International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Email:editorijoer@gmail.com http://www.ijoer.in

Vol.4., S1., 2016

N C L A – 2016

ISSN: 2321-7758

OPTIMIZATION AND EFFECT OF TURNS IN THE COIL ON WIRELESS POWER TRANSMISSION THROUGH MUTUAL INDUCTANCE

Vighneshwar Bhat, Divyashree Bogar, Ashok H. Sidarai*

Department of Studies in Physics, Karnatak University, Dharwad,Karnataka, India

* Email address: ashok_sidarai@rediffmail.com

ABSTRACT

As the man is advancing rigorously into a techno era, and upgrading the technology on his demands. The traditional methods for power transmission have many problems such as losses or the risk of being theft, so to overcome these problems an emerging technology is being worked out i.e., wireless power transmission. Here we optimizing and analyzing the effects of a number of turns in the coils on the wireless power transmission through mutual inductance. In practical cases, receiving coils might be not only one, or not of the same sizes with the transmitting coil. We constructed four copper coils with a varying number of turns for the receiver side and to observe that enhancement in transmission.

Keywords: WiTricity, mutual induction, radiative, non-radiative, electromagnetic coupling, induced flux distance.

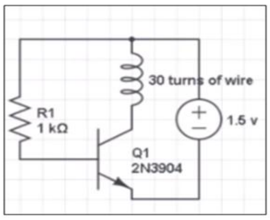
1. INTRODUCTION

Electricity is an interesting aspect in the present era. It is the vital, clean, efficient energy source to everyone and is easily transmitted over long distance through wires by conventional methods. These methods introduce major loss of power during transmission and distribution has grid loss and risk of being theft. As the demand for electricity is increased day by day, the power generation increases and the power loss is also increased, thus, the efficiency is significantly affected. In order to get rid of these problems and hurdles, an alternative solution is presented which is efficient, reliable, safe, cost-effective, and environmentally friendly. An alternative concept WiTricity (wireless electricity), transfer of electric energy or power over a distance without the use of wires, is introduced. Nikola Tesla, 'father of wireless transmission', is the one who reported the wireless power transmission based on magnetic resonance as well as near-field coupling and demonstrated "the transmission of electrical energy without wires" in 1891 [1]. Decades later, based on magnetic resonance a Physics research team led by Prof. Marin Soljacic, at the Massachusetts Institute of Technology (MIT) demonstrated wireless powering of 60 W light bulb with 40% efficiency at a 2 m (6.6 ft) distance using two coils having 60 cm diameter in 2007 [2,3]. Generally, wireless power transfer can be classified as radiative and non-radiative methods. Radiative power transfer relies on the high-frequency excitation of the power source, and it is emitted from an antenna and propagates through a medium (such as vacuum or air) over a long distance (i.e., many times larger than the dimension of the antenna) in the form of electromagnetic waves. Non-radiative wireless power transfer relies on the near-field electromagnetic coupling of conductive loops. Energy transferred over a relatively short distance, which is on the order of the dimension (such as the radius or the dimension) of the coupled coils [4]. Wireless power transmission using magnetic induction is non-radiative in nature and the principle of mutual induction states that the rate of change of current in one coil induces an electromotive force in a neighboring coil. The transfer of energy takes place by electromagnetic coupling through mutual induction [5, 6]. The efficiency of the WiTricity through mutual induction was influenced by other parameters like wires, the thickness of the coils, turns in the coils and etc., compared with plug and socket (i.e., conductive) charging. The primary advantage of the inductive charging approach is that the system can work with no exposed conductors, no interlocks and no connectors, allowing the system to work with far lower risk of electric shock hazards. Wireless power transmission has no limits in its applications. Some of the potential applications are powering of cell phones, laptops, televisions and other devices that normally run with the help of batteries or plugging in wires. WiTricity has its applications in the area of consumer electronics, industry appliances, medical sciences (to power pacemakers) and in military (to power military robots, vehicles etc). Research has always been going on the enhancement of induced distance in order to have desirable efficiency [7].

In this paper, we studied the effect of a number of turns of the coils on the wireless power transmission using the principle of mutual induction. The obtained results are efficient in small-scale applications.

2.MATERIALS AND METHODS

The experimental set up involves the transmitter coil termed as the primary coil, receiver coil as a secondary coil, copper wire of radius 0.3 mm is used, NPN transistor (2N3904), battery 1.5 V as an input source, resistor 1.2-kilo ohm, red LED as an indicator, single standard wires for connections. Initially, the primary and secondary coils varying the number of turns and are constructed to study the effect on mutual induction in otherworld's to enhance the induced flux distance between the coils. The circuit connection is as shown in Figure 1



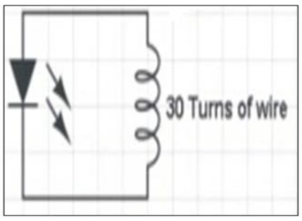


Figure 1 (a) Transmitting circuit, (b) Receiving circuit.

And the photocopy of coils varying numbers in turns are shown in Figure 2.

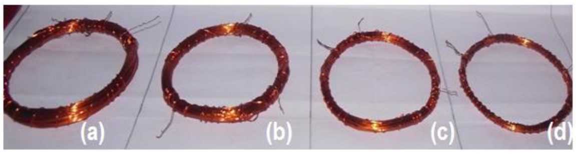


Figure 2: Photocopy of coils varying numbers of turns (a) 100, (b) 80, (c) 60, (d) 40.

There are two copper coils arranged one at the transmitter end which acts as the primary coil and other at the receiver end which acts as the secondary coil. The first coil is connected to the source and second coil to the output (LED). The transmitter end is fed with the DC source of 1.5 V; this DC voltage is converted into pulsating AC by transistor used in the circuit. The resistor controls the flow of current through the primary coil. When the current flows in the primary coil, there is the development of the magnetic field in the coil. This magnetic field induces the current in the secondary coil and then LED glows for certain distance only.

3. RESULTS AND DISCUSSION

Table 1: Number of turns in secondary coils N2 and distance between coils d.

Number of turns in secondary coils (N_2)	Distance between coils d in cm			
	N_1=40	N_1=60	N_1=80	N_1=100
20	2.9	3	3.2	3.5
40	5.3	5.4	5.5	5.8
60	5.5	5.8	5.9	6.1
80	5.9	6	6.2	6.5
100	6.3	6.6	6.8	7

Here N1 = Number of turns in the primary coil.
N2 = Number of turns in the secondary coil.

Table 1 gives the induced flux distance between coils and number of turns in primary and secondary coils. Based on the obtained experimental data, we have tabulated the number of turns with respect to the induced flux distance as shown in Table 1. Also given the graphical representation of the obtained data. It is observed from the Table 1 that distance between the coils was increased from 2.9 cm to 7 cm by increasing the number of turns in the primary and secondary coils i.e., 20, 40, 60, 80, 100. As we increase the number of turns in the coils, the induced flux distance gradually increases. In our experiment, we noticed the maximum distance between the coils up to 7.0 cm for 100 numbers of turns in both the coils. The graph is plotted for the number of turns N2 versus distance between two coils as shown in Figure 3. From the plotted graph we observed that by increasing the number of turns the distance between coils was increased. The curve obtained for N1=100 which lies above the other number of turns. This is because as we increase the number of turns in the coils its corresponding area also increases. As area increases the developed field also increases. So the flux line can be induced by a large range.

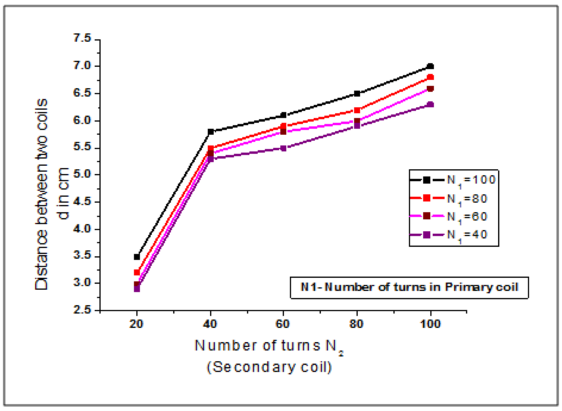


Figure 3: Graph for number of turns versus distance between two coils.

4. CONCLUSION

We have successfully built the experimental set up for wireless power transmission by varying the number of turns in both the primary and secondary coils through mutual inductance. Here we can conclude that the maximum flux induced distance 7 cm were observed in between the coils of the 100 turns. Also, it seems that power transfer can be obtained for a large distance if the number of turns in the secondary coil is large than in the primary coil.

5. ACKNOWLEDGMENT

We would like to express our sincere gratitude to research scholars Department of Physics Vani R Desai and Shirajahammad M. Hunagund for their unconditional support.

6. REFERENCES

[1]. S.Sheik Mohammed, K.Ramasamy, T.Shanmuganantham "Wireless Power Transmission A Next Generation Power Transmission System" 2010 Int. J. Comp. Appli. (0975-8887) volume 1-No. 13.

[2]. Ankur Jain, Gurneet Singh Makked, Neeraj Modi "Wireless electricity (WiTricity)" Proceedings of IRF International Conference, 13th April-2014, Pune, India, ISBN: 978-93-84209-04-9.

[3]. Er.Lince Mathew, Prof. Yash Pal Sing "An Extensive study of 'Wireless Power Transmission'-A Next Generation Power" Transmission System. Int. J. IT, Eng. App.Sci. Res. Volume 2, No. 12, December 2013. ISSN: 2319-4413.

[4]. Wenxing Zhong, Chi Kwan Lee, Member, IEEE, and S.Y.Ron Hui, Fellow, IEEE" General Analysis on the Use of Tesla's Resonators in Domino Forms for wireless Power Transfer" IEEE Trans. Indus. Elec., vol.60, No.1, January 2013.

[5]. Shahbaz Ali Khidri, Aamir Ali Malik, Shakir Hussian Memon "WiTricity: A Wireless Energy Solution Available at Anytime and Anywhere" Int. J. eng. res. Gen. Sci. Volume 2, Issue 5, August-September 2014.

[6]. Sagolen Kripachariya Sing, T.S.Hasarmani, and R.M.Holmukhe "Wireless Transmission of Electrical Power Overview of Recent Research & Development" Int. J. Comp.Elec. Engi. vol.4, no.2, April 2012

[7]. Mohammad Yasir, Md. Shakibul Haque "The Witricity: Revolution in Power Transmission Technology" Int. J. Sci. Eng. Res., volume 4, Issue 8, August 2013.