Technical sciences

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FUNDAMENTAL ISSUES OF INTEGRATING INNOVATIVE SOLUTIONS

Summary. *Fundamental Issues of Horizontal and Vertical Integration of Structural and Technological Solutions in the Context of the Complex Uncertainty of the Final Integrated Solution.*

Introduction. To ensure comprehensive protection of innovative technical ideas from uncontrolled borrowing and even copying, the non-obviousness of an idea for an average specialist in the technological field has immense significance in the context of an increasingly deepening globalization. This importance is further exacerbated by the specific and complex development of the idea and its gradual step-by-step transition from a pure idea to concrete interrelated technical solutions and their integrative penetration and technological diffusion from one technological field to other adjacent technological fields. A fundamental condition for such penetration is the shifting of boundaries between technological fields and the blurring of characteristics and properties of such boundaries.

Purpose. As an example of the emergence and synthesis of this type of innovative idea, the author of this publication presents the development of an idea for contactless remote control and online monitoring of parameters and concentrations of technological solutions. The principle of the sensor-capsule design and the algorithm for its application are detailed, leading to the serial production of such sensor-capsules and their large-scale use in modern complex high-tech manufacturing, as well as in biological technologies, medicine, and agriculture.

Materials and methods. At this point, the author finds it necessary to take a brief detour to analyze both macro and micro variants in the development and application of these technologies, considering the specifics of their use in various scales of application and the different conditions under which they are applied in modern smart manufacturing environments.

Key words: *Technical Ideas, Innovative Technical Ideas, Non-obviousness of Ideas for the Average Specialist, Technological Field, Macro and Micro Variants of Technological Development, Synthesizing Innovative Ideas, Interrelated Technical Solutions, Initial Conditions for the Search for New Innovations, Shifting Boundaries Between Technological Fields.*

Introduction. To ensure comprehensive protection of innovative technical ideas from uncontrolled borrowing and even copying, the non-obviousness of an idea for the average specialist in the technological field has immense significance in the context of increasingly deepening globalization. This importance is further exacerbated by the specific and complex development of the idea and its gradual step-by-step transition from a pure concept to concrete, interrelated technical solutions, as well as their integrative penetration and technological diffusion from one technological field to others. A fundamental condition for such penetration is the shifting of boundaries between technological fields and the blurring of the characteristics and properties of these boundaries.

As an example of the emergence and synthesis of this type of innovative idea, the author presents the development of the concept of contactless remote control and online monitoring of parameters and concentrations of technological solutions. The design principles and application algorithms for the sensor-capsule are outlined, leading to the serial production of such sensor-capsules and their large-scale application in modern, complex, high-tech manufacturing environments. Additionally, their use in biotechnology, medicine, and agriculture is also discussed.

At this point, the author finds it necessary to take a brief detour to analyze both macro and micro variants in the development and application of these technologies, considering the specifics of their use across different scales and conditions. This detour is essential for understanding how these technologies apply to specific real-world scenarios, in particular, how they can be adapted for use in modern smart manufacturing environments with varying scales of operation and differing conditions of application.

Since the author of this publication is a restorer and, due to a number of objective reasons, is working within the conditions of a micro-scale technological factor, a method for qualifying and comparing the innovative modifications of processes and materials is proposed.

It is suggested to consider and compare various starting conditions that form the initial requirements for the search for new innovations, both in the field of new materials and in the field of new innovative technological methods, which ultimately determine the economic efficiency, technological-commercial effectiveness, and the innovative feasibility of innovations.

Thus, for comparison, let's consider two extremes: a complex restoration process, such as restoring a medieval painting that is a museum treasure and even a national heritage, and, for example, the process of homogenizing milk in modern production conditions within a globalized economy.

Both processes require online monitoring, but they have absolutely opposite basic parameters and conditions for assessing the necessity of applying innovative technical solutions for online control.

What sharply distinguishes these two processes is the level of reversible and irreversible losses in the case of a failure to control the monitoring devices. In the case of a milk production failure, irreversible losses have a clearly calculable nature and limit. However, in the case of a failure to control the quality of materials and the techniques used in the restoration process, the level of irreversible material and moral losses can exceed even the highest conceivable limit.

Therefore, for an innovative project to be in demand and bring the necessary material, commercial, and moral effect, it is necessary that the issues of vertical and horizontal integration of the innovative solution from concept to mass production be universal enough that the level of irreversible losses does not exceed the level of reversible losses.

The emergence of the idea and its innovative synthesis occur from methods and techniques of active control of the parameters of liquids in technological containers using so-called "control witnesses." These "witnesses" have a limited service life and, after its expiration, must be replaced with new ones.

As a rule, such elements are placed in the corners of technological containers and baths, where, as it is commonly said, so-called "dead zones" occur, areas where the level of turbulence is significantly lower than in the central zones of the containers or baths.

Again, as a rule, such a witness contains a chemical reagent that reacts with the solution in the container or bath and, gradually, under the influence of the solution, changes its mass.

When the witness is removed, the character of the changes in the solution is determined by weighing its control element.

Naturally, no active online monitoring is involved here. In this case, the witness performs the function of passive periodic control.

The model shows a module for active contactless monitoring of the parameters of a controlled liquid flow (this could be a mixture, emulsion, compressible liquid medium, aerosol, and so on).

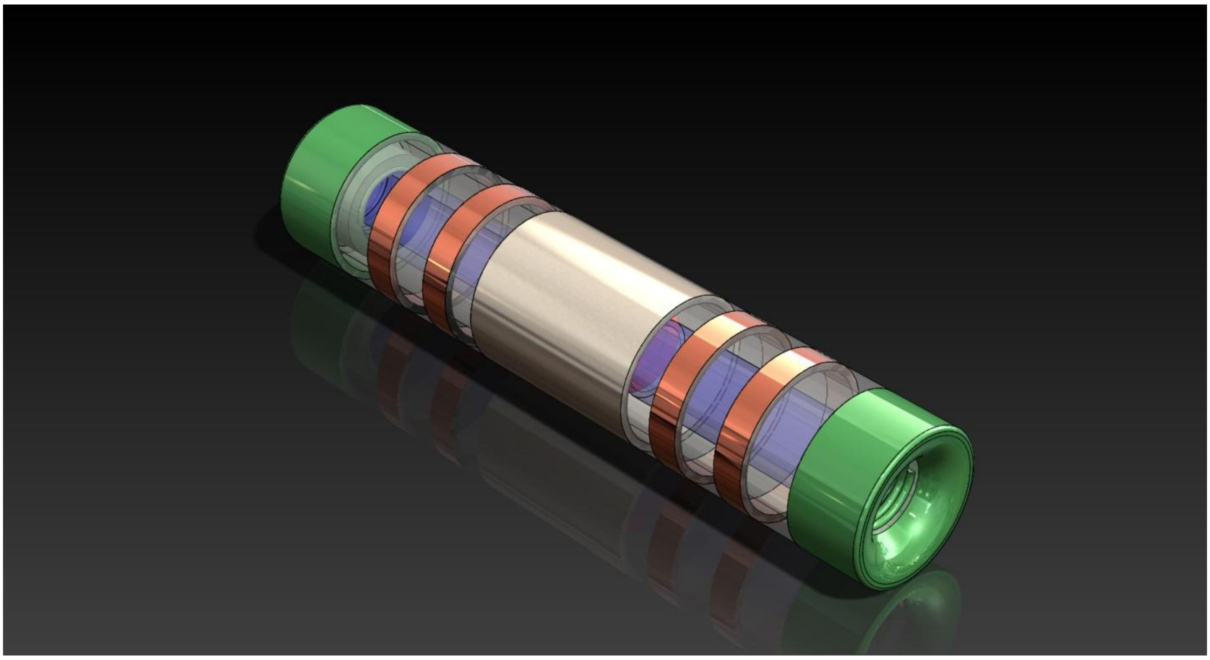

Fig. 1. A module for active contactless monitoring of the parameters of a controlled liquid flow

Let us consider the horizontal and vertical integration schemes of the basic technical solutions that form the basis of the module for remote, contactless monitoring of an object filled with one of the listed types of liquid (though it could also be an aerosol, chemical solution, etc.).

To begin a comprehensive analysis of the distinctive features of the module, the author suggests analyzing the design constraints that exist in the systems of the module and are based on the requirements and limitations of current standards.

As a rule, these are interconnected parameters: dimensions, materials, material combinations, as well as the basic principles of the module's working cycle, which ensure the accomplishment of the main tasks, such as online monitoring of, for example, the acidity level of a cow's stomach acid.

First of all, based on previous experience with the use of such modules, it is known that the main problem is the issue of energy supply. All experiments with chemical power sources for the modules typically ended with the result of needing to stop the experiment, due to the fact that the resource of chemical batteries is very limited, and the possibility of replacing the module is even more restricted.

Therefore, the key to solving the problem is practically solely the question of continuous energy supply for all the module's measurement and communication functions.

Now, let's turn to the conditions inside the cow's stomach where the module is located. As a rule, the cow's stomach acid has an acidic reaction, and if we assume that this stomach acid will, in parallel with its main biological functions, also act as an electrolyte for an improvised battery (or batteries), then by placing electrodes on the outer surfaces of the module's casing, the casing with built-in electrodes, in constant contact with the acidic stomach acid, will function not only according to its design functions but also as a planar, spatial, three-dimensional battery.

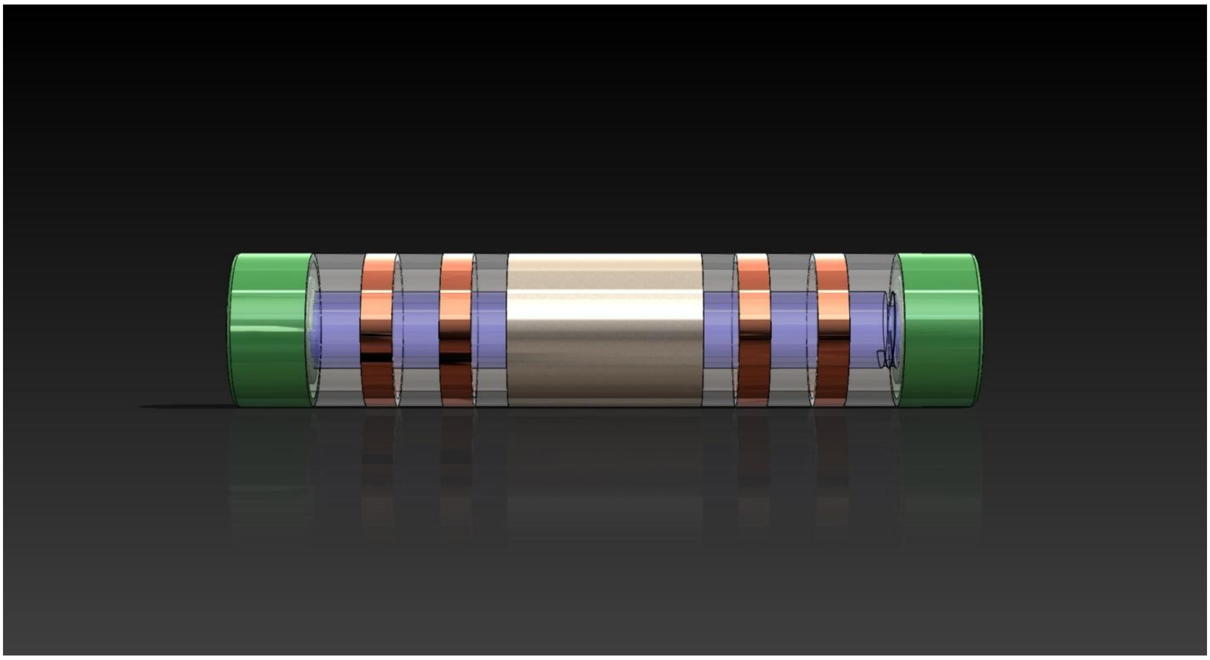

Fig. 2. In the 3D model, at the center of the cylindrical module structure, there is a conductive shield

As can be seen from the following diagram (3D model), at the center of the cylindrical module design, there is a conductive shield that screens the solenoid of the impedance-resonance sensor and also serves as one of the electrodes for the improvised innovative battery.

Once the issue of energy generation is resolved by utilizing an infinitely renewable resource – a sort of electrolyte that continuously undergoes acidity parameter measurements – this electrolyte, in combination with the elements of the module's casing, enters the internal channel of the module. This same electrolyte, the stomach acid, is then subjected to impulses from the solenoid sensor, creating a specific resonance background. At the peak of the impulse, the highest value of the potential difference is recorded, which is equivalent to the acidity level of the stomach acid at the moment of measurement.

At the same time, the stomach acid on the external surface of the module's casing reacts with the electrodes embedded in the module's casing in the form of a ring system.

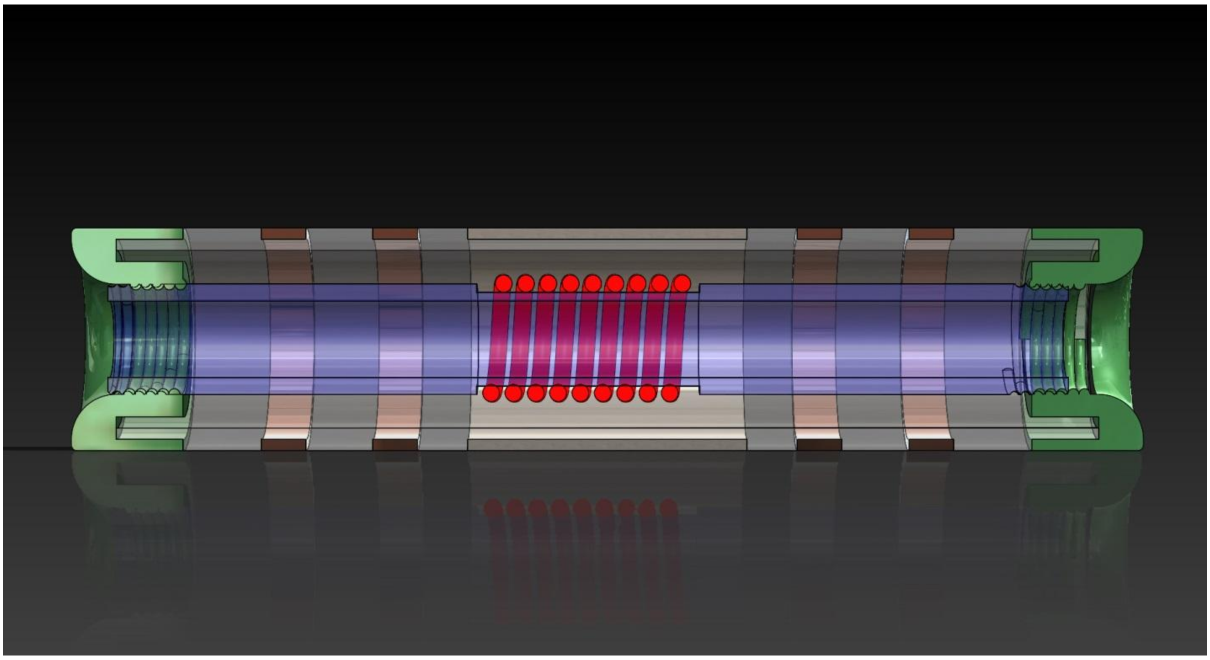

Fig. 3. A module embedded in the casing in the form of a ring system

At the same time, these electrodes, in combination with the electrolyte masses – the stomach acid – interacting with them, form a protective combined shield that protects and cleans the measurement zone from electronic noise, which, in real-time mode, improves the accuracy of the measurements.

Thus, we have a clear connection of functions, ensuring both horizontal and vertical integration through the constant combination of the module's elements and the materials from which they are made.

This combination is precisely what carries the distinct innovative component, where the same module elements combine their functional roles.

It is important to note that within the module, all combined functions are implemented with the simplest geometry, using basic combinations of construction materials and employing well-established technological methods for creating module prototypes and testing their operational parameters.

List of references, patent and license information

United States Patent **9,316,605**
Birk , et al. **April 19, 2016**

Determination of attributes of liquid substances

Abstract

A monitoring unit (100) that determines parameters (p1, p2) of an attribute (P) of a liquid substance flowing (F) through a dielectric conduit (110) includes plural coil members (121, 122) encircling the dielectric conduit (110) that subjects a flow of the liquid substance to plural different electromagnetic fields (B(f)), and under influence thereof measuring circuitry registers corresponding impedance measures (z(f)) of the liquid substance. A processor (130) derives the parameters (p1, p2) of the attribute (P) based on the registered impedance measures (z(f)).

Приложение 2

United States Patent **8,694,091**
Birk , et al. **April 8, 2014**

In vivo determination of acidity levels

Abstract

A bolus for use in a ruminant animal's reticulum includes a cavity (100) configured to receive ruminal fluids present in the stomach. The cavity has walls (110) of a dielectric material and is encircled by a coil member (120), which is configured to subject the ruminal fluids to an electro-magnetic field. A Sensor element (310) measures the electromag-netic field's influence on the ruminal fluids and thus register an electromagnetic property representative of an acidity level of said fluids. A transmitter (410) transmits a wireless output signal (SD) reflecting the acidity measure.