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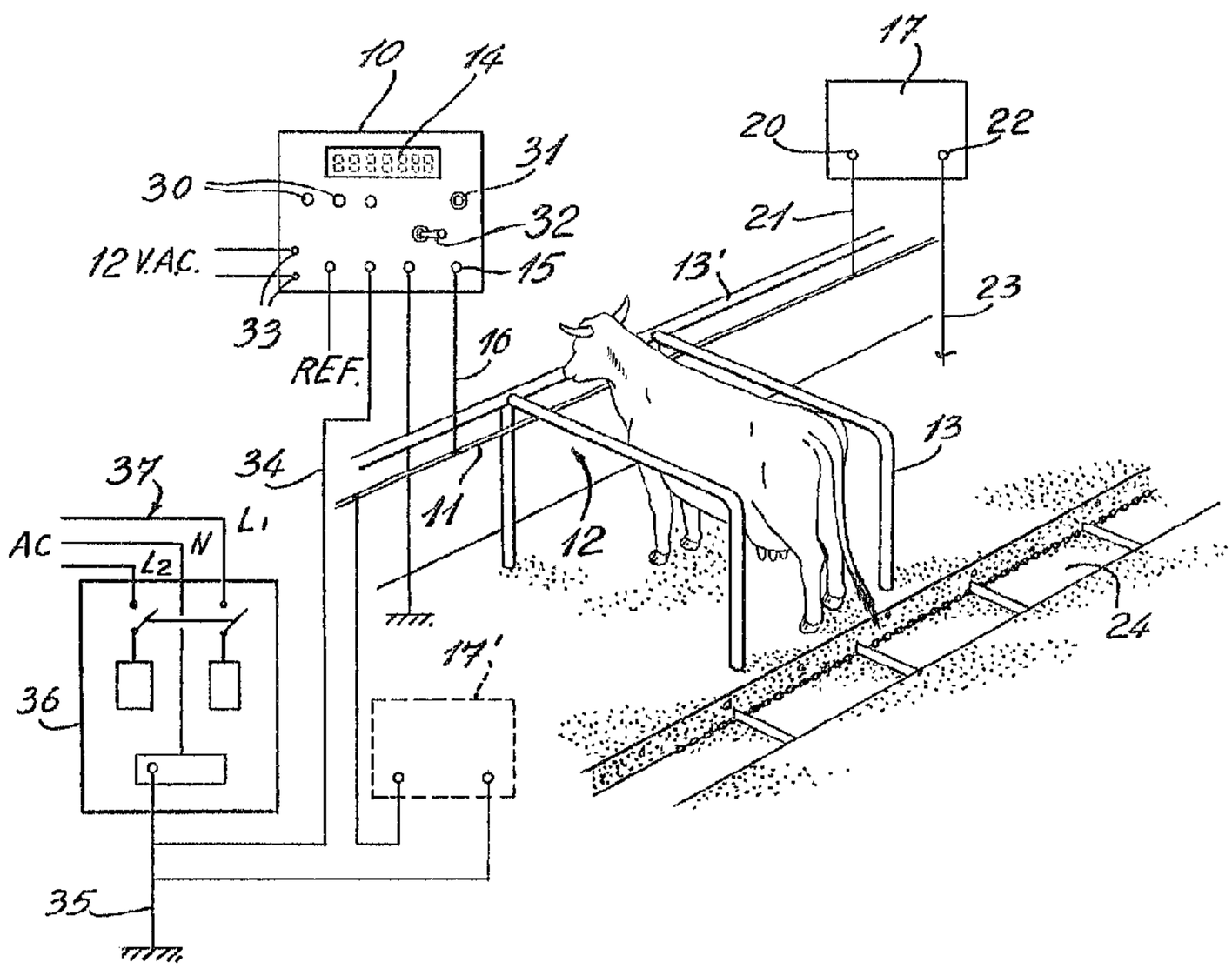

(57) Abrégé/Abstract:
A stray voltage measuring and attenuation system for use in livestock facilities is described. The system comprises an electronic circuit to measure and display actual induced stray voltages on an electrically conductive element present in the livestock stalls and which requires grounding. An attenuation circuit is connected between the electrically conductive element and a ground connection. The attenuation circuit is a three-leg parallel circuit which comprises a single non-polarized electrolytic capacitor for shorting a.c. stray voltages present on the electrically conductive element. A parallel connected LR circuit comprised of an induction coil in series with a resistance is also provided for shorting d.c. stray voltages that may be present on the electrically conductive element. A further anti-parallel diode assembly is also provided for shorting high voltage surges that may be present on the electrically conductive element.

STRAY VOLTAGE MEASURING AND ATTENUATION DEVICE FOR USE IN LIVESTOCK FACILITIES

Abstract of the Disclosure

A stray voltage measuring and attenuation system for use in livestock facilities is described. The system comprises an electronic circuit to measure and display actual induced stray voltages on an electrically conductive element present in the livestock stalls and which requires grounding. An attenuation circuit is connected between the electrically conductive element and a ground connection. The attenuation circuit is a three-leg parallel circuit which comprises a single non-polarized electrolytic capacitor for shorting a.c. stray voltages present on the electrically conductive element. A parallel connected LR circuit comprised of an induction coil in series with a resistance is also provided for shorting d.c. stray voltages that may be present on the electrically conductive element. A further anti-parallel diode assembly is also provided for shorting high voltage surges that may be present on the electrically conductive element.

The present invention relates to a stray voltage measuring and attenuation system for use in livestock facilities or in any other area where induced stray voltages are present on electrically conductive elements and need to be grounded. In particular, the present invention relates to a system which is capable of measuring and displaying actual induced stray voltages as well as grounding both a.c. and d.c. induced voltages and high voltage surges of much higher magnitude.

The present invention was developed particularly, but not exclusively, for use in attenuating induced stray voltages that are found in the piping and electrically conducting, networks of conductor elements present in milking stall areas, particularly where stalls are confined by wall barriers formed of metal pipes and wherein the milking process is also done automatically with the milk being conveyed through stainless steel pipes and a pneumatic system. The milking machines are also constructed of metal and are electrically operated and can generate induced voltages. The floor also includes metal troughs to collect excrement and urine and on which the rear leg of the cow is usually resting during milking. The cow is usually tied to the metal piping by a metal chain. Accordingly, the cow is in contact with some metal conductor in the stall and because these conductors pick up stray voltages generated by electrical equipment nearby or a transmission line or electrical line which may be in the vacinity of the stall, this induced current will flow through the cow.

The effects of voltage and ground currents on livestock is clearly described in an article entitled « Neutral-to-Earth Voltage and Ground Current Effects in Livestock Facilities » as published in the IEEE Transactions on Power Apparatus and Systems, Vol. PAS-101, No. 7, July 1982. It is clearly established in that article that dairy cows do encounter problems with stray induced voltages of fairly low levels in the range of 0.75 to 1.0 V a.c. It has been shown that these low voltages could produce an immediate interference with the milk let-down process in dairy cows. It is also known that these stray voltages do affect other animals in different ways.

It is therefore a feature of the present invention to provide a stray voltage measuring and attenuation system which is comprised of an electronic circuit to measure and display actual induced stray voltages and an attenuation circuit to ground the stray voltages whereby to substantially eliminate the problems referred to hereinabove with respect to dairy cows or other similar problems.

According to a broad aspect of the present invention there is provided a stray voltage measuring and attenuation system for attenuating stray d.c. and a.c. voltages and currents present in a conductor wire-connected to metallic conductors present in the vicinity of milking stalls. The system comprises electronic measuring circuit means to measure and display actual induced stray voltages on the conductor wire to be grounded. Two or more attenuation circuits are each connected between the conductor wire and the ground connection. The two or more attenuation circuits each have a three-leg parallel circuit which is comprised of a single non-polarized electrolytic capacitor for shorting a.c. stray voltages present on the conductor wire. Another leg consists of an LR circuit which is comprised of an induction coil in series with a resistance for shorting d.c. stray voltages present on the conductor wire. A third leg has an anti-parallel diode for shorting high voltage surges on the conductor wire. The capacitor and the LR circuit

have a capacitive reactance which is at least 10 times smaller than the resistance of a dairy cow.

A preferred embodiment of the present invention will now be described with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view showing the stray voltage measuring and attenuation system of the present invention as connected in a milking stall application; and

FIGURE 2 is a circuit diagram showing the construction of the attenuation circuit.

As shown in Figure 1, the stray voltage measuring and attenuation system is comprised of a first housing 10 in which an electronic circuit is provided to measure and display actual induced stray voltages on an electrically conductive element such as the grounding wire 11 as found in milking stalls 12 and which is connected to the various stall piping 13 or milk distribution pipes 13' or any other conductive piping forming the stall. The electronic measuring circuit is one that is well known in the art and the schematic component construction thereof need not be described herein. The housing 10 is provided with a digital read-out counter 14 whereby to display the actual induced stray a.c. or d.c. voltage present on the wire 11. This measurement is made by connecting the input 15 of the measuring circuit to the wire 11 by a conductive wire 16.

The system also comprises an attenuation circuit which is housed in housing 17 and which is separated from the housing of the electronic measuring circuit. The construction of the attenuation circuit 18 is illustrated in

Figure 2. One or more attenuation circuits can be connected in a farm installation where a plurality of stalls are provided. As shown in Figure 1, two of such attenuation circuits are provided, one in housing 17 and the other in housing 17'.

Referring now more specifically to Figure 2, the attenuation circuit is comprised of a three-leg parallel circuit which has an input connection 20 which is connected through conductive wire 21 to the electrically conductive grounding wire 11. The output 22 of the attenuation circuit is connected by a grounding wire 23 to a grounding pipe (not shown) or the excrement connecting trough 24 usually secured to the grounding pipe or other suitable ground connection.

A first leg of the three-leg parallel attenuation circuit 18 is provided with a non-polarized electrolytic capacitor 19 for shorting a.c. stray voltages that may be present at the input 20 or on the electrically conducting wire 11 connected thereto. A second leg of the parallel circuit includes an LR circuit which is comprised of an induction coil 25 connected in series with a resistance 26 whereby to short stray d.c. voltages that may be present on the electrically conductive grounding wire 11. A third leg of the parallel circuit comprises an anti-parallel diode assembly 27 which is adjusted to short high voltage surges that may be present on the electrically conductive grounding wire 11 due to electrical equipment malfunctions or lightning striking the barn.

Referring again to Figure 1, the electronic measuring circuit housed in the housing 10 includes a digital voltmeter, well known in the art, and capable of measuring induced voltages up to 2 decibels below 1 volt

which is quite adequate for the present application. The housing 10 is also provided with indicator lamps 30 to indicate if the power is switched on and to provide a visual alarm should the digital read-out exceed a predetermined voltage value (0.25 V a.c.). The other of these lights 30 indicates when the level of the stray voltage exceeds 0.5 V a.c. Both of these lights are electroluminescent diodes. A reset pushbutton 31 is also provided to reset the voltmeter and a switch 32 switches the system on and off. A 12 V a.c. supply is connected across the input terminals 33 to supply the internal circuit (not shown) of the measuring circuit. Both the housing for the measuring circuit and the attenuation circuit are preferably sealed housings.

It is pointed out that in a milking stall installation as shown in Figure 1, the primary electrical distribution circuit, the secondary distribution circuit and the electrical equipment utilized in close proximity to the stall are all grounded by various conductors to assure protection against short circuits. However, when the various charges are perturbed, current will flow through these various conductors and into the ground. Since these conductors do not all have the same resistance values, there will be different potential values at different areas of this complex grounding network. These differences in potentials are called neutral ground potentials and these can vary from 0 to 10 V a.c. These ground potentials cause current to propagate or flow in the ground and these currents are picked up by the various pipes, troughs and grounding rods present in the stall environment and connected to a ground. To these alternating grounding current are added the d.c. currents generated by the fact

that various metallic conductors are present. All of these currents are at different levels and at different areas in a milking stall environment. A milking cow which is connected to one of these pipes or conductors which has an induced stray voltage therein and which may be in contact with a metal trough or another pipe which is at a different potential, will be subjected to a difference in potential and, consequently, induced current will flow through the animal between the various contact points that the animal may have. It has been proven that a level of induced voltage in the order of 0.5 V (a.c.) is sufficient to effect the health of the animal.

The conductive grounding wire 11, as shown in Figure 1, is connected to all of the metal pipes 13 and the conductive trough 24 and any other metallic conductors that are found in milking stalls. This wire 11 is usually a No. 16 copper wire which is secured to the pipes by metal tapping screws which are then sealed with a sealing solution to prevent corrosion and to assure that a good electrical conduction is made with the pipes.

The reference connection 34, which is connected to the measuring circuit, is connected to the grounding rod 35 associated with the electrical distribution panel 36 of the a.c. electrical distribution line 37 connected to the building in which the stalls are located. This distribution panel is preferably located far from the stall so that the grounding rod 35 is not subjected to the stray voltages as found in the ground surrounding the stalls. The resistance of this grounding rod should not exceed 100 ohms.

In the attenuation circuit as shown in Figure 2, the electrolytic capacitor 19 utilized has a value of about 100 microfarads whereby to support an a.c. voltage of up to 50 V a.c. The induction coil 25 has an induction value of 100 microhenry and is connected to the resistor 26 which is 22 ohms whereby the LR circuit can dissipate about 1 watt. The anti-parallel diode assembly 27 is rated to support a continous charge of 80 amps and a momentary charge of 950 A, one cycle non-repetitive. When an induced stray voltage appears on the input 20 of the attenuation circuit, the capacitive reactance of capacitor 19 is very weak at 60 Hz and there will be a decoupling to ground through the capacitor which acts as a short circuit. Because the capacitor is an open circuit to a d.c. component, the coil 25 and resistor 26 will provide the short circuit path to ground for any d.c. stray voltages on the input 20. The value of the components 19, 25 and 26 are selected so that the capacitive reactance is at least ten times smaller than the resistance of the dairy cow which is secured to the conductive piping and grounding wire 11. The capacitor 19 will also absorb the voltage fluctuations due to a variation of the input voltage in the distribution panel 36. The diode assembly 27 can support a current of 80 amps which would otherwise not be supported by the capacitor or the LR branche.

It is within the ambit of the present invention to cover any obvious modifications of the preferred embodiment described herein provided such modifications fall within the scope of the appended claims.

Claims:

1. A stray voltage measuring and attenuation system for attenuating stray d.c. and a.c. voltages and currents present in a conductor wire connected to metallic conductors present in the vicinity of milking stalls and in the ground, said system comprising electronic measuring circuit means to measure and display actual induced stray voltages on said conductor wire to be grounded, and two or more attenuation circuits each connected between said conductor wire and a ground connection; said two or more attenuation circuits each having a three-leg parallel circuit comprised of a single non-polarized electrolytic capacitor for shorting a.c. stray voltages present on said conductor wire, a parallel connected LR circuit comprised of an induction coil in series with a resistance for shorting d.c. stray voltages present on said conductor wire, and a anti-parallel diode for shorting high voltage surges on said conductor wire, said capacitor and LR circuit having a capacitive reactance which is at least ten times smaller than the resistance of a dairy cow.

2. A stray voltage measuring and attenuation system as claimed in claim 1 wherein said anti-parallel diode assembly for shorting high voltage surges is rated to support a continuous charge of 80 amps and a momentary charge of 950 amps.

3. A stray voltage measuring and attenuation system as claimed in claim 1 wherein said electronic circuit means is mounted in a housing having display means for visually displaying said induced stray voltages on said conductor wire.

4. A stray voltage measuring and attenuation system as claimed in claim 3 wherein said display means is a digital counter, and one or more indicator lights on said housing to give a visual indication that a predetermined stray voltage level has been attained, and reset switch means to reset said indicator lights.

5. A stray voltage measuring and attenuation system as claimed in claim 3 wherein said attenuation circuit is mounted in a separate sealed housing having a pair of terminals, each terminal being connected on a respective side of said three-leg parallel circuit.

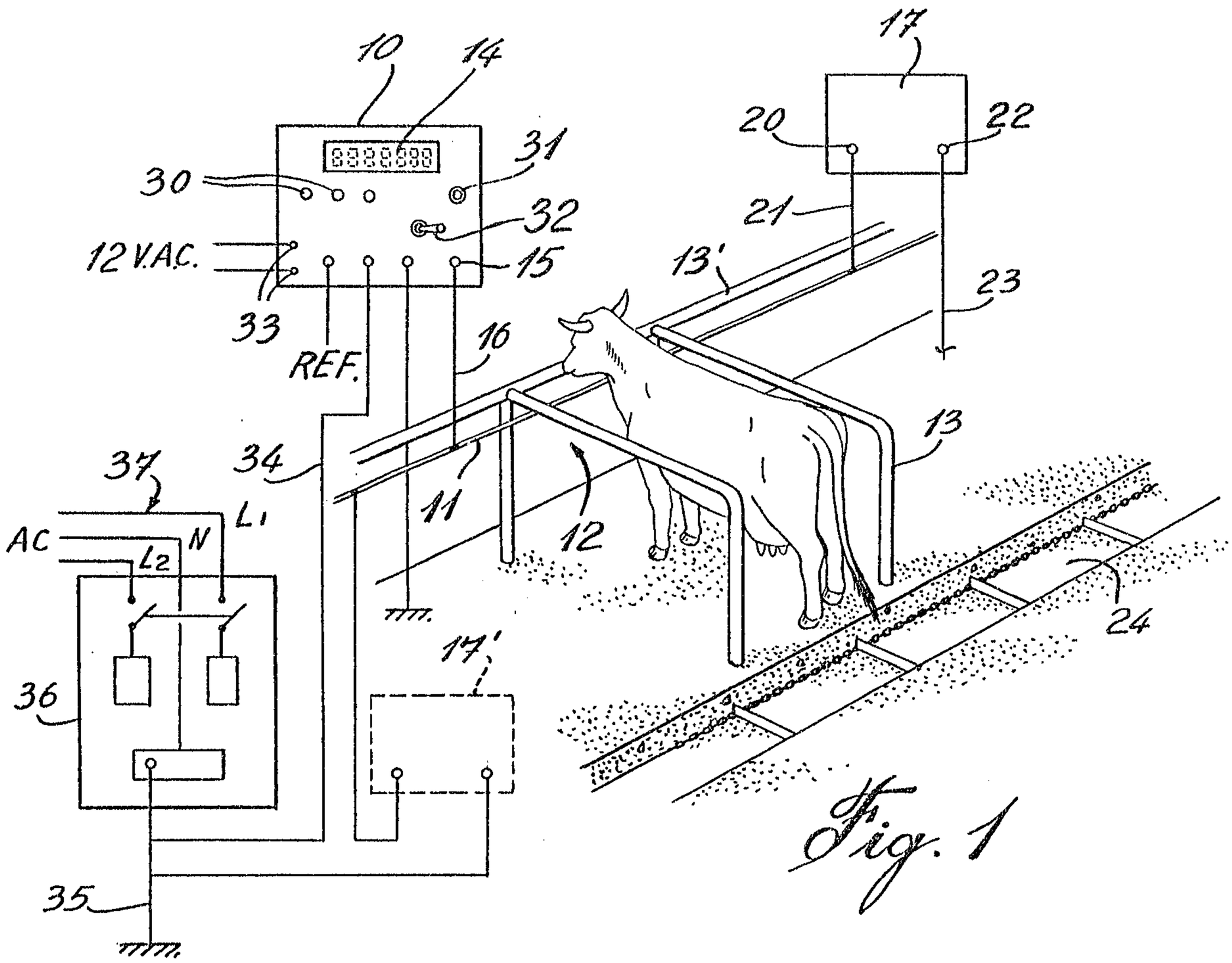

Fig. 1

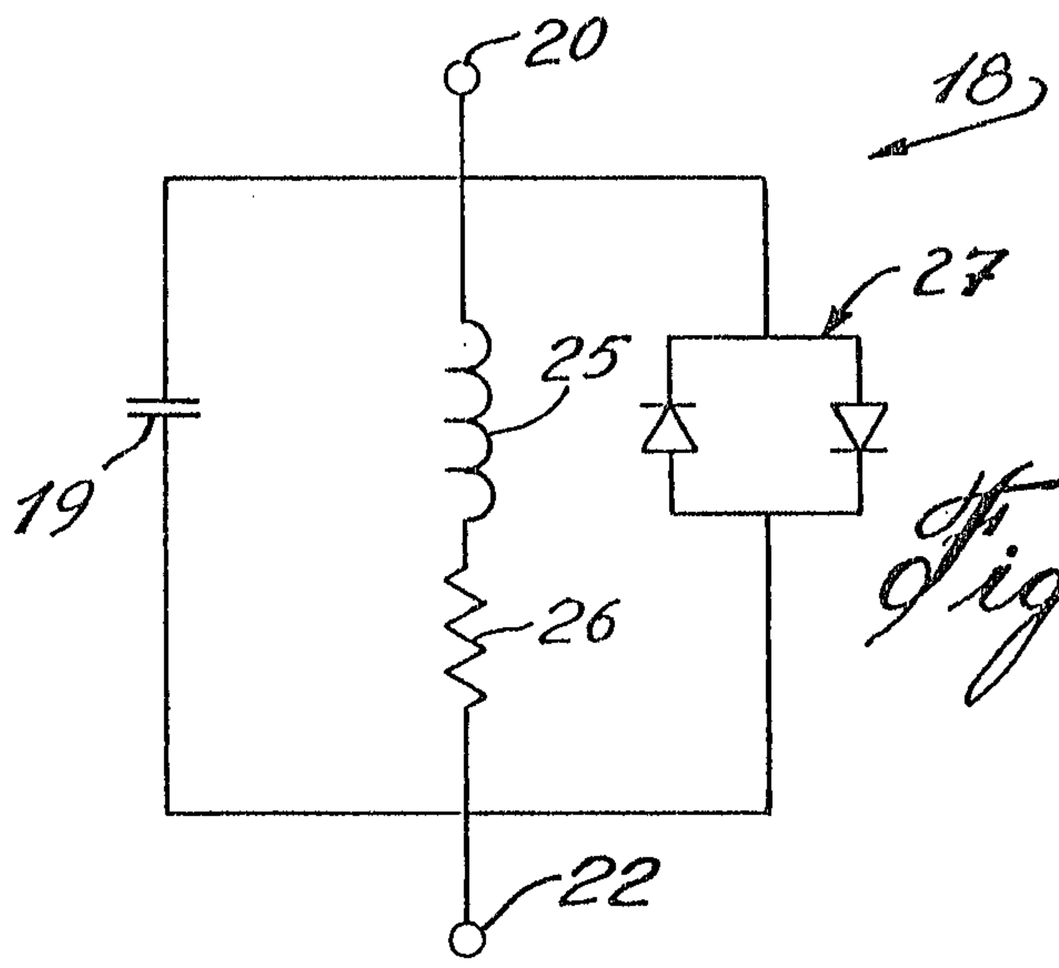

Fig. 2

PATENT AGENTS

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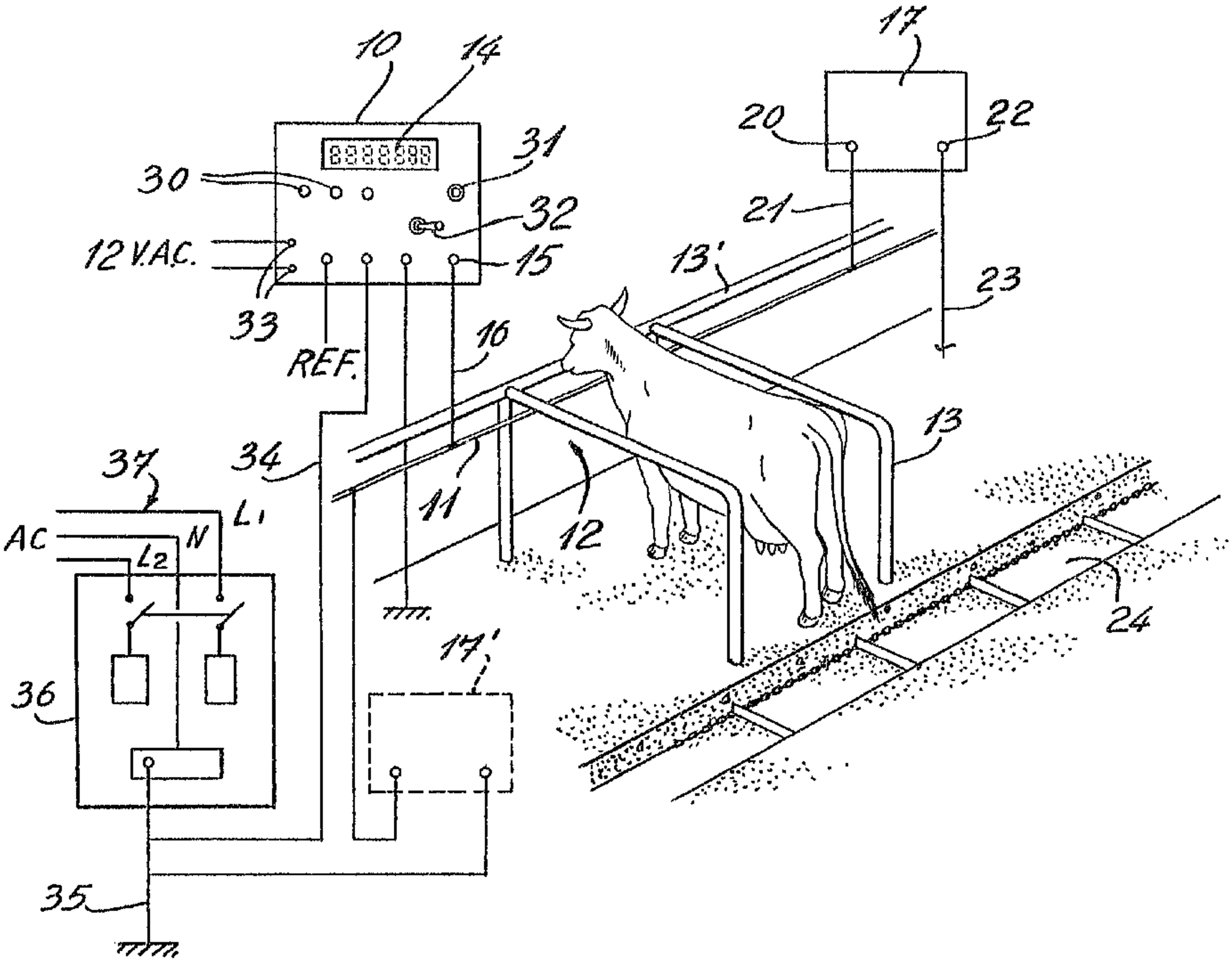
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