Технічні науки

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FURTHER DEVELOPMENT OF INNOVATIVE APPLICATIONS IN LIGHTING TECHNOLOGY

Application of Special Composite Materials in the Processes of Further Development of Innovative Applications, Also Based on the Reverse Piezoelectric Effect

Summary. *As practice has shown, piezoelectric motors working on the basis of reverse piezoelectric effect principles can become the foundation for the latest automation and precision mechanics systems, as well as innovative lighting technology. The main interest of designers is focused on the possibility of building systems and configurations based on the reverse piezoelectric effect, related to precision and compact stepper motor systems.*

As the requirements for accuracy increase and the weight of such motors is reduced, including by decreasing their size, more solutions are proposed for the construction of elements and structures of these motors based on the complex use of special composite materials.

Key words: *Reverse Piezoelectric Effect, Piezoelectric Motor, Composite Material, Rotor of a Piezoelectric Motor.*

In modern electronics, especially mass-produced ones, determining the initial technical requirements for the product is crucial. These requirements must allow for innovative modifications of the product during production and operation without changing its basic construction principles, circuit solutions, and material combinations.

It is most difficult to predict the main possible trends and paths of further development and improvement of the technology underlying the product, in such a way that the product acquires new innovative properties and characteristics without losing the positive qualities and characteristics laid out during its development.

For analysis, the author suggests considering a group of products for non-contact monitoring of the state and parameters of liquids in pipelines, highlighting the most important component – the shielding system of the working area of the electromagnetic resonance sensor, which is the heart of such a device.

For a more detailed examination of all aspects of possible optimization paths for the technical characteristics of devices that have resonance sensor blocks and corresponding shielding elements, the author considers it most productive, under current conditions, to apply computer simulation of the technical characteristics, carried out according to the methodology proposed in her prospective developments, patents, books, and publications by Olena Grafska.

Olena Grafska’s principal approach to the simulation program primarily involves modeling the paths and consequences of integrating new structural materials and circuit solutions into mass-produced devices.

This especially applies to the components responsible for shielding the measurement area and excluding measurement distortion caused by electronic noise.

A three-dimensional model presents such a shielding unit, based on the combination of the latest composite materials and innovative electrolytic coatings, which define the level of effectiveness and quality of the shielding system.

To further utilize the general system recommendations in real developments, the author proposes the basic variants of initial technical requirements for such products, formulated based on the results of computer simulations and software simulations of all resonance phenomena in the module's working zone, protected from electronic noise by the shielding system, all performed in combination and harmonized in accordance with the modeling and simulation methodology and programs developed by Olena Grafska.

Initially, Olena Grafska considers it necessary in her developments to generalize and specify the Technical Requirements relating to the measurement process using the principles of electromagnetic, resonance metrology.

When implementing the technological principle of resonance metrology, the following conditions must be ensured:

- Relatively low unit cost of the measurement process;
- High reliability of the measurement process;
- Simplicity of the measurement process, which allows the use of low-qualified personnel or the technology to be used in household conditions for monitoring or assessing the quality of drinking water;
- Small size of the control equipment;
- The possibility of embedding it into existing technological schemes and equipment complexes;
- High productivity;
- The possibility of continuous operation throughout the day;
- High efficiency of the process and high repeatability of results;
- The possibility of simple and reliable automation of the process;
- The possibility of using disposable technologies and materials;
- The possibility of monitoring and using the results of the monitoring process remotely;

- The possibility of comparative assessment of the process quality and the quality of any liquid or water based on a minimal number of technological parameters.

This requirement deserves more attention, as it exemplifies a combinatory system for forming the future technical characteristics of the innovatively modified product and related products with similar characteristics.

This forecasting principle allows for the creation of several parallel products at all stages of development, with a unified and equivalent component base, at minimal cost.

The introduction of this systemic forecasting analysis principle, proposed by Olena Grafska, enables any innovative development to produce several real results for several products with similar properties and characteristics.

The preparation of the production program and the implementation of the products for the adaptation period to market conditions; development of the warranty service system; finding a strategic partner; the first phase of active marketing;

Thus, as readers have noticed, at all stages, the system follows the main principle outlined in the developments, patents, and publications of Olena Grafska – the principle of horizontal and vertical combinatory integration.

It is also very important for the systematic coordination of all stages of the development process, in terms of the initial requirements for them, to see and identify the minimally necessary state of the device project and its basic technology at the start of the systemic development.

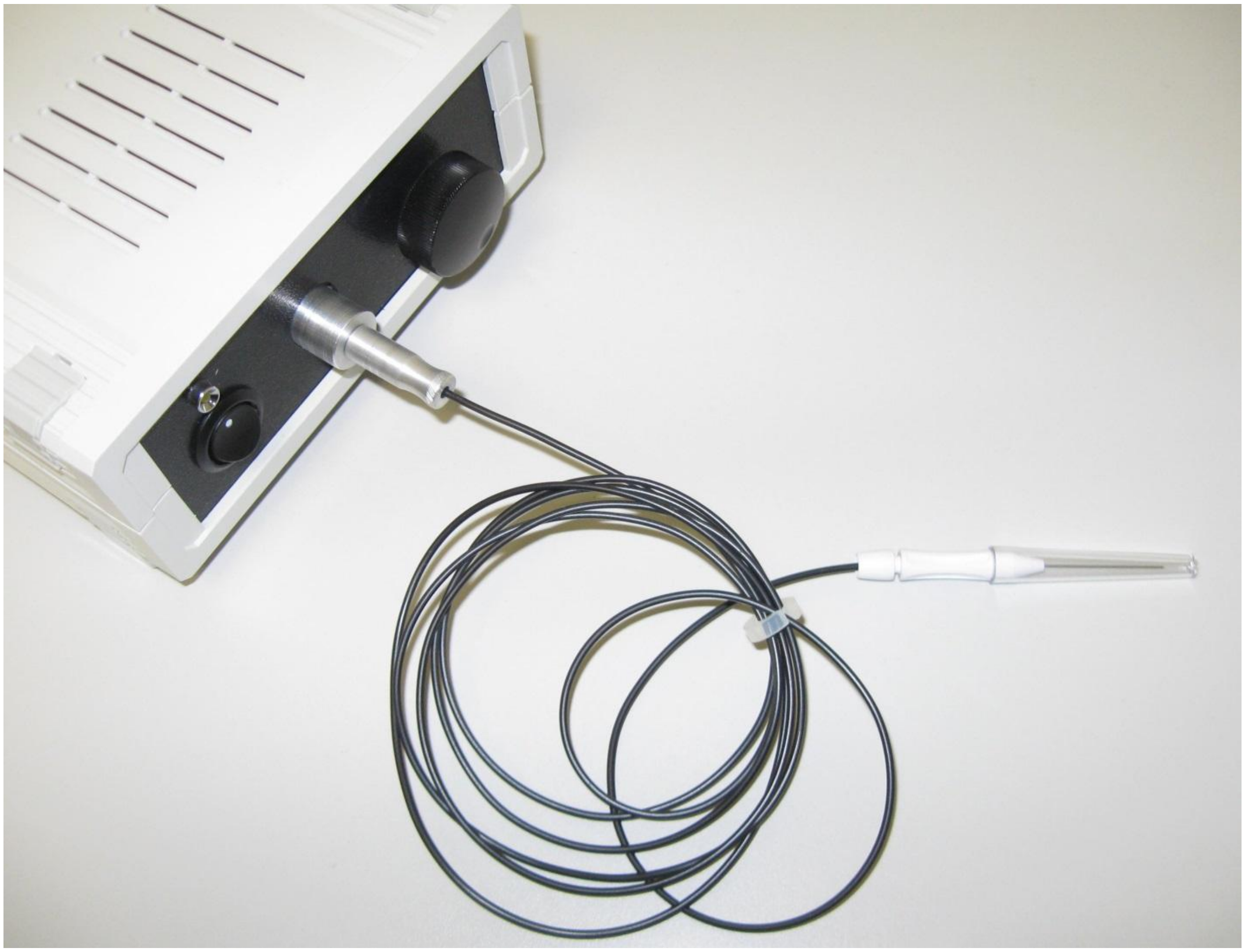
According to Olena Grafska's recommendations, the following should be done:

- Development of the main design and technological principles for constructing the product;
- Manufacturing of a basic universal prototype of the product;

- Conducting a cycle of preliminary product tests;
- Adjusting the universal prototype based on the results of the preliminary tests;
- Preparing materials for the patent application;
- Developing a strategy for patent-licensing protection of the technology;

As can be seen from the material presented, in accordance with the methodology proposed by Olena Grafska and developed in her publications, focusing attention on the most important element of the product in terms of technology and its core development principles allows for deeper work and horizontal and vertical integration, aligning the technological and structural identification tasks and principles of the product to achieve the ideal final result, even in the case of parallel developments.

Using the same methods and techniques declared by Olena Grafska in the innovative organization of the product development project, the author of this publication arrived at a sufficiently optimal variant – stages and phases of the development of a household device for controlling the quality of drinking water.



Based on the Laser Diode Light Emitting Module with Integrated Light Converter

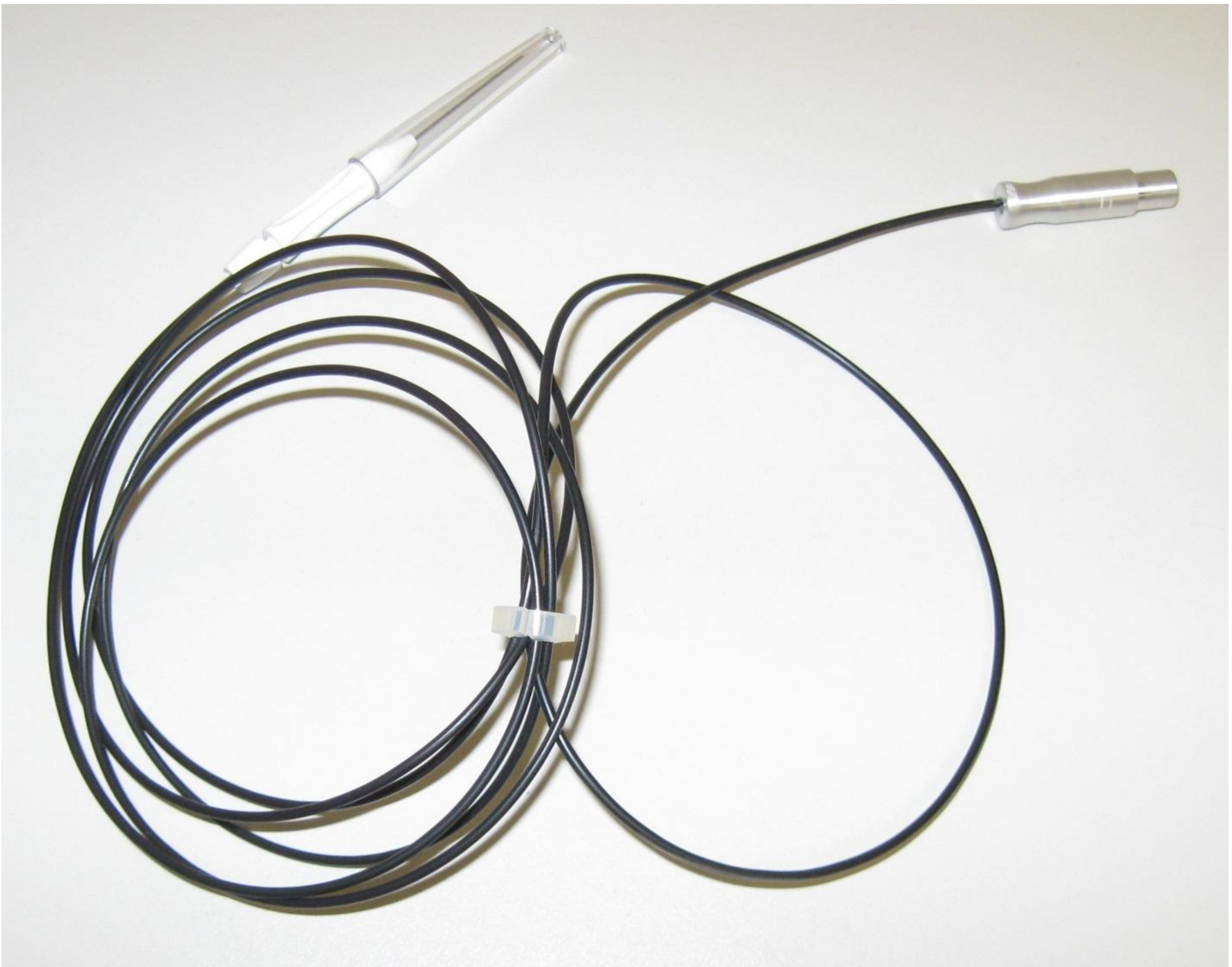
A compact light source is proposed, in which a laser diode is used as the primary initiator of the light flow. In the proposed device, the power of the laser diode can range from 50 milliwatts to 10 watts.

There are no technical or technological limitations for increasing the power of the laser diode, if necessary.

The proposed device contains an integral micro-light converter and a magnetic resonance encoding device, which eliminates unauthorized use of peripheral optical instruments.

In the proposed light source, any types of control systems and pumping of the laser diode can be used, including pulsed and radio-frequency systems.

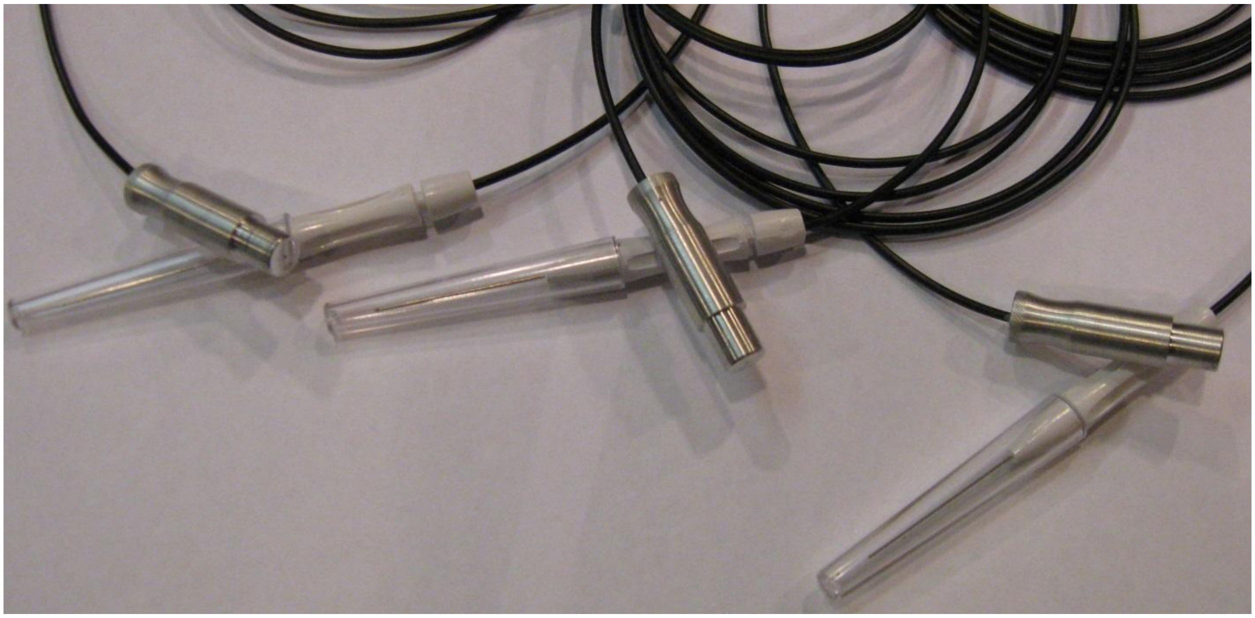
For the transmission of radiation from the module to peripheral instruments, the following types of optical fibers can be applied:



1. For use with the module, fibers with a large numerical aperture, such as POF fibers or glass fibers, are suitable. In the plug-in design variant, it is possible to use several fibers at once. The design specifics will depend on the application.
2. POF fibers are available in diameters of 250, 700, 1000, 1500, 2000, and 3000 micrometers.

3. In the plug-in design, 80% of the laser radiation power can be transferred into the fiber. With lasers with smaller divergence, the radiation input power percentage can be increased to values close to 100%.
4. When using glass optical fibers with the module, a very high aperture of up to 0.6–0.7 and even higher is achieved. The available fiber diameter is up to 250 micrometers, so the plug-in design without removing the cover from the diode provides 45-50% radiation input power from the laser.
5. Glass fibers are particularly promising for introducing spontaneous emission from the converter, as they are insensitive to heating from the pumping light of the phosphor. They are especially effective when creating 27G and 32G probes-illuminators.

The proposed module allows for several options for light flow output from the optical fiber:



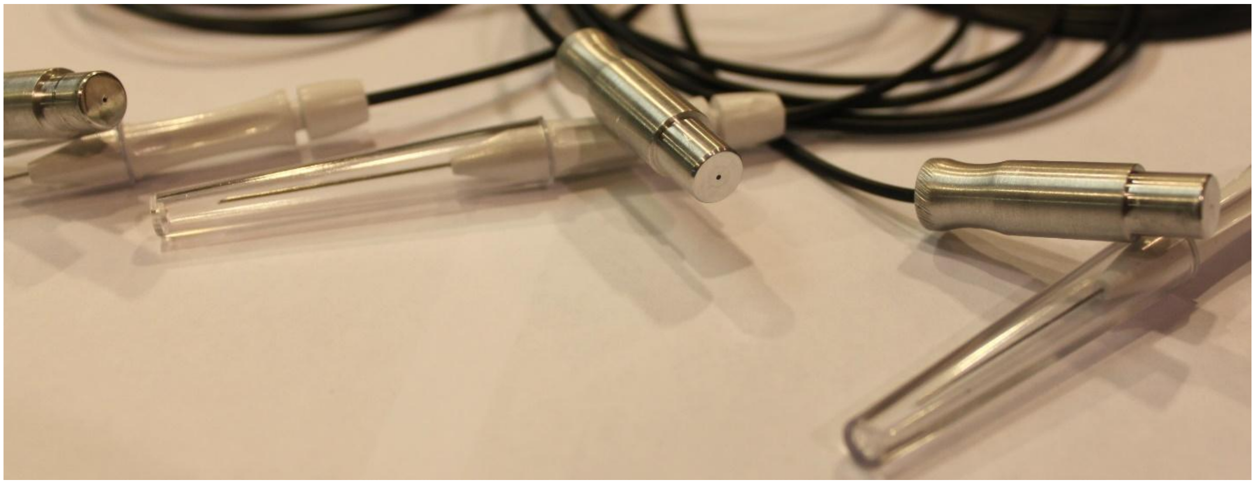
1. Laser radiation from the fiber.
2. Spontaneous radiation from the fiber.
3. Spontaneous radiation from the remote phosphor.

Sequence of steps or stages of the controlled and regulated through-flow process of the operation of the proposed module:

1. **Stage 1 of the process:** Generation of laser radiation. The intensity of generation is regulated and controlled by the pumping current.
2. **Stage 2 of the process:** Input of radiation into the fiber. It is controlled and regulated at the manufacturing stage. It is not regulated during operation.
3. **Stage 3 of the process:** Light transmission through the fiber. This is not controlled or regulated.
4. **Stage 4 of the process:** Output of pump light from the fiber to the integral converter. The light power density at the converter is controlled at the manufacturing and design stage by adjusting the distance from the fiber tip to the converter, the converter's design, the presence of focusing optical elements, and the aperture of the fiber.
5. **Stage 5 of the process:** Light conversion. This is controlled by the thickness of the phosphor, phosphor concentration, dopant concentration in the phosphor, and quantum output type of the phosphor.
6. **Stage 6 of the process:** Input of radiation from the converter into the fiber. This is determined by the distance from the converter to the fiber's output tip, the input aperture of the fiber (including diameter), and losses from reflection off surfaces. This is not regulated during operation.

Advantages of the laser module with the integral light converter over an LED module of the same type, purpose, and power:

1. Thanks to the fact that the active element of the light converter has exceptionally small dimensions compared to LED elements of the same purpose, the proposed module provides the highest brightness light source.
2. The proposed module allows for the optical fiber to be fed directly to the light converter, as there are no issues from the thermocompression wire contacts.
3. The module allows for multiple wavelengths of pumping radiation to be fed to the light converter, and thus, it can use a multi-component composite phosphor. This enables the change of the color rendering index and the light temperature of the converter's radiation. This means the ability to obtain multiple colors from a single light converter.
4. The design and operation principle of the proposed module allow for eliminating the need for current-conducting components at significant distances from the laser radiation source (up to several hundred meters).



Appendices and List of References, Part 1

Appendix 1

United States Patent Application	**20120040166**
Kind Code	**A1**
	February 16, 2012

Composite Material, Method of Manufacturing and Device for Moldable Calibration

Abstract

Composite materials and methods and systems for their manufacture are provided. According to one aspect, a composite material includes a collection of molded together multilayer capsules, each capsule originally formed of a core and shell. The shell, after a plastic deformation process, forms a pseudo-porous structure,

with pores locations containing the capsule cores. The cores are made of a material, e.g., synthetic diamond, which is harder than the external shell, which can be formed of, e.g., a ductile metal such as copper. The composite material has high thermal and/or electrical conductivity and/or dissipation.

Appendix 2

United States Patent Application	**20100224497**
Kind Code	**A1**
	September 9, 2010

DEVICE AND METHOD FOR THE EXTRACTION OF METALS FROM LIQUIDS

Abstract

A volume-porous electrode is provided which increases effectiveness and production of electrochemical processes. The electrode is formed of a carbon, graphitic cotton wool, or from carbon composites configured to permit fluid flow through a volume of the electrode in three orthogonal directions. The electrode conducts an electrical charge directly from a power source, and also includes a conductive band connected to a surface of the electrode volume, whereby a high charge density is applied uniformly across the electrode volume. Apparatus and methods which employ the volume-porous electrode are disclosed for removal of metals from liquid solutions using electroextraction and electro-coagulation techniques, and for electrochemical modification of the pH level of a liquid.

List of References, Patent and Licensing Materials, Part 2

Appendix 3

United States Patent Application	**20130173180**
Kind Code	**A1**
	July 4, 2013

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)).

Appendix 4

United States Patent Application	**20130178721**
Kind Code	**A1**
	July 11, 2013

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.

Appendix 5

United States Patent	**8,694,091**
	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 electromagnetic 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.

Appendix 6

United States Patent **9,316,605**

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)).

Appendix 7

United States Patent **6,188,151**

February 13, 2001

Magnet assembly with reciprocating core member and associated method of operation

Abstract

An electromagnetic assembly includes a casing, a solenoid disposed inside the casing, a stationary magnetic core, and a movable magnetic core. The stationary magnetic core is disposed at least partially inside the solenoid and is fixed relative to the solenoid and the casing, while the movable magnetic core is disposed for

reciprocation partially inside the solenoid along an axis. The stationary magnetic core, the movable magnetic core, the solenoid, and the casing have rectangular or square cross-sections in planes oriented essentially perpendicularly to the axis.