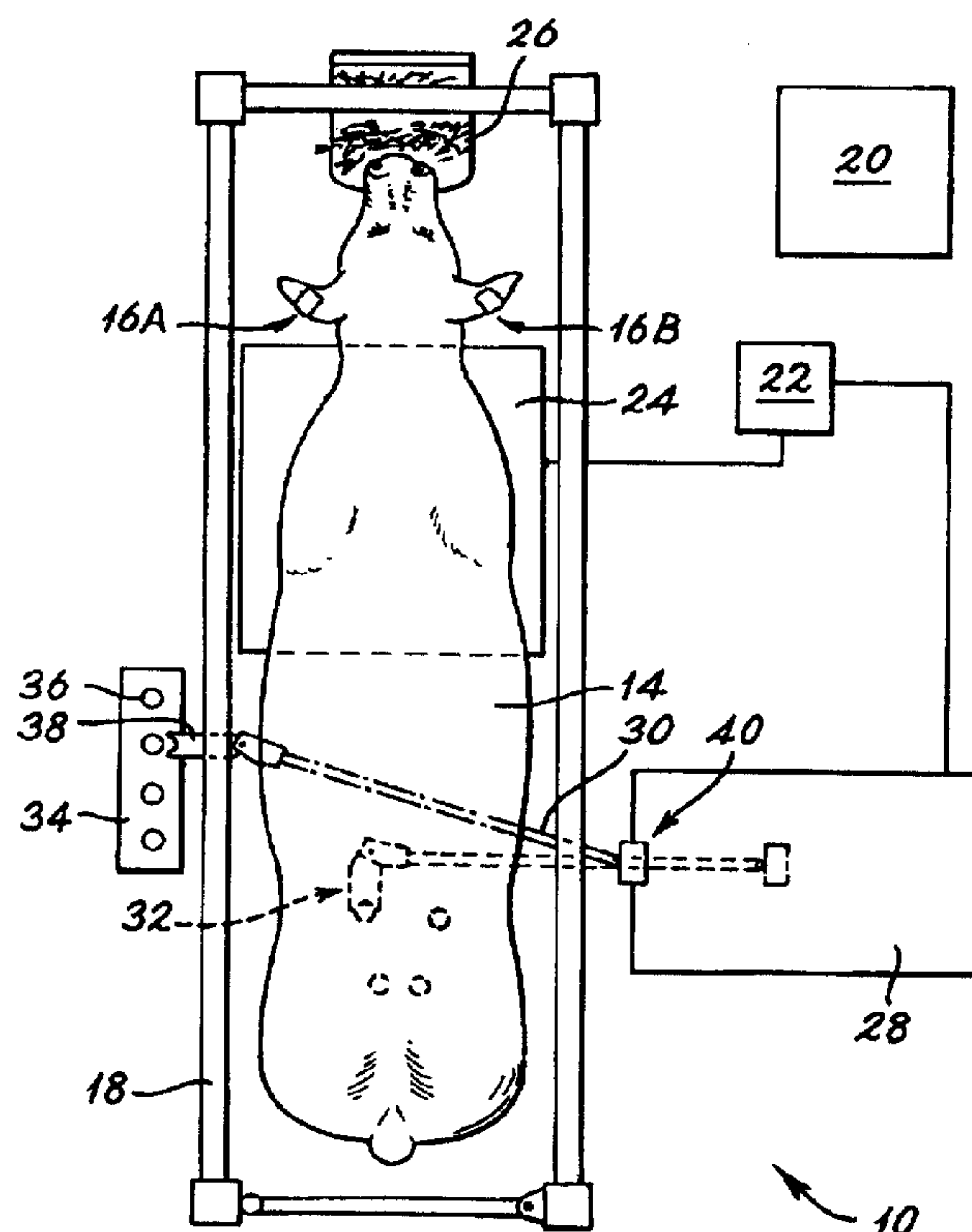


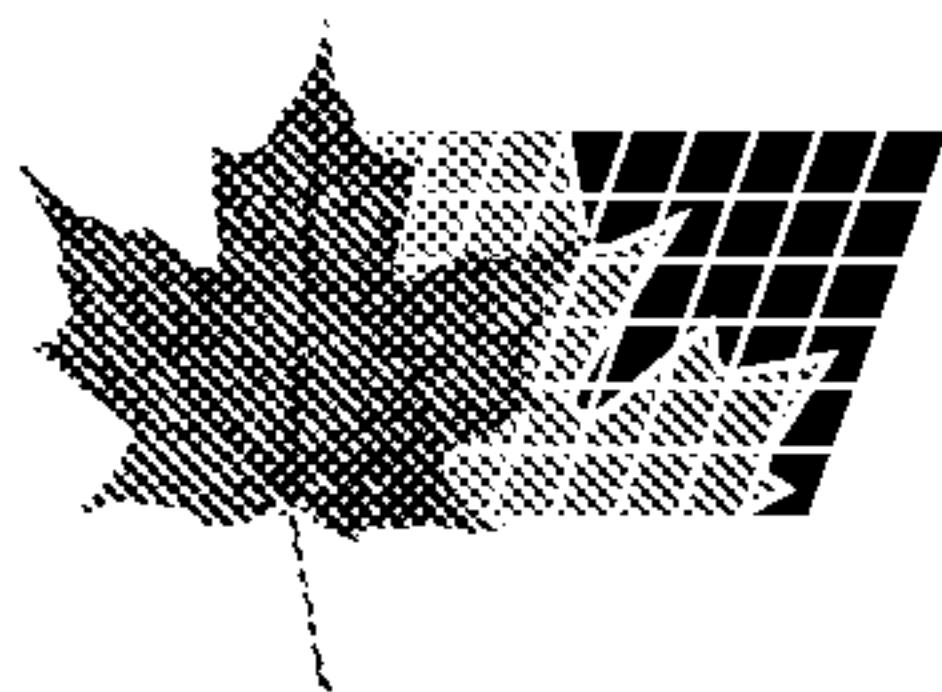
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(54) **SYSTEME DE TRAITE AUTOMATIQUE**
(54) **VOLUNTARY MILKING**



(57) L'invention se rapporte à un système de traite automatique (10) comportant des transpondeurs de lecture/écriture (16A, 16B) destinés à être fixés sur l'animal (14) à traire; un ordinateur (28) réagissant aux informations provenant des transpondeurs et devant calculer un premier ensemble de coordonnées d'un point de traite dans le but de positionner les gobelets trayeurs; et un élément de positionnement (30) dont la fonction est d'amener un dispositif de détection des tétines (38) au niveau dudit premier ensemble de coordonnées du point de traite, ou bien en direction de ce point. Si le premier ensemble de coordonnées du point de traite ne

(57) A voluntary milking system (10) comprises read/write transponders (16A, 16B) for securing to the animal (14) to be milked, a computer (28) responsive to information from the transponders and to derive a first set of milking location co-ordinates for the teat cups, and positioning means (30) operative to move a teat-detection device (38) to or towards said first set of milking location co-ordinates. If the first set of milking co-ordinates do not correspond to the optimum milking location co-ordinates for the teat cups, the positioning means (30) operates to move the teat cups to the optimum milking location co-ordinates (32) in response



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correspond pas aux coordonnées du point optimal de traite par les gobelets, l'élément de positionnement (30) fait se déplacer les gobelets trayeurs en direction des coordonnées du point de traite optimal (32) et ce, en réponse aux informations provenant du dispositif de détection des tétines (38). Ce système comporte enfin un élément d'actualisation (22, 28) destiné à actualiser les informations du transpondeur (16A, 16B) en réponse à la détermination desdites coordonnées du point de traite optimal.

to information from the teat-detection device (38). The system is completed by updating means (22, 28) for updating the information in the transponder (16A, 16B) in response to a determination of said optimum milking location co-ordinates.

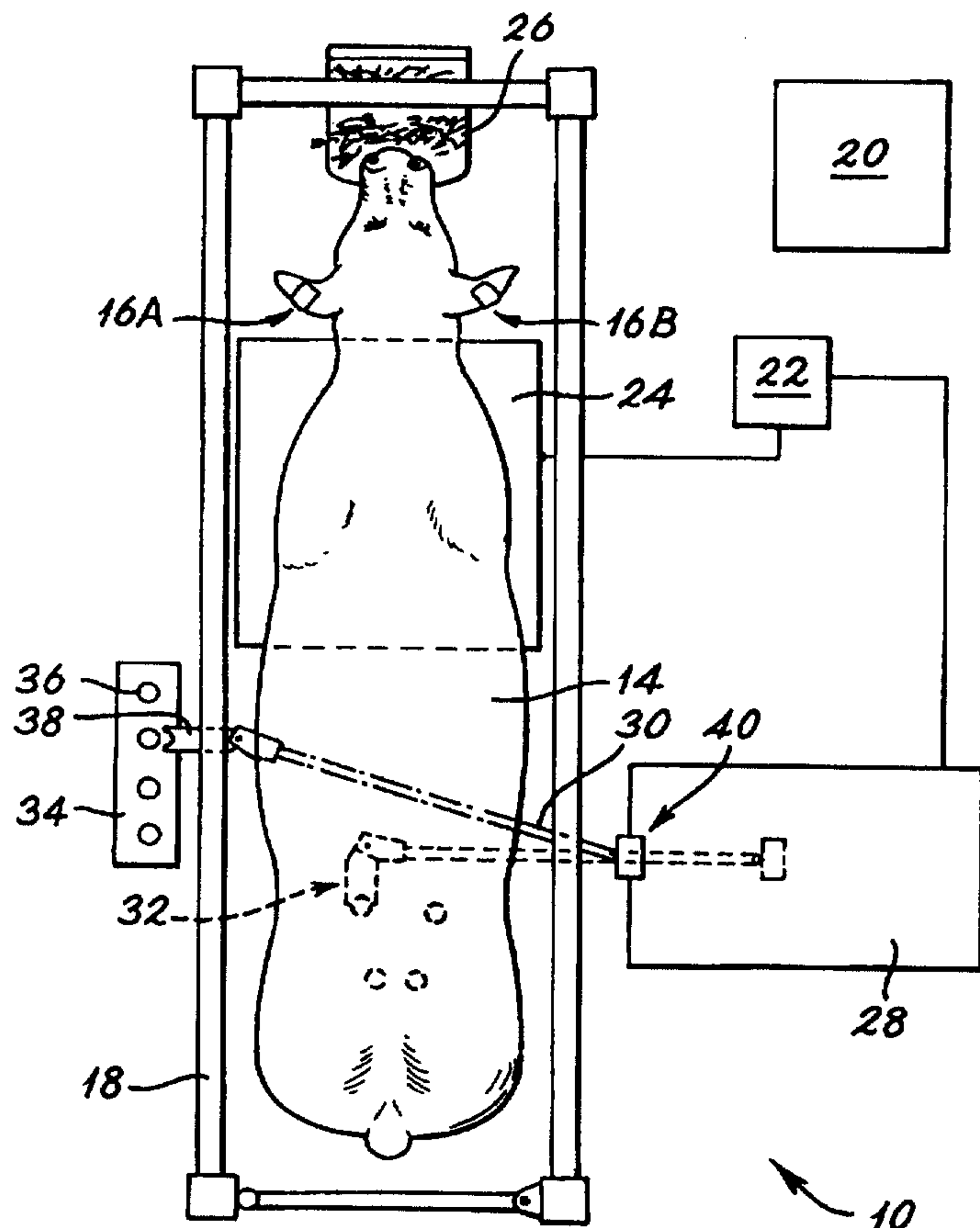
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(21) International Application Number: PCT/GB98/01378 (22) International Filing Date: 14 May 1998 (14.05.98) (30) Priority Data: 9709740.6 14 May 1997 (14.05.97) GB (71) Applicant (for all designated States except US): BTG International Limited [GB/GB]; 10 Fleet Place, London EC4M 7SB (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): STIRLING, Hugh, Gerald [GB/GB]; 67D Shooters Hill Road, Blackheath, London SE3 7HU (GB). BISCOE, Paul, Victor [GB/GB]; Tamworth Cottage, Silbury Court, Silsoe, Bedford MK45 4RU (GB). (74) Agent: NEVILLE, Peter, Warwick; BTG International Limited, Patents Dept., 10 Fleet Place, London EC4M 7SB (GB).		(81) Designated States: CA, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: VOLUNTARY MILKING**(57) Abstract**

A voluntary milking system (10) comprises read/write transponders (16A, 16B) for securing to the animal (14) to be milked, a computer (28) responsive to information from the transponders and to derive a first set of milking location co-ordinates for the teat cups, and positioning means (30) operative to move a teat-detection device (38) to or towards said first set of milking location co-ordinates. If the first set of milking co-ordinates do not correspond to the optimum milking location co-ordinates for the teat cups, the positioning means (30) operates to move the teat cups to the optimum milking location co-ordinates (32) in response to information from the teat-detection device (38). The system is completed by updating means (22, 28) for updating the information in the transponder (16A, 16B) in response to a determination of said optimum milking location co-ordinates.



VOLUNTARY MILKING

This invention relates to the voluntary milking of cows and like animals.

In recent years, attempts have been made to mechanise the traditional milking techniques, allowing the cow to present herself for milking at any time, without human intervention. Mechanical milking systems with the extraction of milk by a vacuum teat cup and the release of the teat cup by mechanical means, are now well-established. However, the placing of the teat cups on the teats has proved less easy to mechanise in such systems. One reason for this is that the positions of the teats will vary from cow to cow and from day to day as the cow proceeds through its lactation cycles.

The voluntary (=automatic) milking art already includes proposals for animal husbandry regimes of on-demand milking related to feed supply with recording of udder form and other parameters to monitor the milk production and well-being of the animals. Techniques for identifying an animal presenting herself for milking and determining whether or not milking is appropriate are already known and are based on control devices such as a specially-programmed small computer. Thus, the general position of the teats of any particular animal can be predicted and this information used to bring a teat cup closer to a teat for the final phase of teat cup application than by just using animal position information. If the actuators have suitable transducers it may be possible to derive information about teat position from the output of the transducers, so as to update information stored about an animal.

The drawback with these known systems is that the required information is only accessible at the particular milking parlour at which the computer or like information storage device is housed. Thus, on large farms where there may be a number of milking parlours located in different parts of the farm; there is the problem of simultaneously updating all the computers every time that a cow is milked.

It also goes without saying that when a cow is first introduced into a herd, a considerable amount of time will need to be spent on "tuning" the teat location system to that cow and in noting that animal's lactation cycle etc. so that changes in the teat positions can be predicted.

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According to the first aspect of the present invention, there is provided a voluntary milking system comprising a computer or like information storage device to derive a first set of milking location co-ordinates for the teat cups, positioning means operative to move a teat-detection device to or towards said first set of milking location co-ordinates and, if these do not correspond to the optimum milking location co-ordinates for the teat cups, to move the teat cups to said optimum milking location co-ordinates, wherein the computer or like information storage device is connected with an interrogator which, in turn, communicates with and updates an information-carrying read/write transponder secured to the animal to be milked, said information corresponding to said first set of milking co-ordinates.

Optionally, in deriving the first set of location co-ordinates from information in the transponder, the information storage device may predict expected changes in the optimum milking location co-ordinates in dependence on relevant information pertaining to the particular animal to be milked e.g. the time that has elapsed since the last milking of that animal, her lactation cycle etc.

Conveniently, there are two said transponders and these are adapted to be secured one to each ear of the animal to be milked so that if one transponder is inadvertently dislodged, e.g. as a result of the animal scratching herself against a post, say, the remaining transponder will still allow satisfactory operation of the system.

Preferably, the two said transponders are operable in a read/write mode without either one interfering with the operation of the other.

It is an added advantage of the system according to at least preferred embodiments of the present invention that the transponder can additionally carry information relating to the special dietary requirements of the animal, her past health etc. This information can be especially significant when the animal is sold from one farmer to another since the purchaser will in this way receive with the animal an up-to-date and comprehensive history of the animal that he has acquired.

Conveniently, practical embodiments of the invention also includes a read/write transponder for use in the voluntary milking system of the present invention.

The invention may use the method and identification systems disclosed in EP 161799 A, GB 2,116,808 A or EP 467,036 A. In such identification systems a plurality of

transmitters, typically transponders, are activated by a power signal (or an "interrogation signal") and then transmit reply signals, usually containing identification data, to a receiver, which typically forms part of the interrogator. The signals may be transmitted in many ways, including electromagnetic energy, e.g. radio frequency (RF), infra red (IR), and coherent light, and sound, e.g. ultrasound. For example, the transmission may be achieved by actual emission of RF energy by the transponders, or by the modulation of the reflectivity of an antenna of the transponder, resulting in varying amounts of RF energy in the interrogation signal being reflected or back-scattered from the transponder antenna.

EP 494112 A, EP 585,132 A and EP 598,624 A disclose an interrogator/transponder system in which an interrogator broadcasts an interrogation signal to a plurality of transponders present in the interrogation field. By way of example only, one form of the identification system comprises an interrogator or reader which transmits interrogation signals at a power of approximately 15W and at a frequency of approximately 915 MHz to a number of passive transponders. The transponders derive a power supply from energy in the interrogation signal, and modulate a portion of the energy received from the interrogator with an identification code to generate a response signal, which is transmitted back to the interrogator.

The transponders can use separate receiver and transmitter antennas, or a single antenna can be utilised for both reception and transmission. If a single antenna is used, the response signal can be generated by modulating the reflectivity of such an antenna: if separate receiver and transmitter antennae are used, then a modulator which redirects energy from the receiver antenna to the transmitter antenna is required. Alternatively, the transponders can be independently powered and may generate their own response signal.

The interrogation system described in EP 598,624 A may be easily adapted to produce interrogators and transponders according to the invention. Alternatively, the system for storage and communication of information disclosed in EP 689,151 A may be modified to function in a milking parlour. In these cases, the interrogator may be positioned in a milking stall, for example adjacent to the manger so that the transponders may be interrogated as soon as they are within range. Each transponder may be interrogated several times during the milking process, either to download information carried by the transponder or to write new information to the transponder.

The communications protocol employed by the identification system may include provisions for determining whether data transmissions, either from the transponder(s) or from the interrogator, have been corrupted and for confirming that the data has been written correctly.

In order to enable the interrogator to distinguish between the situation where a transponder is not functioning correctly and that where a transponder is absent, the transponder(s) may be uniquely coded and may be called individually.

It will be appreciated that the or each transponder may be of any suitable kind e.g. passive or active. The transponder(s) may be strictly timed e.g. by a crystal oscillator with timing derived from the powering/interrogation field, or may have local timing means, such as the tags described in EP 494112 A and EP 585,132 A. The transponder(s) may be given an identity, in addition to the data, and the protocol may include downloading the identity of the transponder(s) (or the cow).

Having historic data stored on a tag attached to an animal could be most advantageous. For example, it would not matter into which stall or pen the animal came, her previous history could be downloaded into the sensor array attached to that particular stall or pen. This could be extremely useful if there was a necessity to adjust some aspect of physical dimension or electronic sensitivity to suit individual animals. This could be the case in ketosis sensing where if an animal had previously low readings then the sensitivity range of an analysis system could be adjusted to ensure that it was appropriate for the animal entering. Similarly, the positioning of sensors to measure physical features of the body e.g. conformation, could again be adjusted on the basis of information carried on the tag.

According to another aspect, the invention includes a method of voluntary milking comprising reading a read/write transponder secured to the animal to be milked, deriving from the information read from the transponder a first set of milking location co-ordinates for the teat cups, moving a teat-detection device to or towards said first set of milking location co-ordinates and, if these do not correspond to the optimum milking location co-ordinates for the teat cups, moving the teat cups to said optimum milking location co-ordinates in response to information from the teat-detection device, and updating the information in the transponder in response to a determination of said optimum milking

location co-ordinates.

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawing which schematically illustrates an voluntary milking system 10 comprises a two-tag interrogation arrangement developed on the protocol described in the co-pending application filed on 14 May 1997 in the name of British Technology Group Limited and entitled Enhanced Identification System.

The description that follows assumes that each cow 14 carries two transponder tags 16A, 16B (collectively referred to as tags 16), and that in a milking parlour stall 18, no crosstalk from tags in stalls either side is possible.

In operation of the system, the milking parlour is bathed in a powering radio frequency field from an interrogator source 20, such that no nulls or low power spots exist. Communication with the tags in each stall is undertaken by a local, short range, narrow beam interrogator receiver or other reader/writer unit 22. The reader/writer unit in each stall uses a slightly different frequency from its neighbour, thereby enabling "crosstalk" to be detected.

The tags 16 remain silent until illuminated by the unit 22, which may be triggered by a pressure sensitive device 24 located in the floor of the stall 18 in front of a manger 26. The unit 22 issues a "who goes there?" question and the tags 16 which receive this question transmit a response after waiting for a random wait cycle. In using a randomly timed reply, it is unlikely that two tags will reply with a response at the same time and for the same duration. When the unit 22 receives a response, from the tag 16A, say, it immediately issues a "mute" instruction to the other tag 16B (and vice versa). The reader/writer unit extracts a clock signal from the response and downloads the information that tag 16A is carrying from the data in its response signal. Once tag 16A has finished transmitting the response signal the tag is acknowledged and the other tag (16B) is reactivated. The reader/writer now waits for a response from tag 16B and the data from both tags is compared.

The most recently updated data is then read by an on-site computer 28 and used to position a robotic milking arm 30 to apply the teat cups to the cow's udder (as shown at 32) and begin milking.

In the drawing, reference numeral 34 indicates a store from which the inverted teat

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cups 36 are removed one by one by cup-handling and teat-sensor assembly 38 carried at one end of the arm 30.

The other end of this arm is mounted on a movable platform 40, both the arm and the platform being controlled by the computer 28 to right the teat cup and to apply it to the appropriate one of the cow's teats as above described.

Further details of suitable designs for the arm 30 and the cup-handling and teat-sensor assembly 38 are disclosed in EP 0452381B.

When the unit 22 needs to write to one or other of the tags 16 to update it with the latest information available, the unit issues a new "who goes there?" question which reactivates the tags to use the randomly timed tag responses. As already described above, when a clear response is received from one of the two tags 16, the unit 22 mutes the other tag and issues a write command followed by the new data to be written to the non-muted tag. At the end of the data stream, a disable command indicates to this tag that all the data has been received and that it is disabled until reactivated e.g. by leaving the powering field for sufficient time to be reset. The unit 22 also unmutes the previously muted tag and the same cycle is repeated to write to the other tag.

Those skilled in the art will immediately appreciate that any suitable interrogator transponder system which enables read/write communications to be performed during the milking process may be used and the above description should be construed merely as an example, without limitation, of one possible embodiment of the invention.

CLAIMS

1. A voluntary milking system comprising a computer or like information storage device to derive a first set of milking location co-ordinates for the teat cups, positioning means operative to move a teat-detection device to or towards said first set of milking location co-ordinates and, if these do not correspond to the optimum milking location co-ordinates for the teat cups, to move the teat cups to said optimum milking location co-ordinates, characterised in that the computer or like information storage device is connected with an interrogator which, in turn, communicates with and updates an information-carrying read/write transponder secured to the animal to be milked, said information corresponding to said first set of milking location co-ordinates.
2. A system as claimed in Claim 1 in which the transponder is one of two such transponders, one secured to one ear and the other secured to the other ear of the animal to be milked.
3. A system as claimed in Claim 2 in which the two transponders are operable in a read/write mode without either one interfering with the operation of the other.
4. A voluntary milking system substantially as hereinbefore described with reference to and/or illustrated in the accompanying drawing.
5. A read/write transponder for use in an voluntary milking system as claimed in any preceding claim.
6. A method of voluntary milking comprising reading a read/write transponder secured to the animal to be milked, deriving from the information read from the transponder a first set of milking location co-ordinates for the teat cups, moving a teat-detection device to or towards said first set of milking location co-ordinates and, if these do not correspond to the optimum milking location co-ordinates for the teat cups, moving the teat cups to said optimum milking location co-ordinates in response to information from the teat-detection device, and updating the information in the transponder in response to a determination of said optimum milking location co-ordinates.

