



Wireless Transmission of Electricity – Development and Possibility

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Abstract –In the present paper the various technologies available so far for wireless transmission of electricity and the need for a Wireless System of Energy Transmission is being discussed to find its possibility in actual practices, their advantages, disadvantages and economical consideration. This paper is mainly concentrated on : i) The most popular concept known as Tesla Theory, ii) The microwave power transmission (MPT) called Solar power satellite, and iii) The highly efficient fibre lasers for wireless power transmission.

Many concepts, research papers, patents are available on wireless transmission of electricity but the commercial technologies are yet to be materialized. The paper also discusses the possible ways to get useful and practical results out of all research carried out so far elsewhere.

Key words – Wireless transmission, Tesla theory, Microwave power transmission, Fiber lasers, Collaborative research.

I. INTRODUCTION

In our present electricity generation system we waste more than half of its resources. Especially the transmission and distribution losses are the main concern of the present power technology. Much of this power is wasted during transmission from power plant generators to the consumer. The resistance of the wire used in the electrical grid distribution system causes a loss of 26-30% of the energy generated. This loss implies that our present system of electrical distribution is only 70-74% efficient. We have to think of alternate state - of - art technology to transmit and distribute the electricity. Now- a- days global scenario has been changed a lot and there are tremendous development in every field. If we don't keep pace with the development of new power technology we have to face a decreasing trend in the development of power sector. The transmission of power without wires may be one noble alternative for electricity transmission.

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II. THE TECHNOLOGIES AVAILABLE

In this remarkable discovery of the "True Wireless" and the principles upon which transmission and reception, even in the present day systems, are based, Dr. Nikola Tesla shows us that he is indeed the "Father of the Wireless." The most well-known and famous Wardencllyffe Tower (Tesla Tower) was designed and constructed mainly for wireless transmission of electrical power, rather than telegraphy [1]. The most popular concept known is Tesla Theory in which it was firmly believed that Wardencllyffe (Fig.1) would permit wireless transmission and reception across large distances with negligible losses [2]. In spite of this he had made numerous experiments of high quality to validate his claim of possibility of wireless transmission of electricity (Fig.2). But this was an unfortunate incidence that people of that century was not in a position to recognise his splendid work otherwise today we may transmit electricity wirelessly and will convert our mother earth a wonderful adobe full of electricity.



Fig.1. The 187-foot Wardencllyffe Tower (Tesla Tower) in 1903. This was to be the first broadcasting system in the world. Tesla wanted to transmit electricity from this Tower to the whole globe without wires using the Ionosphere. The source of the transmitted electricity was to be the Niagara Falls power plant[1].

The modern ideas are dominated by microwave power transmission (MPT, Figure 3) called Solar power satellite to be built in high earth orbit to collect sunlight and convert that energy into microwaves, then beamed to a very large antenna

on earth, the microwaves would be converted into conventional electrical power.

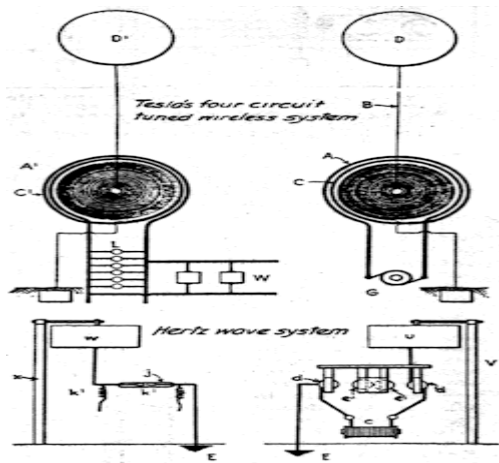


Fig.2. The basis for Tesla's system for the wireless transmission of electrical power[3].

William C. Brown, the leading authority on wireless power transmission technology, has loaned this demonstration unit to the Texas Space Grant Consortium to show how power can be transferred through free space by microwaves. A block diagram of the demonstration components is shown below. The primary components include a microwave source, a transmitting antenna, and a receiving rectenna.

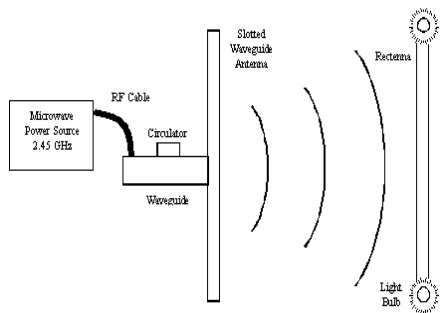


Fig.3. Microwave power transmission [4].

The microwave source consists of a microwave oven magnetron with electronics to control the output power. The output microwave power ranges from 50 W to 200 W at 2.45 GHz. A coaxial cable connects the output of the microwave source to a coax-to-waveguide adapter. This adapter is connected to a waveguide ferrite circulator which protects the microwave source from reflected power. The circulator is connected to a tuning waveguide section to match the waveguide impedance to the antenna input impedance.

The slotted waveguide antenna consists of 8 waveguide sections with 8 slots on each section. These 64 slots radiate the power uniformly through free space to the rectenna. The slotted waveguide antenna is ideal for power transmission because of its high aperture efficiency (> 95%) and high power handling capability.

A rectifying antenna called a rectenna receives the transmitted power and converts the microwave power to direct

current (DC) power. This demonstration rectenna consists of 6 rows of dipoles antennas where 8 dipoles belong to each row. Each row is connected to a rectifying circuit which consists of low pass filters and a rectifier. The rectifier is a Ga As Schottky barrier diode that is impedance matched to the dipoles by a low pass filter. The 6 rectifying diodes are connected to light bulbs for indicating that the power is received. The light bulbs also dissipated the received power. This rectenna has a 25% collection and conversion efficiency, but rectennas have been tested with greater than 90% efficiency at 2.45 GHz[4].

The transmission of power without wires is not a theory or a mere possibility, it is now a reality. The electrical energy can be economically transmitted without wires to any terrestrial distance, many researchers have established in numerous observations, experiments and measurements, qualitative and quantitative [5-9]. These have demonstrated that it is practicable to distribute power from a central plant in unlimited amounts, with a loss not exceeding a small fraction of one per cent, in the transmission, even to the greatest distance, twelve thousand miles - to the opposite end of the globe. This seemingly impossible feat can now be readily performed by electrical researchers familiar with the design and construction of my "high-potential magnifying transmitter," There were three popular theories present in the literature of the late 1800's and early 1900's. They were:

1. Transmission through or along the Earth,
2. Propagation as a result of terrestrial resonances,
3. Coupling to the ionosphere using propagation through electrified gases(Fig.4&5).

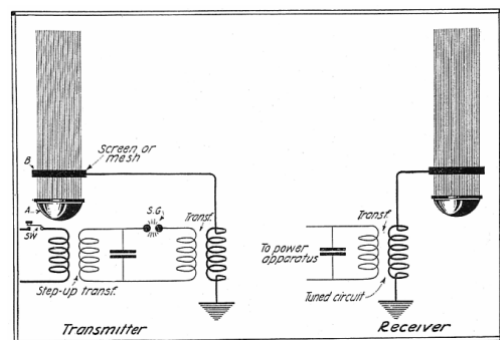


Fig.4. Diagram showing the transmitting & receiving circuit For the transmission & reception of electric power by wireless [5].

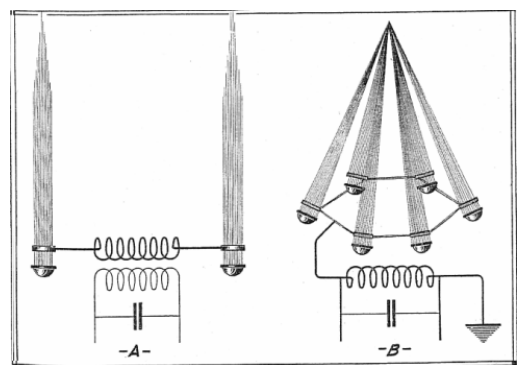


Fig.5. Two optical forms of wireless antennae formed of search light beam- ionised atmospheric streams [5].

It has been proven that electrical energy can be propagated around the world between the surface of the Earth and the ionosphere at extreme low frequencies in what is known as the Schumann Cavity. Knowing that a resonant cavity can be excited and that power can be delivered to that cavity similar to the methods used in microwave ovens for home use, it should be possible to resonate and deliver power via the Schumann Cavity to any point on Earth. This will result in practical wireless transmission of electrical power.

The intent of the experiments and the laboratory Tesla had constructed was to prove that wireless transmission of electrical power was possible. Although Tesla was not able to commercially market a system to transmit power around the globe, modern scientific theory and mathematical calculations support his contention that the wireless propagation of electrical power is possible and a feasible alternative to the extensive and costly grid of electrical transmission lines used today for electrical power distribution.

Power transmission system using directional ultrasound for power transmission includes a transmitting device and a receiving device. The transmitting device has a set of ultrasound transducers forming an ultrasound transducer array, wherein the array is a set of spaced individual transducers placed in the X-Y plane disposed to generate an ultrasound beam in the Z direction (Fig.6) [6].

Another possibility is to use highly efficient fibre lasers for wireless power transmission where the possibilities are similar to microwaves concept but lasers emit energy at frequencies much higher than microwaves.

For several years NASA, ENTECH, and UAH have been working on various aspects of collection of the laser radiation and conversion to electrical power for laser wireless power transmission [7].

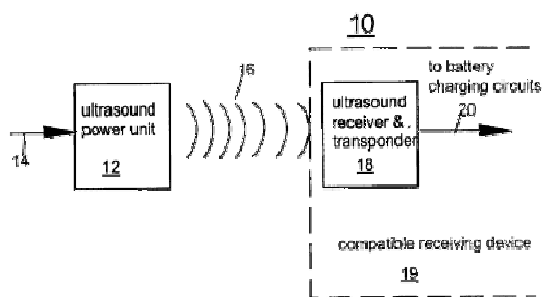


Fig.6. System and method for wireless electrical power Transmission (directional ultrasound for power Transmission) [6].

III. MERITS, DEMERITS & ECONOMICS OF WIRELESS TECHNOLOGIES

3.1. Merits

An electrical distribution system, based on this method would eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations. The system would reduce the cost of electrical energy used by the consumer and rid the landscape of wires, cables, and transmission towers.

There are areas of the world where the need for electrical power exists, yet there is no method for delivering power. Africa is in need of power to run pumps to tap into the vast resources of water under the Sahara Desert. Rural areas, such as those in China, require the electrical power necessary to bring them into the 20th century and to equal standing with western nations. The wireless transmission will solve many of these problems

The electrical energy can be economically transmitted without wires to any terrestrial distance, so there will be no transmission and distribution loss.

More efficient energy distribution systems and sources are needed by both developed and under developed nations. In regards to the new systems, the market for wireless power transmission is enormous. It has the potential to become a multi-billion dollar per year market.

The increasing demand for electrical energy in industrial nations is well documented. If we include the demand of third world nations, pushed by their increasing rate of growth, we could expect an even

Faster rise in the demand for electrical power in the near future. These systems can only meet these requirements with 90–94 % efficient transmission [3, 8].

High Transmission Integrity and Low Loss: - To transmit wireless power to any distance without limit. It makes no difference what the distance is. The efficiency of the transmission can be as high as 96 or 97 per cent, and there are practically no losses.

3.2. Demerits

Biological Impact: - One common criticism of the Tesla wireless power system is regarding its possible biological effects. Calculating the circulating reactive power, it was found that the frequency is very small and such a frequency is very biologically compatible [3, 8].

3.3. Economic Impact

The concept looks to be costly initially. The investment cost of Tesla Tower was \$150,000 (1905). In terms of economic theory, many countries will benefit from this service. Only private, dispersed receiving stations will be needed. Just like television and radio, a single resonant energy receiver is required, which may eventually be built into appliances, so no power cord will be necessary! Monthly electric utility bills from old-fashioned, fossil-fuelled, loss-prone electrified wire-grid delivery services will be optional, much like “cable TV” of today. In the 21st century, “Direct TV” is the rage, which is an exact parallel of Tesla’s “Direct Electricity.”

IV. ADDITIONAL REMARKS

Many concepts, research papers, patents are available on wireless transmission of electricity but most research work were carried out in isolation, so it needs a joint collaborative efforts to get a very useful results on this advanced technology on power transmission for the benefit of mankind globally in future. Whatever the future may bring, the universal

application of these great principles is fully assured, though it may be long in coming. With the opening of the first power plant, incredulity will give way to wonderment, and this to ingratitude, as ever before.

The world is still not able to achieve the benefit of the God gifted potential of Dr N.Tesla. People neglected him and his good work. He deserved much better treatment from the tycoons of his age, than to spend the last 40 years of his life in abject poverty. However, he was too much of a gentleman to hold a grudge. Instead, regarding the magnifying transmitter, Tesla wrote in his autobiography, "I am unwilling to accord to some small-minded and jealous individuals the satisfaction of having thwarted my efforts. These men are to me nothing more than microbes of a nasty disease. My project was retarded by laws of nature. The world was not prepared for it. It was too far ahead of time. But the same laws will prevail in the end and make it a triumphal success." [3, 8-9]. If this has had not been happened, then today we will be in a wonder world of plenty of power using the technology of wireless transmission of electricity.

V. CONCLUSION

The transmission of power without wires is not a theory or a mere possibility, it is now a reality. The electrical energy can be economically transmitted without wires to any terrestrial distance. Many researchers have established in numerous observations, experiments and measurements, qualitative and quantitative. Dr.N.Tesla is the pioneer of this invention.

Wireless transmission of electricity have tremendous merits like high transmission integrity and Low Loss (90 – 97 % efficient) and can be transmitted to any where in the globe and eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations. The system would reduce the cost of electrical energy used by the consumer and get rid of the landscape of wires, cables, and transmission towers. It has negligible demerits like reactive power which was found insignificant and biologically compatible.

It has a tremendous economic impact to human society.

Many countries will benefit from this service. Monthly electric utility bills from old-fashioned, fossil-fuelled, loss-prone electrified wire-grid delivery services will be optional, much like "cable TV" of today.

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