Wireless Electricity Transmission Based On Electromagnetic and Resonance Magnetic Coupling

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Abstract

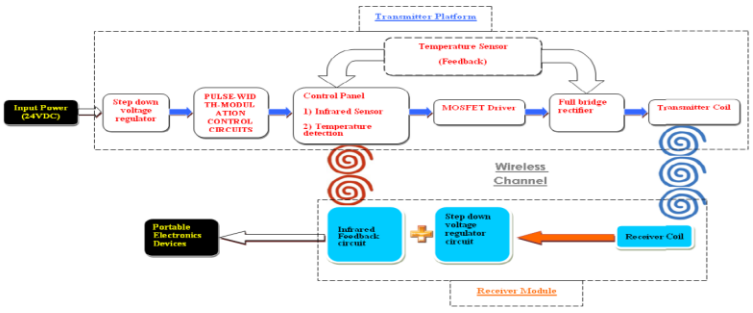
Wireless Electricity transmission is based on strong coupling between electromagnetic resonant objects to transfer energy wirelessly between them. This differs from other methods like simple induction, microwaves, or air ionization. The system consists of transmitters and receivers that contain magnetic loop antennas critically tuned to the same frequency. Due to operating in the electromagnetic near field, the receiving devices must be no more than about a quarter wavelengths from the transmitter [1].Unlike the far field wireless power transmission systems based on traveling electro-magnetic waves, Wireless Electricity employs near field inductive coupling through magnetic fields similar to those found in transformers except that the primary coil and secondary winding are physically separated, and tuned to resonate to increase their magnetic coupling. These tuned magnetic fields generated by the primary coil can be arranged to interact vigorously with matched secondary windings in distant equipment but far more weakly with any surrounding objects or materials such as radio signals or biological tissue [4].

Keywords – AC Electricity, Wireless Electricity Device, Oscilating magnetic Field, Resonant Magnetic Coupling, Magnetic Resonance Imaging

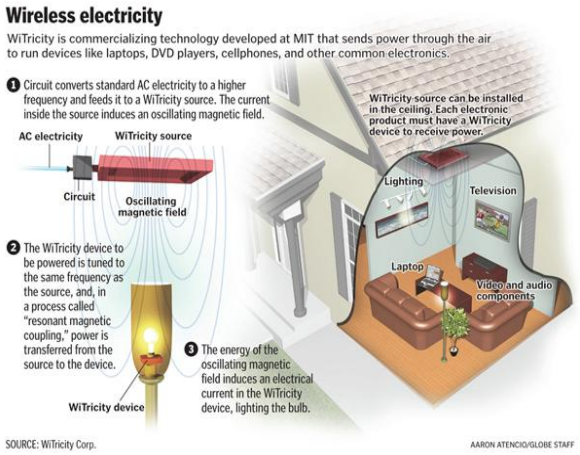
1. INTRODUCTION

Electricity is today a necessity of modern life. It is difficult to imagine passing a day without electricity. The conventional use of electricity is made possible through the use of wires. However researchers in MIT have devised a means of providing electricity without any wires. Wireless Electricity, a portmanteau for wireless electricity, is a term coined initially and used. This principle of wireless electricity works on the principle of using coupled resonant objects for the transference of electricity. The system consists of Wireless Electricity transmitters and receivers that contain magnetic loop antennas critically Tuned to the same frequency. Wireless power transmission is not a new idea; Nikola Tesla demonstrated a "transmission of electrical energy without wires" that depends upon electrical conductivity as early as 1891.The receiver works on the same principle as radio receivers where the device has to be in the range of the transmitter. It is with the help of resonant magnetic fields that Wireless Electricity produces electricity, while reducing the wastage of power. This is unlike the principle adopted by Nikola Tesla in the later part of the 19th century; where conduction based systems were used. The present project on Wireless Electricity aims at power transmissions in the range of 100 watts. May be the products using WiTricity in future might be called Wireless Electricity So we have been able to power a 60 watt light bulb from a power source that is located about seven feet away, while providing forty percent efficiency. This was made possible using two copper coils that were twenty inches in diameter which were designed so that they resonated together in the MHz range. One of these coils were connected to a power source while the other, to a bulb. With this Wireless Electricity setup, the bulb got powered even when the coils were not in sight.

2. BLOCK DIAGRAM



I. I. WIRELESS ELECTRICITY TECHNOLOGY



Understanding what Wireless Electricity technology is transferring electric energy or power over distance without wires is quite simple. Understanding how it works is a bit more involved, but it doesn't require an engineering degree. We'll start with the basics of electricity and magnetism, and work our way up to the Wireless Electricity technology.

3. ELECTRICITY

The flow of electrons (current) through a conductor (like a wire), or charges through the atmosphere (like lightning). A convenient way for energy to get from one place to another.

4. Magnetism

A fundamental force of nature, which causes certain types of materials to attract or repel each other. Permanent magnets, like the ones on your refrigerator and the earth's magnetic field, are examples of objects having constant magnetic fields. Oscillating magnetic fields vary with time, and can be generated by alternating current (AC) flowing on a wire. The strength, direction, and extent of magnetic fields are often represented and visualized by drawings of the magnetic field lines. As electric current, I, flows in a wire, it gives rise to a magnetic field, B, which wraps around the wire. When the current reverses direction, the magnetic field also reverses its direction. The blue lines represent the magnetic field that is created when current flows through a coil. When the current reverses direction, the magnetic field also reverses its direction.

5. Electromagnetism

A term for the interdependence of time-varying electric and magnetic fields. For example, it turns out that an oscillating magnetic field produces an electric field and an oscillating electric field produces a magnetic field.

6. Magnetic Induction

A loop or coil of conductive material like copper, carrying an alternating current (AC), is a very efficient structure for generating or capturing a magnetic field. If a conductive loop is connected to an AC power source, it will generate an oscillating magnetic field in the vicinity of the loop. A second conducting loop, brought close enough to the first, may "capture" some portion of that oscillating magnetic field, which in turn, generates or induces an electric current in the second coil. The current generated in the second coil may be used to power devices. This type of electrical power transfer from one loop or coil to another is well known and referred to as magnetic induction. Some common examples of devices based on magnetic induction are electric transformers and electric generators.

7. Energy/Power Coupling

Energy coupling occurs when an energy source has a means of transferring energy to another object. One simple example is a locomotive pulling a train car the mechanical coupling between the two enables the locomotive to pull the train, and overcome the forces of friction and inertia that keep the train still and, the train moves. Magnetic coupling occurs when the magnetic fields of one object [5]. An electric transformer is a device that uses magnetic induction to transfer energy from its primary winding to its secondary winding, without the windings being connected to each other. It is used to "transform" AC current at one voltage to AC current at a different voltage.Interacts with a second object and induces an electric current in or on that object. In this way, electric energy can be transferred from a power source to a powered device. In contrast to the example of mechanical coupling given for the train, magnetic coupling does not require any physical contact between the object generating the energy and the object receiving or capturing that energy.

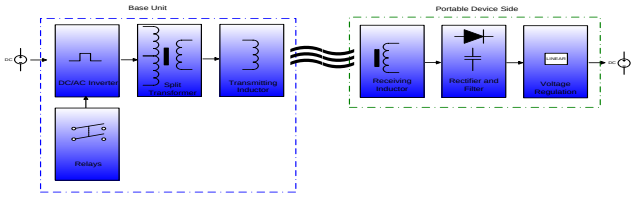
8. Resonance

Resonance is a property that exists in many different physical systems. It can be thought of as the natural frequency at which energy can most efficiently be added to an oscillating system. A playground swing is an example of an oscillating system involving potential energy and kinetic energy. The child swings back and forth at a rate that is determined by the length of the swing. The child can make the swing go higher if she properly coordinates her arm and leg action with the motion of the swing. The swing is oscillating at its resonant frequency and the simple movements of the child efficiently transfer energy to the system. The resonant frequency depends on the size, shape and thickness of the material [4].

9. Resonant Magnetic Coupling

Magnetic coupling occurs when two objects exchange energy through their varying or oscillating magnetic fields. Resonant coupling occurs when the natural frequencies of the two objects are approximately the same. Two idealized resonant magnetic coils, shown in yellow. The blue and red color bands illustrate their magnetic fields. The coupling of their respective magnetic fields is indicated by the connection of the colorbands [4].

10. WORKING OF WIRELESS TECHNOLOGY

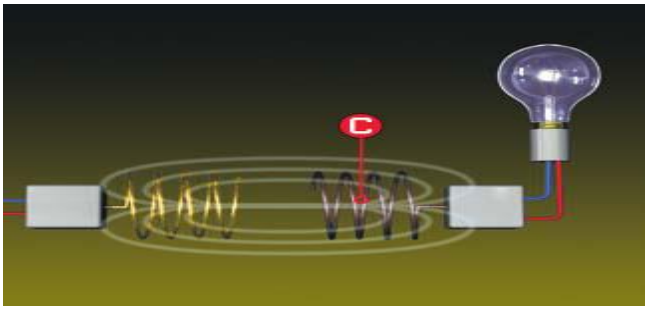


The concept of wireless electricity works on the principle of using coupled resonant objects for the transfer of electricity to objects without the use of any wires. This concept of WiTricity was made possible using resonance where an object vibrates with the application of a certain frequency of energy. So two objects having similar resonance tend to exchange energy without causing any effects on the surrounding objects.

STEP 1

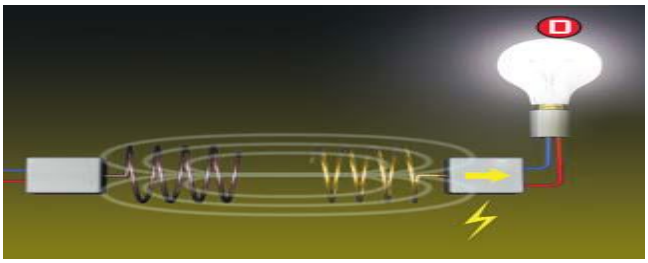
A circuit [A] attached to the wall socket converts the standard 60-hertz current to 10 megahertz and feeds it to the transmitting coil [B]. The oscillating current inside the transmitting coil causes the coil to emit a 10-megahertz magnetic field

STEP 2



The receiving coil [C] has the exact same dimensions as the sending coil and thus resonates at the same frequency and, in a process called magnetic induction, picks up the energy of the first coil's magnetic field.

STEP 3



The energy of the oscillating magnetic field induces an electrical current in the receiving coil, lighting the bulb [D].

11. MAGNETIC RESONANCE IMAGING (MRI)

MRI machines use "magnetic resonance imaging" to produce diagnostic images of soft tissue. Many people assume that WiTricity's "Resonant Magnetic Coupling" must be similar to magnetic resonance imaging (MRI) technology; however, the technologies are similar in name only. MRI is, as its name suggests, a technology for using magnetism as a basis for diagnostic imaging of soft tissue in the human body. It utilizes a strong DC magnet to orient the magnetic fields of atoms within tissues, and radio frequency fields to manipulate those atoms in a selective way, so that tissues and structures can be imaged clearly. The "resonance" referred to in "MRI" refers to the resonance of atomic structures. MRI is not considered to be a method for wireless power transfer [3].

12. ADVANTAGES OF WIRELESS ELECTRICITY

- More Convenient
- More Reliable
- More Environmentally Friendly

13. APPLICATION

- Low Power Product Category.
  Example, Remote controls, game controllers, computer headsets, gaming headsets, sensors, wireless thermostats, smoke detectors.
- Full Power Product Category.
  Example, IPhone/smart phones, smart phone accessories, netbooks, netbook accessories, wireless speakers.
- High Power Category
  Example, Digital photo frames, laptops, laptop accessories, flat panel TV's.
- Industrial Application.
  Example, Robots, packaging machinery, assembly machinery, machine tools, drilling, mining, underwater, etc.

14. CONCLUSION

Wireless Electricity technology is a non-radioactive mode of energy transfer, relying instead on the magnetic near field. Magnetic fields interact very weakly with biological organisms—people and animals—and are scientifically regarded to be safe. WiTricity products are being designed to comply with applicable safety standards and regulations. Hence witricity is technology safe.witricity can transfer power depends on the source and receivers. if it is relatively close to one another, and can exceed 95%.Efficiency is primarily determined by the distance between the power source and capture device, however, the shape may impact the efficiency. it can transfer the power through walls also. Traditional magnetic induction requires that the power source and capture device be very close to one another usually within millimeters to transfer power efficiently. Wireless Electricity technology is based on sharply resonant strong coupling, and is able to transfer power efficiently even when the distances between the power source and capture device are several times the size of the devices themselves.

15. Referances

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