

# **Sapienza Rome University Technology Offer**

in collaboration with  
Miami Scientific Italian Community



**SAPIENZA**  
UNIVERSITÀ DI ROMA

# Abstract

Sapienza University is the largest university in Europe and a leading centre for research. Internationally renowned scientists work in disciplines ranging from the arts and humanities to physics and engineering.

The university continues to welcome highly qualified international researchers and pursue its long history of innovation.

Sapienza carries out important Technology Transfer (TT) activities to promote and share results and knowledge with outside stakeholders.

TT activity is carried out by the Office for Research Enhancement and Innovation (UVRSI). UVRSI coordinates:

- processes related to the connection between the University and public/private external individuals from Italy or abroad;
- development of research, training and experimentation programmes which may be of Sapienza's interest;
- enhancement of achieved results and their legal safeguard;
- transfer of technologies and knowledge of the University to the real world.

UVRSI is divided into 3 areas:

- Agreements and Consortia
- Patents
- Technology Transfer and Spin Off

The office works in synergy with the Vice-Rector and with the Commission for Research and Technology Innovation by:

- aligning its own position to defined strategical issues;
- providing professional contribution to the initiatives and projects Sapienza is interested in.

TT activities that strengthen links between the scientific and business community include:

- organising group meetings inside departments, with a special focus on young researchers, in order to encourage entrepreneurial culture;
- creating training courses for young researchers that help them understand the potential of their activities and improve their ability to transform innovative ideas into commercial realities;
- creating "open spaces" for the development of innovative ideas/products by Sapienza students;
- matching the Athenaeum's specialists with national/international funding opportunities;
- promoting structured actions through partnerships with entrepreneurial/institutional entities;
- brand valorisation activities for Sapienza.

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## IMPROVED ULTRA-MICRO TURBOGAS

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102011901951257 (ex RM2011A000277) of the 03.06.2011

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### **Abstract**

The device is a combustion chamber for ultra-micro turbogas whose main feature is to achieve within a very compact geometry both combustion and regeneration of the fluid entering the same chamber. This regeneration brings a remarkable advantage from the point of view of the total yield of the process (and hence a reduction in specific consumption), making the invention interesting for all those micro applications where the reduction in consumption is one of the project constraints.



Fig. 1 Prototype made of micro room, outer mantle and regenerative body.

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### **Technical Description**

The cylindrical device consists of two coaxial elements and an outlet duct for exhaust gases, which allows the exhaust of combustible gases. On the upper case of the chamber, the ignition device is housed, which can be a car spark plug or a plasma electrode. Of the two coaxial cylinders, one (the outer shell) has an outer diameter  $D1$  and an internal  $D2$ , and the other (constituting the actual combustion chamber) has outer diameter  $D3$  and interior  $D4$ .  $D2$  is sufficiently larger than  $D3$ , and a spiral-shaped channel of the appropriate geometry in which the compressed air flows flows into the gap that is created. Since the internal wall ( $D4$ ) is exposed to flame temperatures, air entering the cavity is heated, while cooling the combustor.

### **Technologies & Advantages**

The device can be used as a portable energy generator and can be carried in a special backpack by a single individual, to power portable electronic devices. If realized on a larger scale (5 kW) it can be used as a range extender in electric urban vehicles or as an additional energy supplier for UAV.

### ***Applications***

Possible fields of application: transportation (vehicular applications), range-extender in electric vehicles; small avionics; distributed energy generation; portable electrical power devices; auxiliary power source in UAV (Unmanned Aerial Vehicles).

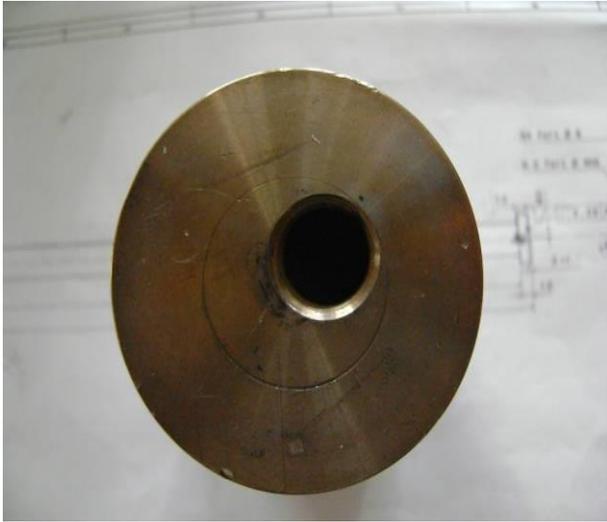


Fig. 2 Detail of the outer cap with housing for ignition

## UNIT FOR REAL TIME EVALUATION OF SUBSTRATE ASPECIFIC TOXICITY

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102011901976969 (ex RM2011A000468) of the 08.09.2011

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### **Abstract**

The SOURSAFE system detects the presence of toxic substances in a wastewater to be treated in an activated sludge reactor, aiming at preventing biomass contamination and decay. The peculiarity of such system is to be non-specific, continuous and able to provide real-time responses, i.e. to detect the presence of a toxic in an incoming substrate avoiding the dosage of specific substances, but by a simple respirometric measurement evaluating the effects of the incoming substrate on the vitality of existing biomass in the reactor. In addition to provide a continuous monitoring of biomass activity, the system can obviously be connected to a valve to send the toxic feed stream in a by-pass safety tank in real time.



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### **Technical Description**

A biomass is placed in contact with a sample of the substrate to be analyzed: the mixture is then oxygenated and the vitality of the bacterial mass is verified by measuring the depletion of oxygen concentration over time. In the absence of toxic substances, a dramatic decrease in oxygen concentration during time due to the biomass respiration activity is expected: in the presence of toxic substances in the substrate, a progressive decrease in the slope of the Oxygen concentration curve (OUR) occur, until full flattening in the case of particularly toxic substances at high concentrations. By equipping the instrument of a potential alarm signal, in case the slope is lowered below a certain threshold, it will be possible, by automatic or manual operation, to stop the input of the substrate, possibly diverting the flow into a parallel storage tank.

### **Technologies & Advantages**

While COD and BOD5 tests provide information on incoming load and estimate its biodegradability, the OUR, or rather the Specific OUR (S-OUR), i.e. referred to the biomass contained in the activated sludge, may highlights the real response of the biological reactor to wastewater feeding, thus allowing an estimation of reactor performances. Depending on the

concentration of the biodegradable substrate in the feed, different respiratory rate may be recorded; as well as, by adding into the reactor biomass taken from the activated sludge tank or the sludge recycle stream, also different SOUR values can be observed. Once the steady conditions have been reached in a given industrial plant, in the absence of toxicity phenomena, the trend of SOUR should remain constant, but it not necessarily is always the same. In fact, one of the benefits that the system can give is that it can appreciate significant variations in the vitality of activated sludge over time, due not only to timely or constant changes in the quality of the feed, but also to non-optimal operating conditions (e.g. oxygen shortage).

### ***Applications***

In wastewater treatment plants management, the monitoring of the biomass oxidative metabolism by determination of the OUR allows to detect anomalies or changes in the conditions in the biological oxidation reactor. The ability to carry out such monitoring in a real time, thus resulting in a rapid intervention and correction, makes the SOURSAFE device an indispensable element in any wastewater treatment plant that has a biological oxidation stage, which is normally the controlling step the overall performance of the whole plant.



## USE OF PLANTS WITH REDUCED LEVELS OF DE-ESTERIFIED HOMOGALACTURONAN IN THE CELL WALL OR PORTIONS THEREOF FOR IMPROVING THE SACCHARIFICATION OF PLANT BIOMASSES

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102011901994329 (ex RM2011A000588) of the 08.11.2011

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### **Abstract**

The present invention relates to expression in plants of pectinolytic enzymes and of pectin methylesterase inhibitors for increasing the degradability of plant tissues through enzymatic digestion, thus improving saccharification efficiency. This application claims priority to and the benefit of Italian Application No. RM2008A000696 filed on Dec. 30, 2008. The invention relates to a process for improving conversion of lignocellulosic biomasses into fermentable sugars, which then allows the production, on an industrial scale, of any product obtained by fermentation, including ethanol (bioethanol).



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### **Technical Description**

The preparation of biofuels and other biomass industrial products depends on a key process called saccharification, that is, the degradation of the plant cell walls in fermentable soluble sugars. The large bottle neck for the industrial scale of this process is represented by the heterogeneity of the walls of plant cells and their recalcitrance to hydrolysis: that is, the natural resistance of the plant cell walls to enzyme and microbial decontamination. Presently, pre-treatments are needed to make biomass accessible to enzymes that degrade cell wall components. Existing pre-treatments are expensive and polluting. This invention focuses on pectin, which carries the cellular wall architecture through crosslinked calcium crosslinked links of homogalacturonan de-methyl esterified acid (HGA). We have shown that cellular walls of plants with a reduced content of HGA acid domains are more susceptible to enzymatic saccharification and avoid expensive and polluting pre-treatments.

### **Technologies & Advantages**

Plant biomass has been the main source of energy for most human history and is considered today as a potential strategic resource. The use of abundant and inexpensive lignocellulose biomass resulting from non-food crops called "energy crops" and crop wastes is a great advantage both in terms of economy and environment. Approximately 70% of the plant biomass consists of cell wall material and bio-ethanol can be produced by treating the polysaccharide (mainly cellulose) components of the cell wall. On the other hand, the use of waste from crops that are mainly used for nutrition can provide added value to agriculture.

### ***Applications***

We expect that invention to have an impact on: 1) the substantial reduction in the number and cost of pretreatments in the transformation of plant biomass 2) the expansion of the range of plant materials potentially used for bio-conversion 3) use of value-added crops and food waste with consequent positive effects on waste management and the environment.



## AN ORGANIC RANKINE CYCLES (ORC) SYSTEM FOR THERMAL RECOVERY OF THE EXHAUST GAS IN A I.C.E. POWERED VEHICLE

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102011902005958 (ex RM2011A000671) of the 16.12.2011

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### **Abstract**

The device is a combustion chamber for ultra-micro turbogas whose main feature is to achieve within a very compact geometry both combustion and regeneration of the fluid entering the same chamber. This regeneration brings a remarkable advantage from the point of view of the total yield of the process (and hence a reduction in specific consumption), making the invention interesting for all those micro applications where the reduction in consumption is one of the project constraints.



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### **Technical Description**

The object of the present invention is to provide a small power OCR system for use in the car. An object of the present invention is a thermal recovery system, which comprises: a) the first heat exchanger that can vaporize, through an external source, an organic organic liquid can be relatively high pressure and can circulate in a closed circuit system; b) an expander where the steam can expand; c) a second heat exchanger for condensing the foam vapor by releasing the latent vaporization energy; d) a pump for pumping the liquid into the first heat exchanger, characterized by the use of a very small ultra-small-diameter, rotating, ultra-small vapor expander and the use of micro heat exchangers, and the fact that it can be mounted on a car.

### **Technologies & Advantages**

In the specific application of this invention, the external heat source is the exhaust gas of the car's thermal engine, the ORC plant acts as an "energy recuperator" from the cooler radiator, muffler or exhaust manifold. Part of this energy is directly converted into mechanical work, and provided, through a generator and a rectifier, to an auxiliary battery on board; the low temperature thermal part can be used, when necessary, for the conditioning of the interior of the car. The working fluid is an organic compound, or a mixture characterized by high molecular weight: this allows to reduce the spin speed of the expander and to provide a direct connection to the generator. One of the advantages of the fluids used in ORC systems is to be "dry fluids" ie characterized by a positive slope of the saturated steam curve. This allows

to have a superheated steam at the end of the expansion even from the saturated vapor curve, with the advantage of no turbine condensation and the consequent preservation of the parts in contact with the fluid from the erosion.

### ***Applications***

The possible fields of application is transportation (vehicular applications): increasing the power output of a gasoline or diesel powered car; generating extra auxiliary power in marine vessels; increasing the power output in diesel-powered electrical generators.



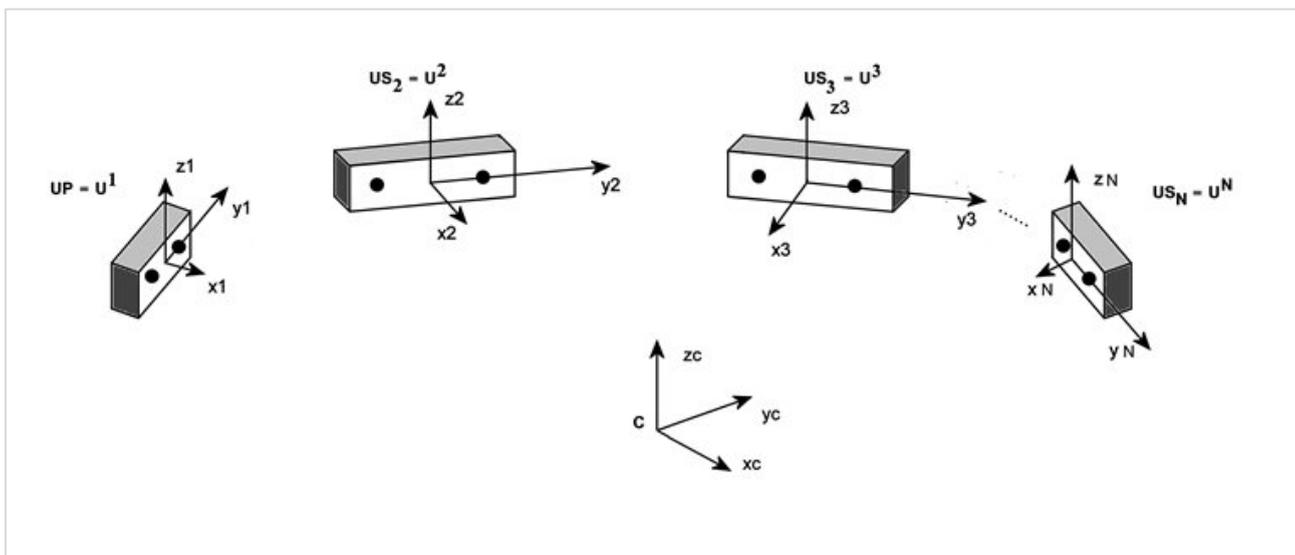
## A MULTIPLE-OPTICAL-UNIT SPATIAL TRACKING SYSTEM, TO BE USED IN NEURO-SURGICAL OPERATIONS AND IN TRANSCRANIAL MAGNETIC STIMULATION GUIDED BY RADIOLOGICAL IMAGES

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102013902115482 (ex RM2013A000009) of the 07.01.2013

### Abstract

Advanced image-guided navigation systems are based on hybrid tracking devices: optical and electromagnetic units, to continuously record and monitor the spatial position of the used instrumentation. Compared to optical tracking devices, the accuracy of electromagnetic ones is lower and is affected by environmental interference. In contrast, optical devices require that a line of visibility be maintained between the optical unit and the position sensor applied on to the instrument. To overcome these limitations, the proposed system allows the simultaneous use of multiple (two or more) optical tracking devices, arranged to resume the operating area from different complementary points of view. The proposed system allows to monitor the operating area with high continuity, accuracy and handling, requiring only the application of optical sensors on to the instrumentation.



### Technical Description

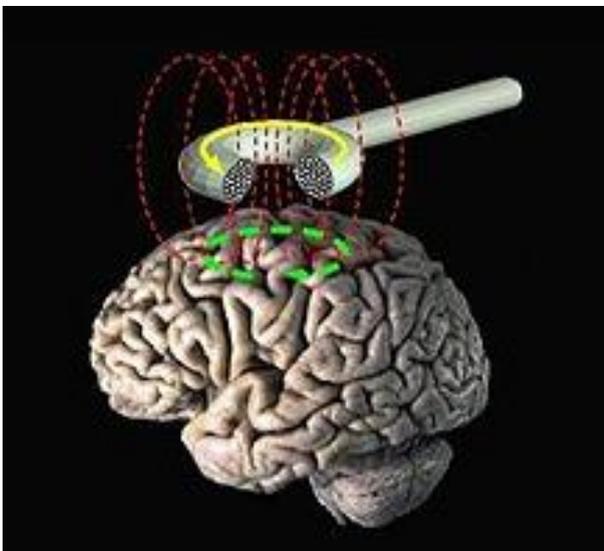
The proposed system allows the simultaneous use of two or more optical tracking devices. The optical units of these tracking devices are suitably arranged to resume the operating area from different and complementary points of view, to reduce the presence of shadow areas where the position of the used instrument is not monitored by the device. In this way, at least one of the optical unit used will have a line-of-sight between itself and the position sensor applied onto the instrument. Therefore, this unit is able to record the position of the used instrument. Spatial data recorded by a single optical unit are referred to the same reference system, common to all the units used.

### ***Technologies & Advantages***

The proposed system: (i) ensures a high continuity of spatial data recording, offering the high spatial resolution of optical tracking devices; (ii) does not require application onto the used instruments of different types of position sensors (i.e.: optical and electromagnetic) and of the calibration procedures, resulting more handling, convenience and fast than hybrid devices; (iii) is well suited for use in the presence of ferromagnetic materials (i.e.: iron, nickel, cobalt and some steels). These materials become strongly magnetic in presence of an electromagnetic field and this phenomenon can distort the reference magnetic field and thereby affect the measurement accuracy of electromagnetic tracking device; (iv) is particularly suitable for use in combination with TMS, a modern and promising and not invasive technique to stimulate human brain, where the instrument used is source of a short but very high electromagnetic field. In this case, the use of an electromagnetic tracking device is even more inadequate as the electromagnetic field produced by TMS distorts the spatial measurements provided by this device.

### ***Applications***

Image-guided navigation systems record the spatial position of the used instrumentation relative to the anatomy of the patient under consideration, using a 3D spatial tracking device. Commonly, a co-registration procedure between the patient's space and the image space used allows virtually mapping the position of the instrument onto the images. In this way, the operator is visually guided to achieve the predetermined target, allowing a high accuracy and a significant reduction in the level of invasiveness of his intervention. The proposed system provides useful applications in various surgical and therapeutic disciplines such as maxillo-facial and orthopedic surgery, neurosurgery, endoscopic surgery, bioptic sampling, radiotherapy, transcranial magnetic stimulation.



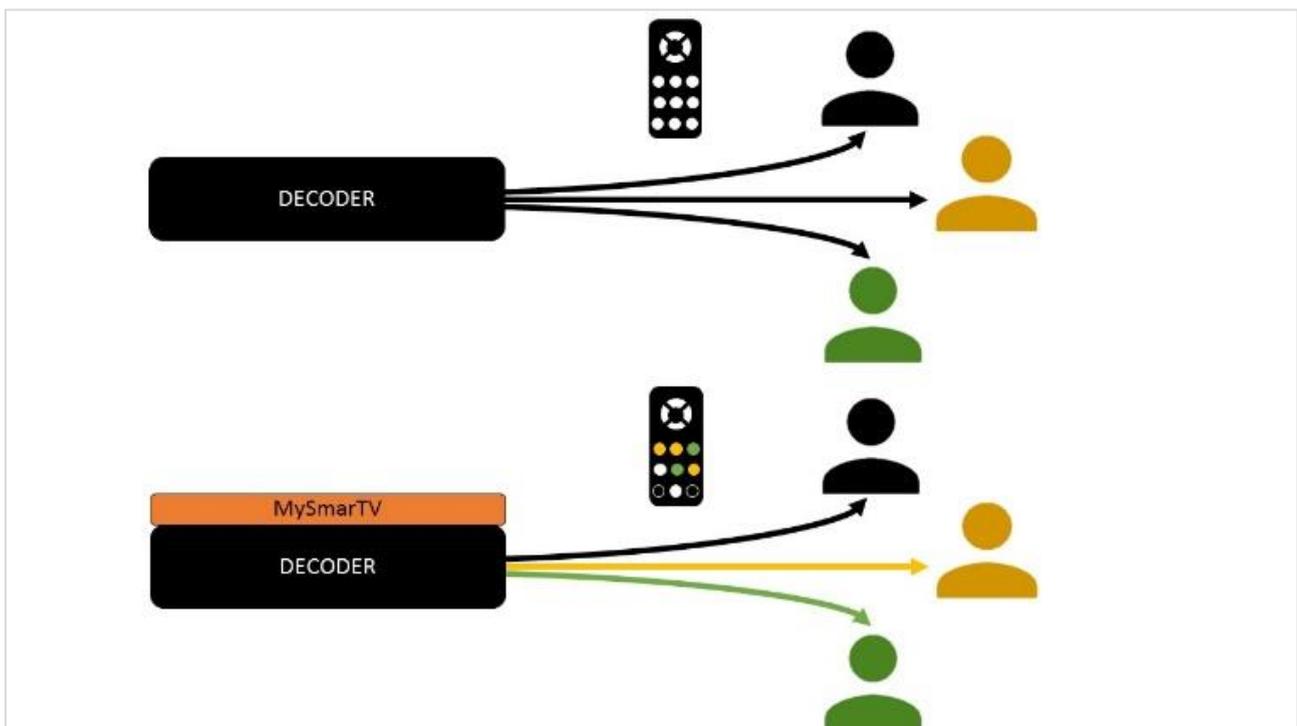
## MYSMARTV\_METHOD FOR THE PERSONALIZED ENJOYMENT OF DIGITAL TRANSMISSIONS, AND RELEVANT SYSTEM

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102013902165928 (ex RM2013A000343) of the 17.06.2013

### Abstract

MySmarTv consists of a method for the personalized enjoyment of digital transmissions, and relevant system. The invention concerns a method that allows the creation and the continuous updating of personalized lists of preferred channels for different users within the family unit. The invention further concerns the system that implements the method according to the invention.



### Technical Description

MySmarTV is able to semi-automatically rearrange the digital terrestrial channels according to the user's preferences. Preferences are acquired directly by the user and indirectly by analysis data describing the user's behavior as observed by decoder equipped with MySmarTV. User preferences can be manually introduced by the user through a suitable graphical interface, or processed by an algorithm that analyzes the behavior of the user in the background and deduces behavioral rules according to the user's profile. The user profile determines a set of preferences that can be used by the decoder to dynamically rearrange the channels. The device is equipped with 3 macro-features: data collection, profile processing, implementation of profiling rules.

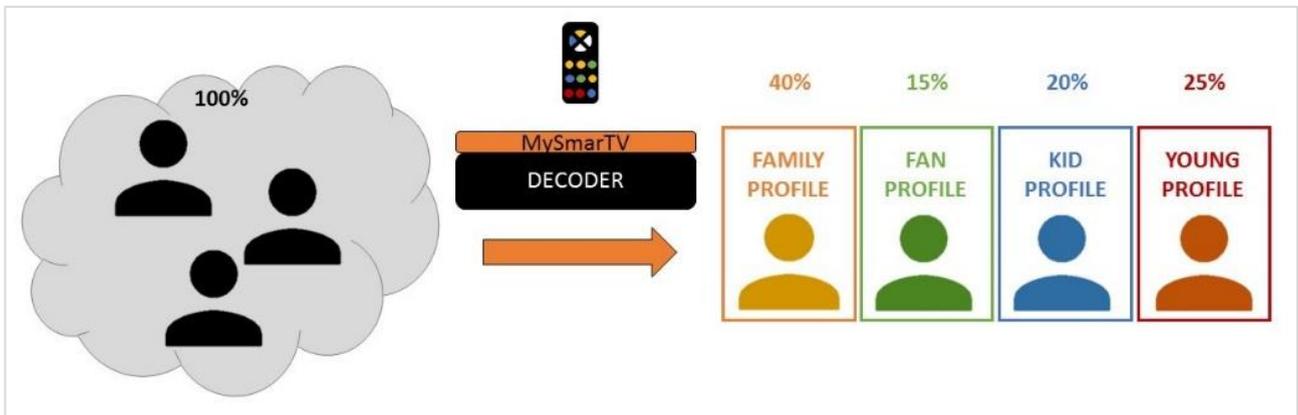
## Technologies & Advantages

MySmarTv is strongly focused on algorithms that can determine user profiling and pattern recognition technologies. Compared to a generic digital receiver for television and/or audio channels, a decoder equipped with MySmarTv can "learn" user preferences based on implicit and transparent user behavior with respect to the decoder. MySmarTv automatically sorts the TV and/or audio channels based on user preferences according to the identified user profile. In this way, MySmarTv can simultaneously solve both the problem of adopting a single national TV channel system (which has been fostering a wide debate between major national and local broadcasters in very recent years) and the problem of every single user to obtain quick access to favorite channels and/or to channels presenting the highest probability of preferences identified by MySmarTv.

## Applications

Business opportunities are identifiable in:

- (i) development of firmware and/or software product providing decoder-enabled features that are in line with existing standards to put end user in position of experiencing a personalized digital terrestrial tv where the 999 channels are not only theoretical and their content obscure or inaccessible;
- (ii) cloud or web services offering personalization of digital television experience through user profiling capabilities, enabling maximum personalization of audiovisual experience with a minimal increase in device cost;
- (iii) providing useful data supporting market analysis with explicit consensus by involved users; we expect that insights about user profiles can represent for service provider an opportunity for additional revenue so to cover the development costs for MySmarTv.



## SMART DESIGN WALL: CONDUCTIVE AND MAGNETIC DEVICE AT LOW VOLTAGE

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102013902216760 (ex RM2013A000683) of the 12.12.2013

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### **Abstract**

The structure of the invention is a system of magnetic and conductive design panels able to produce energy to recharge small appliances without the use of plugs or sockets and without any safety problem, since the low-voltage power (12V). The invention allows the use of any point on the surface of the structure for applying a charger, a light or other source, in fact resolving the problem of having to have outlets in fixed points of a wall and causing a great advantage especially for people with difficulty motor (for example in hospitals, rehabilitation centers, etc.).

The invention therefore provides a technical device capable of improving the usability of inhabited spaces in domestic and working key, making it easy recharging of the portable electronic devices and, more generally, the power supply of devices or complements of low voltage furniture.



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### **Technical Description**

The structure of the wall is a system of magnetic and conductive panels able to produce energy to charge and hold small devices equipped with magnetic plugs on the entire surface. The wall has a programmable power control system of the panels sequential). In the panels the magnetic induction tools, sheet of steel with pattern engraved and spiral magnetic element, generate the magnetic field of the interaction surface, that can be covered in fabric. These panels, customizable with various textures and drawings, can be self-supporting or surfaces that apply on the walls or floors.

The invention therefore provides a technical device capable of improving the usability of inhabited spaces in domestic and working key, making it easy recharging of the portable electronic devices and, more generally, the power supply of devices or complements of low voltage furniture.

### **Technologies & Advantages**

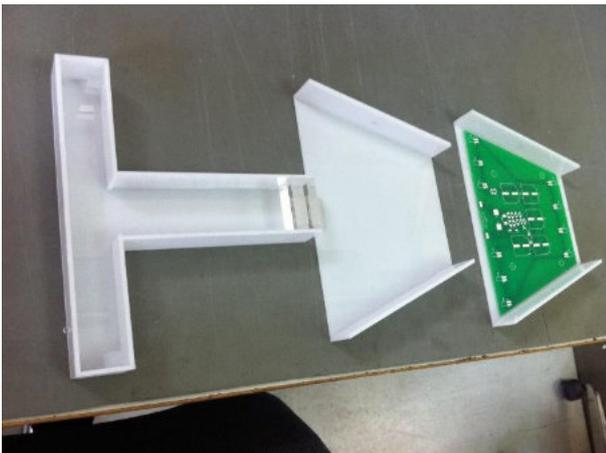
The invention relates to a conductive system and magnetic low voltage with which to recharge small electrical household by contact. Intelligent wall can also accommodate specific lighting fixtures –furniture and promote the same design Made in Italy.

The patent strengths are also: a) possibility to have, thanks to electromagnetic induction, lamps and electrical devices on vertical and horizontal surfaces without the use of sockets, plugs and unsightly wires and source of risks for the user; b) usability of the on / off system, intuitive and inductive; c) ability to recharge at any point of the surface, electrical appliances and electrical devices of reduced dimensions provided by magnetized power supplies; d) energy savings induced by the use of Power LED light, placement of lamps and accessories according to actual user needs, generalized low consumption provided by magnetic induction technology compared to other wireless technologies; e) development of a wide range of lamps, wall lamps and other small appliances to be connected to the wall which, in addition to charge, serves as a continuous feed systems (smart house).

### ***Applications***

The present invention pertains to the field of power systems by means of magnetic induction, and also pertains to the fields of design and functional furniture. The system is activated through a coplanar electricity circuit low voltage (12v), otherwise the system is passive and completely safe.

The fields of application range is from the smart house to the application in a dedicated homecare system and services and also in hospital environments, such as rehabilitation centers, where persist motor difficulties (ex. realization of technical furniture that facilitate and increase the actions and abilities of patients and operators).



## MULTI-PERFORMANCE HYSTERETIC RHEOLOGICAL DEVICE

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102015902332343 (ex RM2015A000075) of the 20.02.2015

### Abstract

The invention deals with a multi-purpose mechanical device capable of providing restoring forces with adjustable nonlinear hysteretic properties. The device can be used in many different forms including: vibration damper, hysteretic isolator, energy absorber, shock absorber, applications requiring a rheological device with custom-designed hysteretic force-displacement characteristics. The device can be employed in civil structures for vibration reduction (earthquake, wind, sea waves), while in mechanical engineering for isolation or shock absorption in machineries.

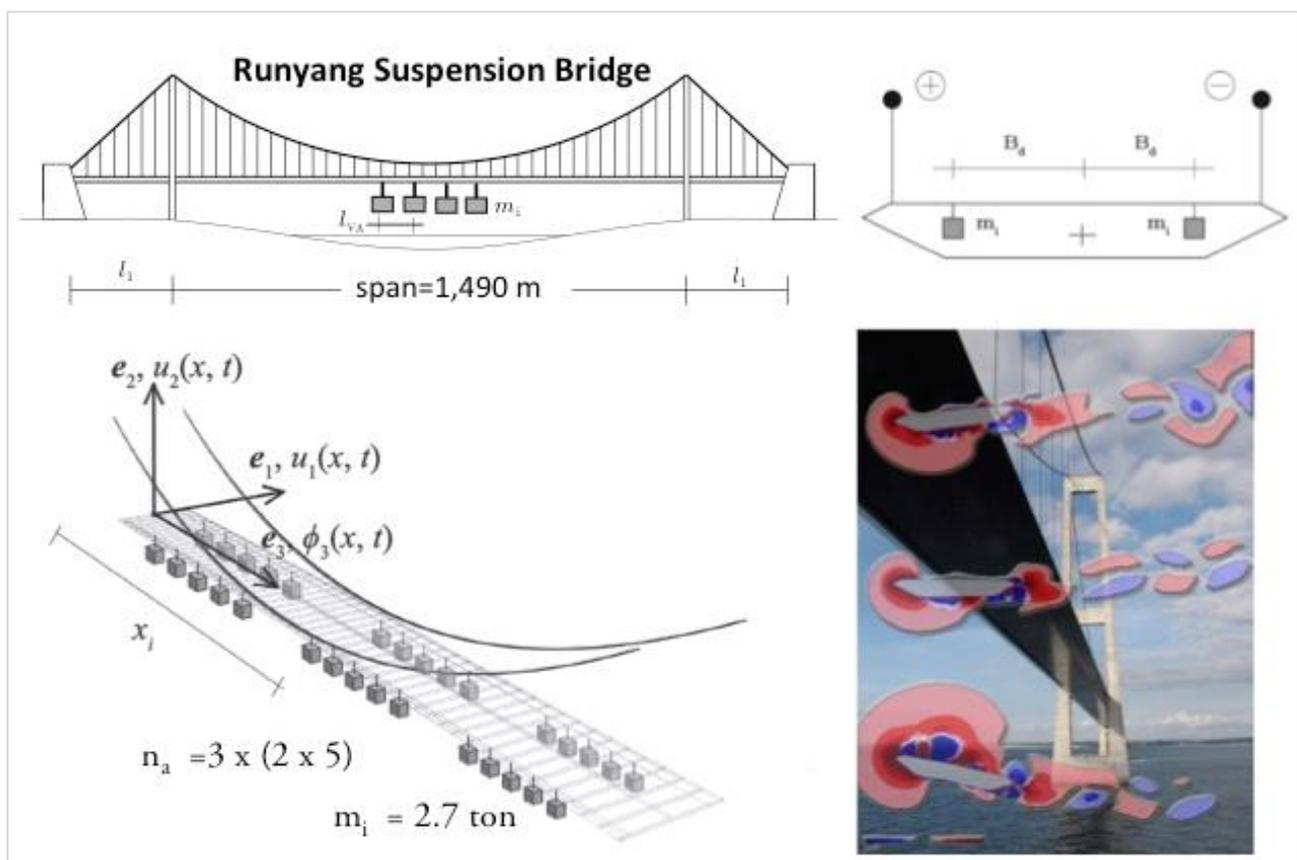


Fig. 1 Flutter control architecture for a suspension bridge: two arrays of TMDs are positioned on the sides of the deck to control both bending and torsion.

### Technical Description

The invention deals with a mechanical device capable of providing nonlinear restoring forces characterized by hysteresis loops whose shapes can be adjusted. The forces are provided by strands of wires made of steel and shape memory alloys subject to flexural or tensile/flexural loads. The possibility of optimizing the hysteresis shape according to the application targets makes the device versatile and capable of high performance. The restoring forces which can also dissipate energy can be applied to an oscillating mass obtaining a damper or introduced in the base of a structure to

achieve isolation from the base excitation. In addition, the hysteretic force can act as a localized damper of kinetic energy for vibration mitigation of different structures.

### Technologies & Advantages

The proposed device can be employed for various applications which exploit the restoring force of an assembly of several ropes and wires made of different materials. The main advantage of the device is the capability of adjusting the shape of the hysteretic cycles according to the application targets. The damping and stiffness trends can be suitably designed as function of the displacement along the loading and unloading branches. In this way, the loss of performance in reducing vibrations of structures whose dynamical features depend on the amplitude of the displacements they undergo. The version of the device based on steel wire ropes is designed for civil applications where the large scale of the system does not result in high costs due to the low-cost materials. The version which employs shape memory alloy wire ropes is designed for customized applications where the size of the system is relatively small and the required precision is higher. The proposed device exhibits higher performance than existing devices since it is more robust and, more importantly, it is cheaper.

### Applications

The device can be used for various applications such as vibration damper, energy dissipator, adaptive structural element, actuator, rheological element capable of providing hysteretic restoring forces according to design specifications that require nonlinear stiffness and damping. The planar and spherical configurations can be employed as tuned mass damper to be integrated in buildings floors, in skyscrapers, in towers (including off-shore wind turbines), in monumental buildings, to reduce the seismic hazard, to mitigate the oscillations due to wind or to increase the fatigue life of off-shore structures reducing the level of stress due to sea wave motions. In mechanical engineering, the device can be used as a vibration isolator of machines or mechanical parts.

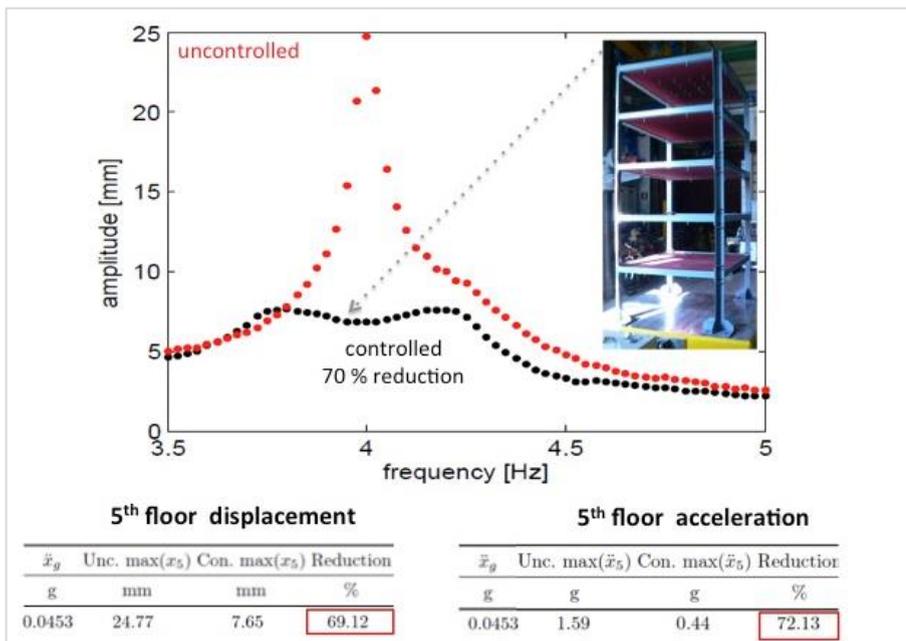


Fig. 2 Frequency responses of the uncontrolled (red dots) and controlled structure (black dots). The sway motion amplitude of the fifth floor versus frequency is reported for a multistory building. Reductions of the order of 70% are achieved both for the sway motion and acceleration.

## METHOD AND KIT FOR THE MICROINVASIVE SAMPLING OF ARTICLES

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102015000042409 of the 05.08.2015

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### **Abstract**

The invention relates to a kit containing the necessary for carrying out a micro-sampling protocol with rigid gel portions (gellan) associated with analytical techniques such as surface-amplified Raman spectroscopy or mass spectrometry. The kit contains components that allow multiple samplings to be performed quickly and easily, and keep the gel matrices containing the samples in an orderly and stable manner over time, allowing spectroscopic analysis even after a long period of time.

Sampling is quick, effective, and micro-invasive and provides a protocol with the following phases: a) Micro-sampling of the surface on which the substance to be analyzed is present with an amount of the rigid gel matrix, possibly in the presence of an organic solvent; b) Drying in a sample holder; c) Spectroscopic analysis of the micro-sample(s) obtained.



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### **Technical Description**

The method and kit for micro-invasive sampling of the invention are applied in all fields where micro-sampling of trace substances is required. In particular, substances are organic substances such as colorants, traces of biological materials, explosives, narcotic substances, whose detection can be carried out by analytical techniques suitable for tracing substances.

The uses of the method and kit are in the fields of Diagnostics for Cultural Heritage, in which it is essential to noninvasively sample the article, and the forensic one, in which it is also extremely important to be able to analyse traces of organic or biological substances in a repeatable way, in order not to destroy the article and above all not to alter the scene of the crime.

### **Technologies & Advantages**

The kit of the invention contains the necessary for carrying out a micro-sampling protocol (with a rigid gel matrix) that allows multiple sampling to be carried out in a simple and rapid manner and to preserve the gel matrices containing the samples in an ordered and stable manner over time, allowing spectroscopic analysis even after a long period of time from sampling.

The kit and the use of a rigid gel such as gellan for micro-sampling in the forensic and cultural heritage fields allow to perform a plurality of non-invasive micro-samplings that leave no traces of the material used for sampling and allow the spectroscopic analysis of the sampled material even after long periods of time; the kit as claimed allows in fact such sampling in a simple and quick manner and allows to preserve the gel matrices containing the samples in an ordered and stable manner over time.

## ***Applications***

Microinvasive analysis of articles in the field of cultural goods and forensics.

The gel matrix that is particularly suitable for this type of analysis is gellan. The kit of the invention allows sampling within seconds without altering the article on which the sampling is performed. Just think to the high number of possible samplings in a single inspection that at the same time guarantees excellent specimen storage.

The kit has excellent sterility properties as rigid gel blisters are stored in an inert atmosphere and possibly in monodose packs. Additionally, by providing all ready-to-use materials reduces the number of manual operations with the dual effect of speeding up the picking operations and reducing the risk of contamination.



## TENSAIRITY STRUCTURE WITH SHAPE MEMORY ALLOY WIRE ROPES

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102015000055410 of the 25.09.2015

### Abstract

The invention deals with the structural element known in the technical field as “tensairity” and introduces as new elements with respect to state of the art shape memory alloy wire ropes with superelastic and shape recovery behavior together with a control apparatus thus obtaining an active structure. A highly damped structure capable of sustaining dynamic loads is obtained together with its adaptability of the mechanical properties in real time according to the needs. Potential applications belong to the civil, industrial and aerospace engineering fields: long-span roofs, bridges, aerostats, stratospheric platforms and space habitat.

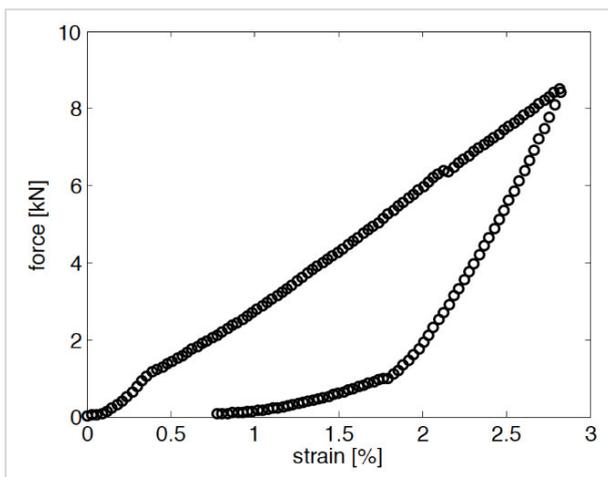


Fig. 1 Axial hysteresis cycle of a mixed steel-alloy rope with form memory.

### Technical Description

The basic component is a cylindrical inflatable element with a slender rod fixed longitudinally along one of its directrices. A couple of shape memory alloy wire ropes with superelastic and/or shape recovery capacities are wrapped around the pneumatic element and connected to the rod ends. A control apparatus makes the structure active adapting in real time its mechanical properties according to the requirements. The apparatus is formed by a CPU, sensors monitoring the kinematic and mechanical conditions of the structure, electrical circuit for regulating the electricity flux in the wire ropes. The latter are controlled exploiting the Joule effect. Starting from this basic configuration more complex structures can be realized.

### Technologies & Advantages

Broadly speaking, tensairity structures can sustain huge loads in spite of their being very lightweight. The proposed tensairity allows its load-bearing use in applications which feature multi-direction dynamic loads. This advantage is given by the additional damping provided by the shape memory wire ropes that make also the structure active. The geometric stiffness of the structure can be varied in real time through a processor connected to a sensors network monitoring the temperature and tension in the wire ropes as well as the oscillations (i.e., accelerations) of the tensairity. According to

the processed information the control apparatus regulates the electrical flux in the wire ropes and the temperature and tension of the wire ropes.

### **Applications**

The proposed tensairity can be employed for long-span roofs subject to dynamical loads (wind gusts) as for example require in buildings of historical, artistic, and monumental interest which are generally subject to structural constraints. For realizing temporary bridges capable of sustaining vehicles which induce dynamic loads. In aerospace applications, the basic tensairity structure can be developed for more complex (variable) geometries for realizing airships which operate as stratospheric platforms. The capacity to sustain dynamic loads combined with their being lightweight makes the invention particularly convenient for manufacturing high performance airships mainly in terms of payload and flight operative time.

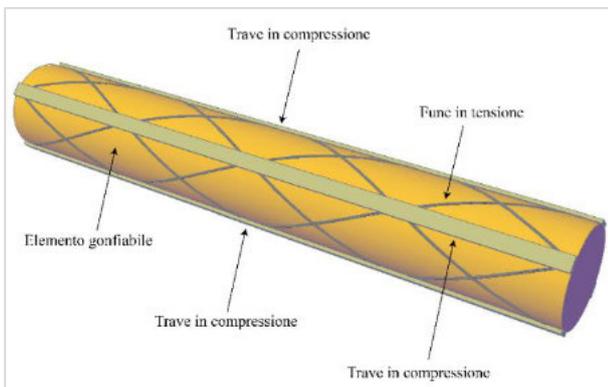


Fig. 2 Tensairity for multidirectional actions.

## ELECTRIC ENERGY GENERATOR

**Ownership** Sapienza University of Rome.

**Priority Number** n. 102017000032837 of the 24.03.2017

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### **Abstract**

The invention defines a micro-electric energy generator that adopts a swirling combustion chamber, catalytic deposition (on the internal walls), a micro turbine and a micro-fuel cell. Non-premixed combustion, of hydrogen/oxygen-air or hydrocarbons/oxygen-air (or a blend of hydrogen and hydrocarbons), occurs inside a combustion chamber that adopts a swirling fluid dynamics in order to increase the relative residence time and then the combustion efficiency. Hot products expand into the turbine, on the relative shaft is joined an electric generator, and finally pass through the microfuel-cell for additional energy production. The catalytic deposition is assumed to simplify, up to completely remove, the common spark ignition system.

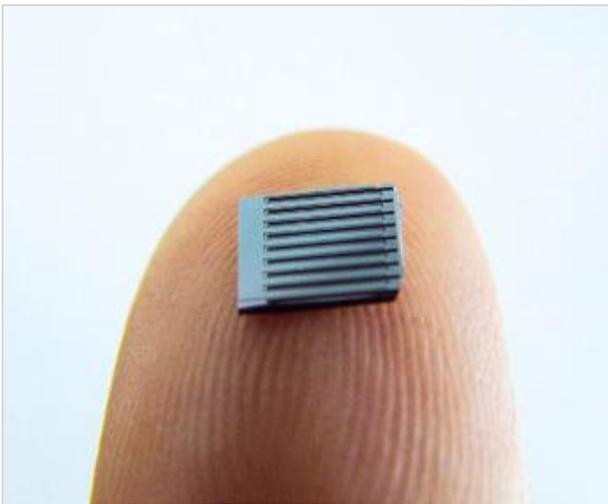


Fig. 1 Micro-fuel cell

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### **Technical Description**

The cylindrical swirling combustion chamber presents injection ducts respectively orthogonal (fuel) and tangential (ox) to the chamber's wall. The outlet duct, orthogonal to the wall, imposes recirculation creating a central zone that works as flame-holder. All that increases the residence time, mixing and then the combustion efficiency permitting high values with devices of few millimetres. Ignition, of hydrogen/oxygen-air or hydrocarbons/oxygen-air (or a blend of hydrogen and hydrocarbons), is supported or occurs by means of catalysis. Hot products expand into the turbine, on the relative shaft is joined an electric generator, and finally pass through the microfuel-cell for additional energy production.

### **Technologies & Advantages**

The invention has its additional values in its small dimensions, high combustion efficiency, scalability (as function of the necessities), easy manufacture, low number of components, possibility to adopt several kind of fuel/ox combinations and its energy-dimensions ratio (much higher than the similar devices). The liquid energy density, orders of magnitude higher than the batteries one, and its intrinsic scalability permit to be adopted for all those applications in which

batteries must be recharged (mobiles, laptops, exoskeletons, batteries for automotive, etc.) and where the energy distribution is limited or absent (isolated homes, military and first aid camps, etc.).

### Applications

- Applications for which would be an asset extending the operability of systems usually working with batteries (i.e. automotive range extenders, unmanned aerial vehicles, unmanned ground vehicles, mobile phones, laptops, exoskeleton, etc.);
- Conditions for which the energy distribution is absent or limited (i.e. isolated homes, military and/or first aid camps, campers, etc.).

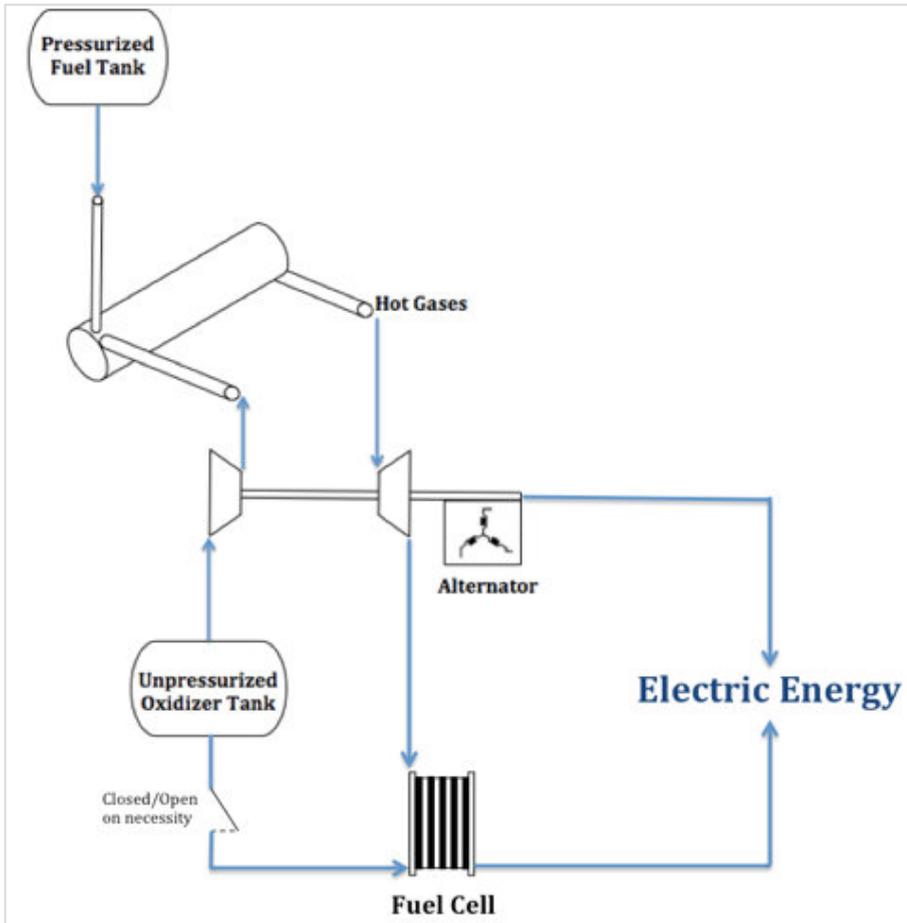


Fig. 2 Overall system