WIRELESS POWER TRANSMISSION

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Abstract- Wireless power transmission is already researched for long. In the late nineteenth century, the scientist Nikola Tesla was able to light up downtown lamps power using electromagnetic induction. Approximately one hundred years later, with the intensification of studies in the area of wireless energy transfer, researchers at MIT managed to transmit power with great efficiency rate through this technology, plus electromagnetic resonance concepts. The technology works very simply, because only need to have a device that contains small loops or coils emit magnetic field and another device that has coils or receiving coils of this field. The transmitter must be connected to a source of alternating voltage in order to generate a varying magnetic field. The receiver, to suffer influence of this field starts producing current through the magnetic induction.

Keywords- Power Transmission, Magnetic Induction, Resonant Circuit.

I. INTRODUCTION

The technology of wireless power transmission begins in the year 1893 when Nikola Tesla, Serbian-American scientist whose work with electricity are notorious, commences studies on wireless power transmission. He found out that, by induction electromagnetic, energy can be transferred without the need for an electrical conductor, such that could ignite low wattage bulbs with this method. Due to the need of energy available to be used in various situations, had to be intensified in the studies of Electrical Engineering, mainly on Branch electromagnetism and electromagnetic wave propagation.

From the intensification of modern studies on the electromagnetic properties of materials and their applications at scale macroscopic, society has undergone a process of popularization of wireless transfer data over the mobile phone, bluetooth and wireless internet. With the advancement of technology mobile devices and increasing use of the same by the world's population, came the reflection that wireless data transmission would not be enough to fully portability to them, for they were still electrically powered only using installation and wiring taken. Because of this, it was thought to make solutions of these feedback devices, and transmit power generally no need this wiring. It may seem a futuristic theme, the wireless power transmission is already searched long time.

In the late nineteenth century, the scientist Nikola Tesla was able to light up downtown lamps power using electromagnetic induction. With the intensification of studies in the area of wireless energy transfer, about a hundred years later, researchers MIT managed to transmit power with great efficiency rate through this technology, plus the concepts of electromagnetic resonance. In 2008, large companies joined together to form a large consortium to develop, standardize and make available feeding new devices without the need to electrically connect the taken. In recent years, this technology has been expanding increasingly being used to development of portable devices such as mobile phones, laptops, smartphones, gadgets.

II. THEORY

The concept of the “field” was not available at that time, and Faraday’s goal was to show that a current could be produced by “magnetism.” He worked on this problem intermittently over a period of 10 years, until he was finally successful in 1831. He wound two separate windings on an iron toroid and placed a galvanometer in one circuit and a battery in the other.

Upon closing the battery circuit, he noted a momentary deflection of the galvanometer; a similar deflection in the opposite direction occurred when the battery was disconnected. This, of course, was the first experiment he made involving a changing magnetic field, and he followed it with a demonstration that either a moving magnetic field or a moving coil could also produce a galvanometer deflection.

In terms of fields, we now say that a time-varying magnetic field produces an electromotive force “emf” that may establish a current in a suitable closed circuit.

An electromotive force is merely a voltage that arises from conductors moving in a magnetic field or from changing magnetic fields, and we shall define it in this section. Faraday's law is customarily stated as

$$\text{emf} = -\, d\phi/dt \qquad (1)$$

Equation (1) implies a closed path, although not necessarily a closed conducting path; the closed path, for example, might include a capacitor, or it might be a purely imaginary line in space. The magnetic flux is that flux which passes through any and every surface whose perimeter is the closed path, and d Φ /dt is the time rate of change of this flux. A nonzero value of d Φ /dt may result from any of the following situations:

1. A time-changing flux linking a stationary closed path
2. Relative motion between a steady flux and a closed path
3. A combination of the two

The minus sign is an indication that the emf is in such a direction as to produce a current whose flux, if added to the original flux, would reduce the magnitude of the emf. This statement that the induced voltage acts to produce an opposing flux is known as Lenz's law. If the closed path is that taken by an N -turn filamentary conductor, it is often sufficiently accurate to consider the turns as coincident and let

$$\text{emf} = -\, N \cdot d\phi/dt \qquad (2)$$

where Φ is now interpreted as the flux passing through any one of N coincident paths.

We need to define emf as used in (1) or (2). The emf is obviously a scalar, and (perhaps not so obviously) a dimensional check shows that it is measured in volts. We define the emf as

$$\text{emf} = \oint \mathrm{E} \cdot d\mathrm{L} \qquad (3)$$

and note that it is the voltage about a specific closed path.

If any part of the path is changed, generally the emf changes. The departure from static results is clearly shown by (3), for an electric field intensity resulting from a static charge distribution must lead to zero potential difference about a closed path. In electrostatics, the line integral leads to a potential difference; with time-varying fields, the result is an emf or a voltage. Replacing in (1) with the surface integral of B, we have.

$$\text{emf} = \oint \mathrm{E} \cdot d\mathrm{L} = -\, d/dt \int_S \mathrm{B} \cdot d\mathrm{S} \qquad (4)$$

where the fingers of our right hand indicate the direction of the closed path, and our thumb indicates the direction of dS. A flux density B in the direction of dS and increasing with time thus produces an average value of E which is opposite to the positive direction about the closed path. The right-handed relationship .between the surface integral and the closed line integral in (4) should always be kept in mind during flux integrations and emf determinations. We will divide our investigation into two parts by first finding the contribution to the total emf made by a changing field within a stationary path (transformer emf), and then we will consider a moving path within a constant (motional, or generator, emf). We first consider a stationary path. The magnetic flux is the only time-varying quantity on the right side of (4), and a partial derivative may be taken under the integral sign,

$$\text{emf} = \oint \mathrm{E} \cdot d\mathrm{L} = -\int_S \partial \mathrm{B}/\partial t \cdot d\mathrm{S} \qquad (5)$$

Before we apply this simple result to an example, let us obtain the point form of this integral equation. Applying Stokes' theorem to the closed line integral, we have

$$\text{emf} = \int_S (\nabla \times \mathrm{E}) \cdot d\mathrm{S} = -\int_S \partial \mathrm{B}/\partial t \cdot d\mathrm{S}$$

where the surface integrals may be taken over identical surfaces. The surfaces are perfectly general and may be chosen as differentials,

$$(\nabla \times \mathrm{E}) \cdot d\mathrm{S} = -\partial \mathrm{B}/\partial t \cdot d\mathrm{S}$$

$$\nabla \times \mathrm{E} = -\partial \mathrm{B}/\partial t \qquad (6)$$

III. RESONANCE

Resonance is a property that exists in many different physical systems. It can be thought of as the natural frequency, at which the energy can more effectively be added to an oscillatory 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 speed that is determined by the swing length. The child can take stock go higher if it properly coordinate his arm and leg action with the swing movement. The balance oscillating at its resonant frequency and the simple movements of the child efficiently transfer energy to the system.
Resonant 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.

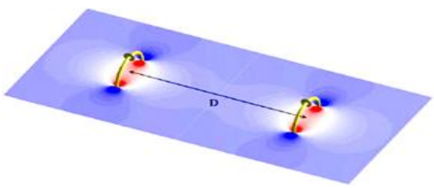

Fig. 1. Two idealized resonant magnetic coils, shown in yellow. The blue and red color bands illustrate their magnetic fields. The coupling of their respective magnetic fields is indicated by the connection of the colorbands.

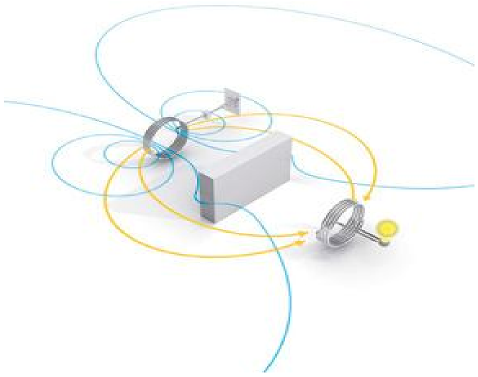

Fig. 2. The power source, left, is connected to AC power. The blue lines represent the magnetic near field induced by the power source. The yellow lines represent the flow of energy from the source to the capture coil, which is shown powering a light bulb. Note that this diagram also shows how the magnetic field (blue lines) can wrap around a conductive obstacle between the power source and the capture device.

Energy coupling occurs when an energy source has a means of transferring energy to another object. Magnetic coupling occurs when the magnetic field of one object 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.

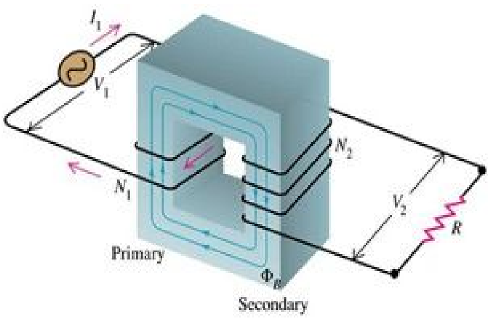

Fig. 3. An electric transformer uses magnetic induction to transfer energy from its primary winding to its secondary winding, without connected to each other. It is used to “transform” AC current at one voltage to AC current at a different voltage. An electric transformer uses magnetic induction to transfer energy from its primary winding to its secondary winding, without connected to each other. It is used to “transform” AC current at one voltage to AC current at a different voltage.

IV. APPLICATIONS

This technology is already being widely used for development notebook chargers, tablets, smartphones and similar gadgets. It is expected to join the market in the second half of this year. Many auto companies are partnering with companies that deal with wireless energy transfer technology and getting new boots within their cars.

CONCLUSION

From the study, the wireless energy transfer, which is based on the principle of electromagnetic induction, combined with electromagnetic resonance, will become increasingly present in our daily lives through the car chargers, cell phones and gadgets in general as well as being applied in industrial assembly lines. However, this technology still has some drawbacks, for example, not be as effective for long distances, making it applicable in very restricted situations. And to overcome these disadvantages and popularize this technology, several companies have joined forces in two major groups, the Wireless Power Consortium (WPC) and Alliance For Wireless Power (A4WP). Thus, the energy wireless energy transfer is being optimized, trying to be the form of the future energy transfer.

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