

Технічні науки

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MONITORING THE QUALITY OF DRINKING WATER AND MILK
Inventions in the field of non-contact monitoring of the quality of drinking
water and cow's milk in real time

***Summary.** The quality of drinking water practically determines the quality of life. In all methods of water quality control, it is accepted that the conductivity of water is a clear indicator of its purity.*

Almost all existing technologies, devices and equipment for water quality control have a very narrow range of technical capabilities and do not cover all the parameters that must be constantly monitored in order to prevent water from reaching the user that, due to the above reasons, is contaminated to such an extent that it poses a danger to human life and health.

Milk is one of the most important products in a complete diet, and since a significant percentage of its composition is also water, it requires equivalent mobile, reliable and accurate control technology, adapted both to the increased quality requirements of milk and to new visions of regulatory requirements for quality.

Based on this far from complete set of information, one can make a reasonable conclusion about the need for constant monitoring of the quality of milk and water before use, especially in relaxation processes;

***Key words:** Drinking water, Cow's milk, Range of technical capabilities, New visions of regulatory quality requirements, Equivalent mobile, reliable and accurate control technology, Need for continuous monitoring, Device for selective identification in real time of the current value of the complex digital indicator of the dynamic state of drinking water quality, Complex Digital*

indicator of the dynamic state of cow's milk, Integral equivalent of the current value of the content and concentration of components in water.

Introduction. Inventions in the field of non-contact monitoring of the quality of drinking water and cow's milk

The quality of drinking water practically determines the quality of life. In all methods of water quality control, it is accepted that the conductivity of water is a clear indicator of its purity.

The more impurities in water, the lower its electrical resistance, and the cleaner the water, the higher its electrical resistance.

This suited everyone for a long time, until international terrorism reached such a level of spread as it does now and until general environmental pollution reached such unprecedented scale and dimensions as it does now.

These are of course not all the factors that determine the urgent need for more complete control of water quality, but they are very important.

Almost all existing technologies, devices and equipment for water quality control have a very narrow range of technical capabilities and do not cover all the parameters that must be constantly monitored in order not to allow water to reach the user that, due to the above reasons, is contaminated to such an extent that it poses a danger to human life and health.

Milk is one of the most important products in a complete diet, and since a significant percentage of its composition is also water, it requires equivalent mobile, reliable and accurate control technology, adapted both to the increased quality requirements of milk and to new visions of regulatory requirements for quality.

When monitoring the quality of milk, adaptation to new technological conditions and processes of its industrial processing is also very important.

Based on this far from complete set of information, we can make a reasonable conclusion about the need for constant monitoring of the quality of milk and water before use.

Such technologies have been invented and below is a brief description of these technologies:

1. Device for monitoring the current value of drinking water quality in real time

The device is designed to monitor and evaluate in real time the current value of a complex digital indicator of the dynamic state of drinking water quality; The device can be adapted to process water quality control systems at the inlet to the process and to monitor the quality of wastewater before discharge into the sewer system or before returning to the process after regeneration

Complex Digital indicator of the dynamic state of water and aqueous solutions, this is an integral parameter, which, according to the criteria of frequency, amplitude, resistance, parameters of resonance phenomena, inductance and a complex of dynamic characteristics of the water flow, is an integral equivalent of the current value of the content and concentration of components in water and the relationship, including biological, between the specified components and parameters

The device for selective identification in real time of the current value of a complex digital indicator of the dynamic state of drinking water quality is a compact device designed for operation as part of water supply pipeline systems, as part of water flow meters or in field conditions powered by solar batteries

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of water flow, wherein the system for transformation of water flow includes an aerodynamic mechanism for removing gases from said flow.

The device can be designed for use in stationary conditions and designed for express analysis.

The device and the procedure for working with it do not require special training of the operator or user.

2. Device for monitoring the current value of cow's milk condition in real time

The device is designed to monitor and evaluate in real time the current value of a complex digital indicator of the dynamic state of cow's milk quality

Complex Digital indicator of the dynamic state of cow's milk is an integral parameter, which, according to the criteria of frequency, amplitude, resistance, inductance and a complex of dynamic characteristics of the milk flow, is an integral equivalent of the current value of the content and concentration of components in cow's milk and the relationship, including biological, between the specified components

The device for its selective identification in real time is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

3. Complex integral indicator of water and aqueous solutions quality and device for its identification in real time

A digital indicator of the dynamic state of drinking water quality, which, when comparing the pulse directed to the sensor according to the criteria of

frequency, amplitude, resistance, inductance and the same parameters arising in the pipeline from resonance phenomena in the flow, in combination with a set of dynamic characteristics of the water flow, is an integral equivalent of the current value of the content and concentration of components in the water

The device for its selective identification in real time is a compact device designed for operation in urban or main water supply systems or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of the water flow supplied for control, wherein the water flow transformation system includes an aerodynamic mechanism for removing gases from the flow

The complex integral indicator of water quality also includes a complex integral indicator of the sensor, which for each type of sensor, its design parameters and parameters of the signal supplied to the sensor, is a constant value, which is confirmed by the results of a series of tests in more than 1000 cycles on 4 types of sensors.

The device can be designed for use in stationary conditions and designed for express analysis.

4. Comprehensive integral indicator of cow's milk quality and a device for its identification in real time

A digital indicator of the dynamic state of cow's milk, which, according to the criteria of frequency, amplitude, resistance, inductance and a complex of dynamic characteristics of the milk flow, is an integral equivalent of the current value of the content and concentration of components in cow's milk

The device for its selective identification in real time is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

5. Dynamic indicator of the current value of the number of somatic cells in cow's milk and a device for its selective identification in real time

A digital indicator of the dynamic state of cow's milk, which, according to the criteria of frequency, amplitude, resistance, inductance and a complex of dynamic characteristics of the milk flow, is an integral equivalent of the current value of the content and concentration of somatic cells in cow's milk

The device for its selective identification in real time is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

6. Dynamic complex indicator of the current value of fat concentration in cow's milk and a device for its selective identification in real time

A digital indicator of the dynamic state of cow's milk, which, according to the criteria of frequency, amplitude, resistance, inductance and a set of dynamic characteristics of the milk flow, is an integral equivalent of the current value of the content and concentration of fat or fatty acids in cow's milk

The device for its selective identification in real time is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

7. Dynamic complex indicator of the current value of lactose content in cow's milk and a device for its selective identification in real time

A digital indicator of the dynamic state of cow's milk, which, according to the criteria of frequency, amplitude, resistance, inductance and a complex of dynamic characteristics of the milk flow, is an integral equivalent of the current value of the lactose content in cow's milk

The device for its selective identification in real time is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

8. A comprehensive integral indicator of mastitis in a cow and a device for its identification in real time

A digital indicator that, based on the criteria of frequency, amplitude, resistance and inductance, is an integral equivalent or indicator of the occurrence of mastitis in a cow

The device for its real-time identification is a compact device designed for operation in dairy farm conditions or in the field, powered by solar batteries.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device can be designed for use in stationary conditions and designed for express analysis.

9. Device for selective identification in real time of cow's milk quality during its transportation to the collection tank after milking

A compact unit designed for use on a dairy farm or in the field, powered by solar panels

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control and transformation of milk flow, wherein the system for transformation of milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

10. Device for contactless monitoring of cow's milk condition parameters

The device includes systems for introducing milk for control, removing the milk flow from the control zone, a sensory electronic integrated control module with an interface

The device may include a signal identification system and a device for accelerated comparison of identified signals with a standard.

11. Device for simultaneous monitoring of several parameters of cow's milk condition during transportation

The device has two versions

The first version is intended for installation on tanks to control the quality of milk during transportation and when transferring milk for processing into dairy products.

The second version is designed for installation on flexible or rigid pipelines through which milk is directed to storage tanks; this version can additionally have real-time temperature measurement functions.

12. Device for express analysis of cow's milk quality

The device is a mobile compact device with an internal cavity into which milk (or any other liquid) is introduced for analysis.

Around the cavity there is a sensor, selectively tuned to a specific parameter of either milk or any other liquid.

The device does not require setup or calibration and has several levels of protection.

13. Device for selective express analysis of cow's milk quality parameters

The device is a mobile compact device with an internal cavity into which milk (or any other liquid) is introduced for analysis.

Around the cavity there is a sensor, selectively tuned to a specific parameter of either milk or any other liquid.

The device does not require setup or calibration and has several levels of protection.

14. Contactless sensors for milk level in containers

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The device has several design options.

It can be located in a container with liquid, it can be located outside the container, it can have different sensor designs.

15. Device for complex control of milk level in containers with simultaneous assessment of integral milk quality indicator at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to monitor and evaluate the integral quality indicator of milk (and any other liquid), and a level sensor.

The device can also simultaneously monitor any physical characteristics of milk or liquid, such as conductivity, density, acidity level.

16. Device for complex control of milk level in containers with simultaneous assessment of the number of somatic cells in milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to monitor the number of somatic cells, and a level sensor.

The device can also simultaneously monitor any physical characteristics of milk or liquid, such as conductivity, density, acidity level.

17. Device for complex control of milk level in containers with simultaneous assessment of fat content in milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to monitor the concentration of fat, and a level sensor.

18. Device for complex control of milk level in containers with simultaneous assessment of lactose content in milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to monitor the concentration of lactose, and a level sensor.

19. Device for complex monitoring of milk level in containers with simultaneous assessment of blood traces in milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to monitor the concentration of blood, and a level sensor.

20. Device for complex control of milk level in containers with simultaneous sequential assessment of the concentration of basic components in this milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is both a resonant sensor, which is configured to control parameters, and a level sensor.

21. Device for complex control of milk level in containers with simultaneous assessment of concentration of several basic components in this milk at this level

The device controls the level of milk (or any other liquid) in a special section of the pipeline connected to the tank in which the liquid level is controlled.

The specified section of the pipeline is simultaneously a resonant sensor that is configured to control the parameters and concentrations of components in milk or any other liquid and has several sensors, each configured to control one parameter, and each sensor is also a level sensor.

22. Device for changing the level of turbulence of milk flow

The device is designed to convert and dynamically transform the turbulent flow of milk with the formation of a local zone of laminar flow in it, in which milk is monitored using a resonant sensor.

In addition, when transforming the flow, the device releases air from the milk flow and stabilizes its hydrodynamic characteristics.

23. Device for preparing milk flow for real-time monitoring of condition parameters

The device is designed to convert and dynamically transform the milk flow with the formation of a local laminar flow zone, in which milk is monitored using a resonant sensor.

24. Device for monitoring the level of gas content in milk in real time

The device is a resonant sensor that records changes in a set of parameters in milk depending on the concentration of air or any other gas in it.

The device can simultaneously control the degree of filling of the pipeline in which the milk flow moves and the level of turbulence of the milk flow in the pipeline.

25. Milk aeration process control system with real-time air content monitoring in milk

Milk aeration process control system with air content level control in milk; the system has feedback with a resonant sensor and changes the parameters of compressed air depending on the air concentration in milk

The system includes a resonant sensor, an interface and a converter of signals from the sensor into control signals to the compressed air source, with the help of which the pressure and flow rate of compressed air are changed.

The system also includes an aerodynamic function for introducing air into the milk.

List of references, patent and license information:

APPENDIX 4.1

**United States Patent
Slobozhanyuk, et al.**

**10,732,237
August 4, 2020**

Magnetic resonance imaging machine

Abstract

The invention relates to medical diagnostics and can be used in magnetic *resonance* imaging and magnetic *resonance spectroscopy* for increasing the

quality of diagnostics of the internal organs of humans and animals. By virtue of a metamaterial, which is used as an *electromagnetic* field amplifier, being made from a set of advantageously oriented conductors, it becomes possible to spatially rearrange magnetic and electric fields operated at radio frequencies. In particular, in the examined object area, the radio frequency magnetic field is resonantly amplified, which makes it possible to increase the signal/noise ratio in MRI and to obtain better quality images and/or to perform the MRI examinations more quickly as there is no need to accumulate the signal. The proposed design of the metamaterial makes it possible to distance the radio frequency electric field from the area where the examined object is located, therefore enhancing safety of MRI scanning.

APPENDIX 4.2

United States Patent
Godoy, et al.

10,564,308
February 18, 2020

Electron paramagnetic resonance (EPR) techniques and apparatus for performing EPR spectroscopy on a flowing fluid

Abstract

Certain aspects of the present disclosure provide methods and apparatus for performing electron paramagnetic *resonance* (EPR) *spectroscopy* on a fluid from a flowing well, such as fluid from hydrocarbon recovery operations flowing in a downhole tubular, wellhead, or pipeline. One example method generally includes, for a first EPR iteration, performing a first frequency sweep of discrete *electromagnetic* frequencies on a cavity containing the fluid; determining first parameter values of reflected signals from the first frequency sweep; selecting a first discrete frequency corresponding to one of the first parameter values that is less than a threshold value; activating a first *electromagnetic* field in the fluid at the first discrete frequency; and while the first *electromagnetic* field is activated, performing a first DC magnetic field sweep to generate a first EPR spectrum.

APPENDIX 4.3

United States Patent
Wang

9,952,297
April 24, 2018

Parallel plate transmission line for broadband nuclear magnetic resonance imaging

Abstract

A parallel plate waveguide forms a volume coil used for magnetic *resonance* imaging and *spectroscopy*. The waveguide includes a first conductor arranged on a first side of the waveguide and a second conductor arranged on a second side of the waveguide. Excitation of the first conductor and the second conductor creates a transverse *electromagnetic* field between the first conductor and the second conductor which causes a target within the volume coil to emit radio frequency signals used for producing an image of the target.

APPENDIX 4.4

United States Patent
Hetherington, et al.

9,316,709
April 19, 2016

Transceiver apparatus, system and methodology for superior In-Vivo imaging of human anatomy

Abstract

The inventive subject matter as a whole is an improved transceiver apparatus and system for diagnostic evaluations of living subject, human or animal; and is particularly effective as a clinical tool for the spectroscopic scanning or magnetic *resonance* imaging of humans suspected of being affected with a particular disease, disorder, or pathology. The improved transceiver apparatus is used as an essential component in a computer controlled system suitable for magnetic *resonance* imaging ("MRI"), or nuclear magnetic *resonance spectroscopy* ("MRS"), and/or nuclear magnetic *resonance* spectroscopic imaging ("MRSI"); and the present improvement of these *electromagnetic* signaling systems will provide far more accurate and precise visual images and accumulated data for the clinician or surgeon, as well as serve as a basis upon which to make a diagnosis and decide upon a mode of therapeutic treatment for that individual.

APPENDIX 4.5

United States Patent
Yonamoto, et al.

9,018,954
April 28, 2015

Sample holder for electricity-detection electron spin resonance device

Abstract

A sample holder structure is provided with which it is possible to reduce current noise derived from *electromagnetic* induction, etc. in electricity-detection electron spin *resonance spectroscopy*. Also provided is a process for producing the structure. The material of the sample holder, which is used in an electricity-detection electron spin *resonance* device, is an FR-4 resin, aluminum, glass, or Teflon. The sample holder has four wiring leads formed on the surface thereof. The four wiring leads each has a three-layer structure composed of a nickel layer, a gold layer, and a resist layer which have been arranged in the order from the sample holder surface, and the sample holder has the shape of the letter T. The sample holder has, formed in the end thereof, a gold pad for affixing a sample, and the gold pad has a multilayer structure composed of a nickel layer and a gold layer arranged in this order from the sample holder surface. In the T-shaped head part of the sample holder, the four wiring leads are spaced wider from each other.

APPENDIX 4.6

United States Patent
Neu, et al.

8,884,608
November 11, 2014

AFM-coupled microscale radiofrequency probe for magnetic resonance imaging and spectroscopy

Abstract

The present disclosure is discloses the development of a new device, system, and method that combines advantages of magnetic *resonance* and atomic force microscopy technologies, and the utility of the new device, system, and method for a wide range of biomedical and clinical researchers. According to one aspect of the present disclosure, a device for micro-scale *spectroscopy* is disclosed. The micro-scale *spectroscopy* device includes a beam having a distal end, a proximal end, a top surface and a bottom surface, where the beam is attached to an anchor at the proximal end and further includes a tip extending substantially perpendicular from the bottom surface at or near the distal end, and a coil having at least one turn mounted to the top surface of the beam at or near the distal end opposite the tip, where the coil is capable of both transmitting and sensing *electromagnetic* radiation.

APPENDIX 4.7

United States Patent
Tang, et al.

8,780,344
July 15, 2014

Waveguides configured with arrays of features for performing Raman spectroscopy

Abstract

Embodiments of the present invention are directed to systems for performing surface-enhanced Raman *spectroscopy*. In one embodiment, a system for performing Raman *spectroscopy* includes a waveguide layer configured with at least one array of features, and a material disposed on at least a portion of the features. Each array of features and the waveguide layer are configured to provide guided-mode *resonance* for at least one wavelength of *electromagnetic* radiation. The *electromagnetic* radiation produces enhanced Raman scattered light from analyte molecules located on or in proximity to the material.