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WIRELESS ELECTRICITY: AN INNOVATIVE IDEA

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ABSTRACT

Wardenclyffe Tower was an early experimental wireless transmission station that Nikola Tesla developed and constructed on Long Island in the years 1901–1902 in the community of Shoreham, New York. Wireless power transfer (WPT) has caught the attention of researchers from different fields because it has the potential to bring advanced technology to our everyday lives. This research examines the various wireless energy transmission approaches since wireless power transmission incorporates numerous theories and is explicated by numerous techniques. Because of the technology's ability to send electrical energy across an air gap without utilizing wires to connect them, a power source can now transmit electrical energy to an electrical load., it will soon be required to employ wireless power transmission. We conduct pilot research in this paper to describe the current wireless power transmission technologies, their latest technology, and their anticipated future developments. We also go into great detail about other wireless transmission applications.

KEYWORDS: *Wireless Electricity Transmission, Electromagnetic radiations, Inductive coupling, Internet of things (IoT), Electromagnetic radiations, Laser Transmission.*

1. INTRODUCTION

Wireless electricity transmission is the exchange of electrical vitality without the utilize of wires from an electrical load to a power supply. Today, the mobile, industrial, and medical sectors all make extensive use of the transfer of power wirelessly. The use of batteries and wires can be done away with thanks to advancements in wireless power transfer technologies. As a result, it is very practical and secure for all users. There are numerous ways to transmit wireless power, but the most widely used ones are inductive coupling and the more contemporary resonant coupling. The design and development of hardware for wireless power transfer is the subject of this article. A wireless power system is made up of two parts: a coil that sends out power called the primary coil, and a coil that receives the power called the secondary coil. The primary coil receives an alternating current**.** Cords are needed to supply electricity to the distribution lines. Power gearbox has a number of issues, one of which is that energy is lost amid the transmission and conveyance of electrical control as a result of the conductors and equipment utilized for transmission. Power generation and power loss both increase along with the daily rise in demand. Additionally, the price of producing electricity is bad for the environment. Therefore, lowering gearbox loss is essential since the power saved can be utilized in another way to cut costs. Even though power loss throughout the gearbox process is inevitable, there are several solutions that may be taken to lessen this issue.

This research has the following organizational structure. After an introduction, Section II covers Tesla's inception of wireless electricity. Section III reviews wireless power transfer. Section IV demonstrates

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how the concept operates. In Section V, a few advantages are presented. While some power transmission applications are covered in Section -VI. In Section VII, conclusions are offered.

2. TESLA'S INCEPTION OF WIRELESS ELECTRICITY

Tesla invested his profits from the engenderment of alternating current in his other innovations, and his work culminated in a significant development in Colorado Springs in 1899 when he claimed to have wirelessly transferred 100 million volts of high-frequency electric power over a distance of 26 miles, enabling him to operate one electric motor and a bank of 200 light bulbs. Tesla asserted that just 5% of the transmitted energy was wasted when using this Tesla coil. However, he ran out of money once more and sought out investors to support his plan to transmit electric power in virtually endless quantities to any location on the planet. He planned to generate this wireless power by using the earth's natural resonance.

3. WIRELESS POWER TRANSFER

A transmitter is necessary for all wireless power transfer systems in order to convey signals, a medium and a signal-receiving device, or receiver. Power can go large distances and short distances. There are techniques for short-range and long-range transmission.

I. **Electromagnetic radiation:** Using radioactive EM waves, energy can be transferred from a power source transmission antenna to a receiving antenna. This process is known as EM radiation.
II. **Inductive coupling**: Using electromagnetic induction to transmit power.
III. **Magnetic Resonant Coupling**: To transfer power across coils by resonance-based induction. There are two suggested approaches for long-distance transmission.
IV. **Microwave transmission**: Power transfer over vast distances using shorter wavelengths is known as microwave transmission.
V. **Laser transmission**: In order to transmit energy, electricity is converted into a laser beam and then pointed towards a solar cell.

Long or even short distances can be covered cordlessly via inductive power transfer, also known as wireless power transmission. Compared to earlier technologies, this one offers efficiency, speed, and reduced maintenance costs. Additionally, it enables the self-charging of portable electronics that have never been plugged into a standard power outlet. In contrast, this method suffers from much less power loss than cable electrical transmission. Eliminating the restrictions of a power cord and enabling continuous charging of electrical devices are the main goals of wireless power transfer. For WPT, the three main systems include microwaves, resonance, and solar cells. The first WPT tests were carried out by Nikola Tesla, the inventor of AC power. His theory was predicated on the belief that the earth is a conductor capable of moving a charge across its whole surface. Tesla's experiments did not actually create electricity; rather, they only transmitted it. Nevertheless, his theories can still be connected to illuminate our current vitality emergency. Although every single application has drawbacks of its own, they all have the potential to assist the earth in meeting its diminishing demand for a power generation alternative.

Portable technology is now commonplace in daily life. However, another issue that arises from portability is energy. Since nearly all portable electronics are battery-powered, they will soon all require recharging with the wired chargers currently in use.

Even though wireless power transfer is beneficial and practical in day-to-day life, it has some drawbacks, such as interference with other electronic devices and the requirement for a network of hundreds of satellites. Around 26% of power is lost during transmission and distribution.

Wires and the grid cause losses, thus in order to lower this loss percentage, we are adopting wireless transmission with the aid of several widely used techniques, such as wireless electricity transmission.

3.1. Electromagnetic Radiation

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The process of transferring energy from a power source's transmission antenna to a receiving antenna by means of radioactive electromagnetic waves is known as emission via EM radiation. In terms of the direction in which energy is emitted, omnidirectional radiation and unidirectional radiation are the two categories. A transmitter broadcasts electromagnetic waves in a certain ISM band, such as 850-950 MHz or 902-928 MHz, by employing omnidirectional radiation in the United States, depending on the region. With a 915 MHz center frequency, these two bands are identical. To gather radio power, a receiver, such as an RFID tag, tunes to the same frequency band. Omnidirectional radiation has a serious issue with energy transfer efficiency even though it facilitates and suits information communication.

3.2. Inductive Coupling

Inductive coupling is widely understood as two LC circuits with the same resonance frequency being coupled. To deliver an illustration, substituting current in an essential coil connected to a source can make a changing attractive field that causes a voltage to be actuated over the terminals of an auxiliary coil at the recipient.

It works by using the natural flow of electric current through a wire to create a magnetic field. The primary and secondary coils are two separate coils that are used for inductive coupling. Inductive coupling is currently a very important and popular method for transferring energy wirelessly because of its simplicity, convenience, and safety. These gadgets are all wirelessly linked. This technological development has enabled a wide range of electrical devices.

3.3. Coupling of Magnetic Resonance

The last and most important WPT technology subset within the category of near-field techniques is mentioned in Figure 3.1 Magnetic resonant coupling. This strategy, created by Kurs et al, combines inductive coupling with resonance and enables very strong interactions between two independent elements. Energy will also be exchanged between the magnetic field encompassing the coil and the electric field encompassing the capacitor. In that a string tuned to a specific pitch can be forced to vibrate by a distant sound generator if their resonance frequencies coincide, magnetic resonance works similarly to classical mechanical resonance. This technique allows for the effective transmission of energy from a source coil.

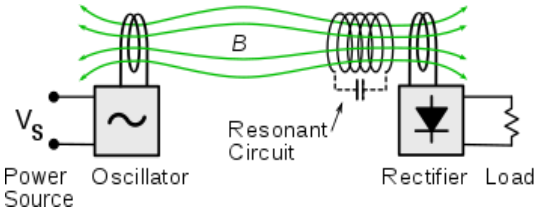

Fig 3.1 Magnetic Resonant Coupling

3.4. Microwave Transmission

This strategy exchanges solid control from the base station to the getting station or portable gadgets with two places within the line of locate. By utilizing the magnetron and geosynchronous getting and transmitting satellites, this method empowers the objects to receive electricity from the base station. MPT enables effective energy conversion, however, it can be difficult to focus the beam in a small space. This innovation may too effortlessly travel through the environment. Within the beginning organize of control transmission, electrical energy is converted into microwave energy, which is then captured using a rectenna. Alternating Current (AC) cannot be transformed into microwave energy directly with this technique.

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3.5. Laser Transmission

Applications for low-power commercial and consumer electronics will be developed using the laser "power beaming" technology, which has mostly been researched for military weaponry and space applications. Consumer space wireless energy transmission systems using lasers must adhere to laser safety regulations. Higher energy densities, a tighter beam focus, and smaller emission and receiver diameters are all made possible by laser energy transmission. Mass of the laser generation system and the needed laser generation temperature.

4. WORKING

According to Figure 4.1 Wireless Power Transmission System (WPT), two coils are needed for the technology: a sender and a recipient. A magnetic field is produced by the transmitter coil when it receives an alternating current. The receiver coil then experiences a voltage as a result, which can be utilized to power a battery or power a portable device.
To further clarify, whenever you run an electrical current via a wire, a magnetic field forms in a circle around the wire as a natural phenomenon. And the magnetic field of that wire gets stronger if you coil it or loop it. Inductive coupling occurs when a second wire coil, which does not have an electrical current flowing through it, is placed within the magnetic field of a first coil. This causes the electric current from the first coil to pass through the magnetic field and begin flowing through the second coil.

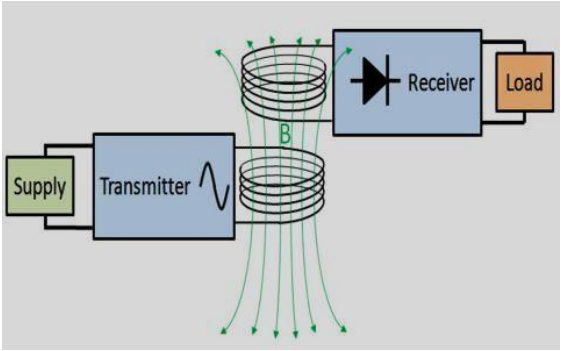

Fig. 4.1: WPT System

Figure 4.2 Wireless Electricity Block Diagram shows a High frequency-Transformer, HF diode, rectifier, essential transistor, two air-filled inductor coils, voltage controller, and BLDC fan are among the hardware components needed for wireless power transfer.

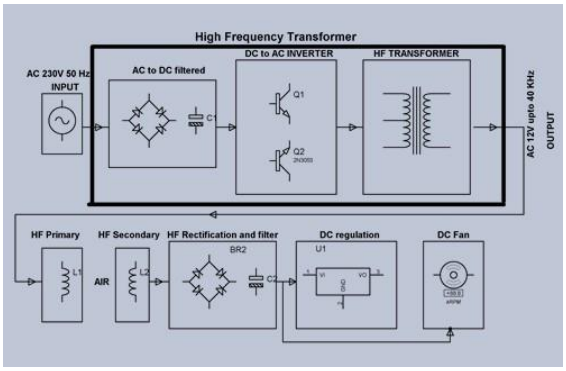

Fig. 4.2: Wireless Electricity Block Diagram

A special sort of tele-energy that transmits energy as long-distance electromagnetic waves between two points using a wireless network of antennas and rectennas (rectifying antennas). Initially, electricity is

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sent through antennas as a non-ionizing beam with a frequency similar to radio waves. Low-power laser safety curtains ensure sure the transmission beam stops right away before any stray objects (like a bird or a helicopter) can get to the main beam, ensuring that it never touches anything other than pure air. At a fraction of the infrastructure requirements, maintenance costs, and environmental effect a wired solution implies, it has the ability to transport power thousands of km away. It functions in all weather, including rain, fog, and dust. The line of sight between each relay is the single factor that limits the transmission distance.

5. ADVANTAGES

The concept of wireless electricity has many advantages over the current wire transmission system.

I. No more cables: Eliminating the maze of cables that keep gadgets tethered to an electrical outlet is the most transparent and immediate benefit of wireless power transfer.
II. Economic: If electricians didn't have to wire the entire building, the infrastructure for buildings would be less expensive. The cost of distributing power would be lower since there would be less need for system maintenance.
III. Electricity could be available in more places: It is difficult to imagine, yet there still exist a lot of regions on Earth without easy access to electrical energy. Some constructions have extremely difficult access to power because of a lack of infrastructure, environmental issues, or a combination of the two. Millions of people throughout the world would have access to electricity if energy could be transported via the air.
IV. EVs could be charged while driving: Regardless of reservations, as worries about climate change and rising petrol prices have grown, demand for electric automobiles has gradually grown in recent years. Electric vehicles might charge while being driven if wireless power transfer were feasible.
V. Less toxic wastes.
VI. Eliminates wiring connections and mechanical connectors to prevent corrosion and sparking.

6. APPLICATIONS

I. Moving targets include, but are not limited to, flying machines, electric cars, robots, and rockets that don't burn fuel. RF power adaptive rectifying circuits, wireless sensors, and wireless power sources are further applications for WPT.
II. Mobility - Within the wireless range, the user device may be relocated with ease.
III. The major use of WPT will be the creation of Solar electricity spacecraft (SPS), which are spacecraft equipped with enormous solar arrays that are placed in Geosynchronous ground Orbit and transfer electricity as microwaves to the ground.

7. CONCULSION

It introduces the idea of wireless power transmission. Recently developed technical applications that make life better for people in the present era have been highlighted. This presents the idea of wireless power transfer for short and long transmission. As is well known, there are benefits and drawbacks to using microwaves for power transmission. Therefore, the choice of technology depends on a variety of factors, including needed power, distance, medium, application, complexity, and cost.
More than any invention or discovery, this idea opens up the possibility of power transfer with minimal losses and ease of transmission.

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