



Energy reuse of mechanical vibrations in helicopters

Reutilización energética de las vibraciones mecánicas en helicópteros

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Abstract: In this article, shown that the world of new energies is every day invite to move forward and furrow a new world, this is evidenced at the moment when there is a significant reduction in the use of fossil fuels to generate the movement of something as common as a car, which has a significant change from petroleum-derived fuels to purely electric cars. With science and technology working together, on many occasions they are directly responsible for putting situations that seem out of fiction into our daily lives.

At present the advances of science and technology, it has been possible to work with a large number of new tools, thanks

this, where found today a new field of study, known as nanoscience, and this due to the world where he found his field of action, is the world of the small science.

Thanks to these advances, it has been possible to find a route by way of smartphones can have hundreds of functionalities, such as the ability to maintain their charge for a longer time, or the fact that through small carbon tubes it is possible to increase the hardness and strength of the materials.

For our daily life, vibrations are a way of seeing how external forces act on a device.

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This type of oscillatory movement is responsible for accompanying at all times the passing of people, either from the moment they get up by the sound of their mobile devices, until the moment the engine vehicle is turned on to return to home.

These vibrations are the ones that will be reused for the execution of this prototype, in which, through the movement generated by the same helicopter for this operation, the electric current will be generated by deformation in a piezoelectric element.

Keywords: Vibrations, Energy, Reuse, Helicopters.

Resumen: Este artículo resalta el avance hacia un nuevo paradigma en el mundo de las energías, donde se observa una marcada reducción en el uso de combustibles fósiles en favor de alternativas más sostenibles. Se destaca especialmente el cambio en la industria automotriz hacia vehículos eléctricos, evidenciando el poder de la ciencia y la tecnología al introducir innovaciones que antes parecían ser parte de la ficción en la vida cotidiana.

En la actualidad, los avances en ciencia y tecnología, ha posibilitado el desarrollo de numerosas herramientas, lo que ha dado lugar a un nuevo campo de estudio, conocido como nanociencia, Este campo se

centra en el mundo de lo diminuto, explorando fenómenos y aplicaciones en una escala nanométrica.

Gracias a estos avances, se ha podido encontrar una vía para dotar a los teléfonos inteligentes de numerosas funcionalidades, como la capacidad de prolongar la duración de la carga de la batería o aumentar la resistencia y dureza de los materiales mediante pequeños tubos de carbono.

En nuestra vida cotidiana, las vibraciones son una forma de ver cómo actúan las fuerzas externas sobre un dispositivo. Este tipo de movimiento oscilatorio es el encargado de acompañar en todo momento el paso de las personas, ya sea desde que se levantan por el sonido de sus dispositivos móviles, hasta el momento en que se enciende el motor del vehículo para volver a casa.

Estas vibraciones son las que se reutilizarán para la ejecución de este prototipo, mediante el movimiento generado por el mismo helicóptero para esta operación, se generará la corriente eléctrica por deformación en un elemento piezoeléctrico.

Palabras clave: Vibraciones, Energía, Reutilización, Helicópteros.

1. Introduction

The man, in the course of his history around the world, has sought through his effort natural sources and in them the generation of energy; Among these sources are renewable energies [1]. These renewable energies are those that are produced continuously and are inexhaustible. Energy is a fundamental concept of physics, defined as the ability of bodies to perform work, which is manifested by a change or transfer of it that is work is a measure of energy transfer [2].

Today, renewable energies (ER) are contributing about 21.5% in world energy consumption, where by 2030 this percentage is expected to have increased and given 25.9% or more [3].

Within the typology of renewable energies is wind energy, which can convert the kinetic energy of wind into mechanical and electrical energy [3]. This is made it by wind currents of approximately greater than 4 m/s which, when hitting on blades, cause the movement of the mechanism, this generating a current of approximately 200 KW [4].

In these devices for generating electric current using wind currents, the blades can be two or three on an axis, being according to studies more feasible of three; This is

because they are quieter, have a higher starting torque, and greater stability in their rotation [5].

In countries such as France and Russia a relatively new type of energy has been implemented, which by means of the use of mechanisms strategically located in bays with close communications to the sea and where with the help of a closing device you can take the water that It is located in a reservoir and thanks to its movements of both ascent and descent, it causes hydraulic turbines that are in the closure to begin to move, thus generating electrical energy [6].

For our current situation around the world renewable energies have been making a great contribution, such as geothermal energy, which has allowed the saving of 206.5 million barrels of oil per year [3].

Geothermal energy is produced approximately at depths between 5 and 10 km from the earth's surface in this type of energy the heat that exists in the earth's crust is used and that is generated by magma. Magma tends to accumulate and heat everything around it, all this without ever touching the surface creating a geothermal system. At the moment in which the fluid leaves under pressure and at high temperatures the movement of generators is attain, for the creation of energy [3].

On the other hand, it is observed that there are in nature or in machines, movements that can help in the creation of a new type of energy, which is currently being wasted a clear example of this is the case of vibrations.

2. Nanotechnology

What it means and where it comes from:

Richard Phillips Feynman, in the year of 1959, made a talk entitled "There is enough space in the background" where he talked about that there is no physical law that says about the impossibility of creating elements in small dimensions but have the possibility of having the information of the 24 volumes of the British encyclopedia [9].

The term nano has its etymological origin in the latin word nanus, which when translating in our language means something small or dwarf, this in the international system of measures has to be equal to a prefix whose factor is 10^{-9} [7]. In nanoscience, objects that are in these dimensions have different properties from those of their "older brothers", that is, they are objects that can have different electrical magnetic properties, or simply in a change in their color [7].

The term nanotechnologies have brought with it some interpretations; of which many are wrong or do not adhere to the true meaning of their prefix. When talking about nanotechnologies, we are dealing with how materials, structures, devices, and functional systems are manufactured, through the control and assembly of matter at the nanometer level, that is, with a measurement between 0.1 at 100 nanometers, which is comparatively below the cell [8].

At the moment we talk about technology, we refer in the form of how the basic concepts that have been created in a research laboratory will be used, that is, we will apply the science that was created through inquiry and studies on some idea, and is going to translate into a functional device, in this case at about nano dimensions [8].

2.1. Application of nanotechnology

At present, many of these advances at the nano-level have had a great impact not only at the height of technology but also that its repercussions have also touched on areas such as construction. An example of the advances in construction is the Linakret company located in Mexico, which entered this industry with nano-Bots; these employing semiconductors which, when added to cement or hydraulic concrete,

allow them to come into contact with sunlight by generating a chemical reaction reducing the level of contamination [11].

Some of these small advances are also reflected in small and everyday situations, such as the fact that due to water vapor a surface such as glass becomes opaque due to fogging, being very recurrent in days where Rain predominates and hinders the simple driving action.

These problems are eliminated through the use of resistors, which are not viable enough because of their low performance and because they do not end up fully fulfilling their function. This problem will be eliminated through the use of a transparent lacquer with carbon nanotubes, which using a potential difference that, when applied to the glass, will eliminate the traces of condensation in a homogeneous way and without risk of damage [10].

Currently, smartphones head the list of equipment with the best technology of the decade, this arises under the need to create devices of smaller sizes and with a larger load capacity [12], where it can be provided power to each of the tools that the phone has and it is able to remain on regardless of what is being used, how much and when it is being used.

Although advances have been more focused on consumption, the fact of situations such as ensuring the well-being and good preservation of health in people cannot be ignored, and inventions such as bone substitutes have been commissioned, which despite having several drawbacks and needing factors such as good biocompatibility, rapid bone formation, and optimal biomechanical properties, have emerged from anonymity [10].

This has been due to very promising inventions such as hydroxyapatite, this is because it is the compound most similar to the natural component of bone. Hydroxyapatite is composed of components such as calcium and phosphate, although the main elements for regeneration, and if they are present in natural hydroxyapatite are sodium, chlorine, magnesium and carbonates that, despite not being present in the synthetic hydroxyapatite, thanks to the union with the plasma of the same patient can have excellent bone regeneration properties [12].

2.2 Vibrations

What they mean and where they come from:

For the history of man, the study of vibrations begins in the least expected way, this topic of analysis arises through the

study of the first musical instruments, on which it was to find laws that govern the reproduction of sound and methods that will improve somehow the music emitted by the instruments that were being used for the moment [19].

Now, today it has gone a little beyond the musical instruments, and it has been found that in all our surroundings we always have the vibrations present, that are touching the senses like the ear with the movements of the eardrum, which we allow you to capture the different frequencies of sounds that accompany us. And they reach a force in the machines, which makes structures with moving parts that are subject to variable actions begin to vibrate with different frequencies and amplitudes [13].

Already for this moment, it is necessary to take into account that the cause of vibration is generated is through an excitation force, which can be exerted from the external part of the object of study or in its defect inside the device. The vibratory movement that can be perceived in a body is described as a combination of individual movements that are of 6 different types [14].

An example of this situation can be a helicopter that can be moved in a way:

- Forward-backward.
- Bottom-up.

- From left to right.
- Roll around the vertical axis.

3. Uses and some effects

Thanks to the evolution in the way man is transported, we have that at the time the first engines and turbines were created, they arose inherently in these propulsion devices, thanks to design errors and imbalances, vibration problems, which are responsible for causing damage to the structure, this due to cyclical variations due to the induced stress.

In the machines, it has been verified that the vibrations can generate problems such as:

- Wear on machine parts in a shorter time than estimated
- Generates a noise that becomes excessive and may cause damage to personnel operating the machine.
- Cause that hardware elements end up losing their initial support, being a possible cause in the failure or detachment of some component of the machine.

As it was already said, the vibrations are born from an external force that is applied on a body, at the moment when the frequency that comes from the outside and

the natural frequency of the body enter into equal conditions, a phenomenon called resonance occurs, where as a starting point is the birth of all deformations and deflections that can lead to failures or excessive deflections in the device, and thereby cause damage to the machine.

On this subject, we have that the main characteristic of resonance, and for which it deserves its denomination of evil on machines, is that it is the cause of large displacements, which for a machine is synonymous with large deformations and efforts. The latter are the direct causes that after a while the machine begins to fail in some of its systems, or given the situation in all.

To avoid this type of situation in the machines that go out to play an important role in our environment, such as the means of transport, these situations can be corrected, by changes in the mass or failing in the rigidity of the material with which the system is being developed. However, these changes because these two parameters are main for the natural frequency of the system in which we are working. Although in many cases situations are created in which the mass generates restrictions at the moment in which it is desired to change since it is had as reinforcement for functional requirements of the system.

It is difficult to avoid resonance in the machines, and more so in certain working conditions, but another option to avoid this type of situation without touching properties of the material with which we are working, is that the machine is used of damping elements, which are responsible for limiting the amplitude of the vibration on the device and thus reducing the undesirable effects that are caused by the vibration on the device. For this it is very common to find high performance structural materials, such as cast iron or laminated materials.

4. Nanogenerators

What does it mean and where does it come from?

For the year of 1880 the brothers Jaques and Pierre Curie, were responsible for finding a rather peculiar property in a sheet of glass.

Mr. Curie used a sheet of quartz crystal, which he was being subjected to in experiments on a new instrument of these brothers. The experiment was intended to ionize the air and the current that was being lost was being replaced by the direct effect of the piezoelectric [15]. There they found that, by a mechanical deformation in a

glass sheet, electric current can be generated, that is, using a force applied on the glass it is possible to create a potential differential where current is passed, which is known as the effect direct piezoelectric [16].

The piezoelectric phenomenon we are dealing with is mainly due to the orientation of its atoms in space and to the geometry that molecules have in the structure. For example, in quartz crystals, which are composed in their main structure by silicon and oxygen atoms, where the latter are under negative charge and the first ones with positive charge, are distributed evenly throughout the crystal, generating that the charges are in a state of equilibrium.

On the contrary, at the moment when some effort is applied to the piezoelectric, it is generated that this uniformity in its structure is broken, thus causing differences in its lengths to be generated,

resulting in the charges that each atom has move, creating in this way a movement in the electrons, bringing with it that an electric current is generated, which is what you want to obtain to put into operation some component.

At the moment in which a deformation is generated to the crystal, this can be through a compression or tensile effort in some two points of the piezoelectric, these alterations that are caused to it on the surface cause slight changes to occur as it is originally organized the crystal. These changes that we are talking about are evidenced in terms of the flow of electrons that go to one or the other end, giving rise to a negative current being generated on one side, while the other has a current positive.

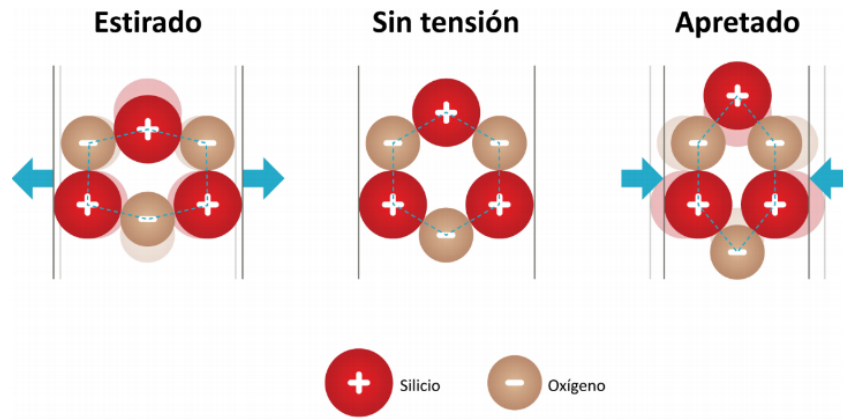
3.1 Piezoelectric types according to their material.

For the piezoelectric, as progress has been made in its technology, progress has also

Figure 1. Piezoelectric effect schematically.



Source: <https://www.ceramtec.es/materiales-ceramicos/piezoceramica/basicos/>

Figure 2. Quartz molecule under stress and at rest

Source: https://www.nisenet.org/sites/default/files/catalog/uploads/spanish/12194/electricsqueeze_images_13nov13_sp.pdf

been made in terms of materials for its manufacture, this because they can now be created in laboratories, through the use of ceramics, minerals and some polymers in These types of features are presented.

When we talk about composite materials, we need to know that these types of materials are made up of two or more parts, which have a discrete and recognizable interface that separates them. These materials are born under the need to have in some single material properties that usually does not have a single element in nature [17]. At present these elements made by the hand of man are the most innovative because it gives polymers the ability to be piezoelectric materials, since they are allowed in a single material to present both polymeric and ceramic properties.

Now, it is intended to use hand in hand the advantages that the creation of nanoscience has brought, through the joint use of piezoelectric and the good use of vibrations to create an energy source, which will be possible for Stay alone.

However, at the moment in which an aircraft is in operation, it has been possible to register vibrations that go from 12 to 28 HZ [18].

Through the differential vibration equation, we can find the different parameters under which our mechanism will function.

$$x(t) = \sqrt{x_0^2 + \frac{v_0^2}{w^2}} \left[\sin \left(\sqrt{\frac{k}{m}} t + \phi \right) \right]$$

of this we have to:

x_0 = distance to the equilibrium position.

\emptyset = phase angle.

m = mass.

k = Spring constant.

w = Natural frequency.

v_0 = initial speed.

5. Conclusions

Understand where the different physical and aerodynamic phenomena that occur in the daily operation of an aircraft come from, and through the channeling of these phenomena, transform them into useful devices that benefit the operation of some others.

Through the present work, it was possible to understand that, in an aircraft through its vibrations, and the implementation of technology that is at hand, different types of knowledge can be implemented, which allow the advancement in the technology that is present within of aircraft.

Through this study, it was possible to see beyond conventional technologies, seeking in this way to make innovations in technology and to transform the devices that are currently being used in the FAC by providing for the implementation of new materials and unconventional forms. of the

studies that have been carried out, encouraging research and implementation of new ideas.

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