

Research on Wireless Power Transmission Technology and the Related Problems

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Abstract: Wireless Power Transfer (WPT) has been widely used in recent years, it has the advantages of high transmission efficiency, long transmission distance, and so on. Firstly, this paper introduces the application progress of transmission technology at home and abroad. Secondly, combined with the development of the current technology, this paper puts forward the basic problems of wireless power transmission technology from four aspects. Lastly, the paper summarizes and puts forward the current hot and difficult problems.

Keywords: Wireless Power Transfer, The Direction of Electric Transmission; application of wireless power transmission.

INTRODUCTION:

The traditional cable power transmission has the problems of aging, wear and produced electric spark and so on. Meanwhile, it is difficult to use the cable to transmit electricity in some special occasions, such as high mountain and seabed, which greatly reduces the safety and reliability of its use [1]. Therefore, with the development of technology, the wireless power transmission technology has made people look on it. Because it has the advantages of low wear rate, high reliability and safety, convenient and flexible use, beautiful appearance and so on.

At present, there are some ways in which the wireless power transfer technology, such as electromagnetic WPT, resonant WPT, electromagnetic radiation WPT and so on [2]. In this paper, the progress of WPT application in recent years is analyzed. In this paper, the transmission mechanism and modeling of resonant WPT technology are discussed in detail, and then put forward some important problems.

APPLICATION OF WIRELESS POWER TRANSMISSION TECHNOLOGY:

In nineteenth century, Nicola Tesla conceived the transmission mechanism of radio energy [3]. After years of development, wireless power transmission technology has made a great achievement. In 1983, Donaldson's research shows that the optimal electromagnetic coupling coefficient of the transmitter and receiver can be achieved by using the S/P capacitance compensation technique, and the transmission efficiency can reach 50% [4]. Then in 1996, Professor Joun proposed the S/S capacitor compensation technology [5]. Then, the wireless charging hybrid compensation ways has P/P, P/S, S/P-S/SP and so on.

In 2007, Professor Soljagic Marin and the research team proposed resonant WPT principle in Science, it began to step into people's vision and achieved rapid development [6-7]. MIT successfully put a 2m far away from a 60W light bulb lit, and achieved the efficiency of charging transmission more than 40%. Furthermore, they found that with the distance to shorten the charging efficiency is very rapid rise. When the distance is 125cm, the efficiency is more than 85%. When the distance is 75cm, the efficiency reached a more staggering 95%. In 2009, KAIST was tested on the SUV car, and achieved the output power was 15kW, the efficiency reached 71% [8]. In 2009, Witricity to achieve a 6.4MHz based, transmission distance of 60cm electrical wireless charging, and the efficiency of 95% [9]. In 2011, Witricity achieved a comprehensive transmission efficiency about 90% of the 3.3kW radio [10]. In 2012, Professor Hori of University of Tokyo in Japan realized the high efficiency power transmission based on the automatic group anti-match technology, the transmission distance is 6 ~ 30cm, the resonance frequency is 13.56MHz, the maximum charge efficiency is 85% [11]. In 2013, Professor Mi of Michigan Chris University and his team has achieved the following 200kHz car wireless charging, the transmission power of 2 ~ 6kW, transmission efficiency as high as 94% [12]. From 2012 to 2015, professor Park C and his team has achieved a transmission distance of 5m to achieve the 'bipolar magnetic core coil' wireless power transmission system, and expanding the transmission distance [13].

Although China's research carried out late, but the development is very rapid. In 2005, the team of Professor Sun Yue began to carry out the related research of frequency stability of contactless power transmission, he also improved the CPT system related voltage output control technology [14]. Then, in 2011, Liu Sucheng of Chongqing University, analyzed the characteristics of the power, efficiency and frequency of the near field magnetic resonance WPT [15]. Professor Chen Qianhong summed up the development of wireless power transmission technology [16]. What is more, Professor Zhang Bo introduced the magnetic resonance WPT about 3 basic ways, and analysed the limit parameters may occur, not that the transmission efficiency of WPT reached 100% [17]. In 2016, Xi'an University of Technology research team introduced 4 kinds of wireless charging hybrid compensation topology technology, focusing on the analysis of the compensation method of S/P-S/SP [18]. Professor Huang Xueliang, made researched on the development process of radio transmission technology, magnetic resonance series and model, reception device and so on

[19]. In addition, many conferences are important ways to promote the development of radio transmission technology. For example, the Chinese Conference on Decision and Control (CCDC), Chinese New Energy Vehicle Charging and Driving Technology Conference (GVCD), silk road international wireless charging union WPC meeting and related meetings held by IEEE.

SEVERAL KEY PROBLEMS OF WPT TECHNOLOGY:

Compared to the traditional technology, WPT technology has obvious advantages, but its development is still restricted by many factors, which needs further research.

Several Quantitative Relationships:

The factories frequency, power, efficiency and transmission distance have been the focus of WPT technology research all the time. The research shows that the transmission efficiency and the transmission distance of the inductive WPT technology are positively correlated. With the same resonant frequency, resonant WPT technology is the better transmission efficiency. But beyond a certain frequency range, the efficiency decreases sharply and the quantitative relationship of these aspects is relatively few. Therefore how to realize the quantitative relationship between these factors will have a very important practical significance.

The Direction of Electric Transmission about Resonant WPT:

MIT's research team proposed resonant WPT technology, but also in theory shows that the power transmission can do without direction. In recent years, a large number of studies have been carried out to study, which is under the coaxial parallel state, which is based on the coupled, critical coupling and over coupled square. Experimental results show that there is no direction in a certain range under the condition of over coupling. Under the condition of critical coupling and under coupling, there are some directions. The direction of the system energy transmission has a great impact on the transmission distance, transmission efficiency and so on, the research of this content is still continuing, and has not yet achieved a unified research results within the industry.

WPT Transmission Mechanism and Spatial Power Density Variation:

According to literatures, it is not difficult to find that many countries analysis of the WPT technology by the Circuit Theory, Coupled Mode Theory and Two Port Network Theory. The Coupling Mode Theory is mainly used to study some basic characteristics of resonant WPT, which is mainly used for the transmission efficiency of the system, the system parameters and so on. However, the research on the WPT transmission mechanism and the spatial power density change is relatively small, such as the spatial power density change with time, the law of spatial transfer and its mechanism. Therefore, this study will help to grasp the spatial transmission of electromagnetic energy, so as to achieve effective spatial constraints, and further to increase the transmission distance, the coil size and so on, to improve the transmission efficiency.

Biological Safety Problems Caused by High Frequency Electromagnetic Leakage:

WPT is the transmission of energy by the coupling of high frequency electromagnetic space. According to the research that the power transmission efficiency cannot reach 100%, which is affected by the internal and external factors. The lost electric energy is consumed in the form of heat energy, and the other part is lost in the space electromagnetic transmission. According to the research, long term in the radio frequency environment, the plant body will produce genetic variation and other phenomena, the animal's heart disease, blood vessels and blood diseases will occur.

At present, there are two standards for electromagnetic radiation in the world: ICNIRT and IEEE. Australia, Europe and other countries mainly use the ICNIRT standard. Japan, the United States, Canada and other countries mainly use the IEEE standard. In addition, China has also introduced a series of standards, the most widely used is GB8702-88, etc.. Study on the model given in reference [20] for adults and children in the body to withstand four SAR radiation magnetic coil system in value distribution between human body model and the distance from the coil and power system size effects on human body were discussed, the WPT technology will guide electromagnetic induced by excessive leakage, irreversible effects the biological safety of the surrounding system.

However, most of the research on electromagnetic radiation at home and abroad is based on the model simulation analysis and quantitative qualitative test, which has certain limitations. In order to obtain a more complete magnetic radiation effect, the system power, frequency, environment and radiation time of different grades is needed to be studied comprehensively.

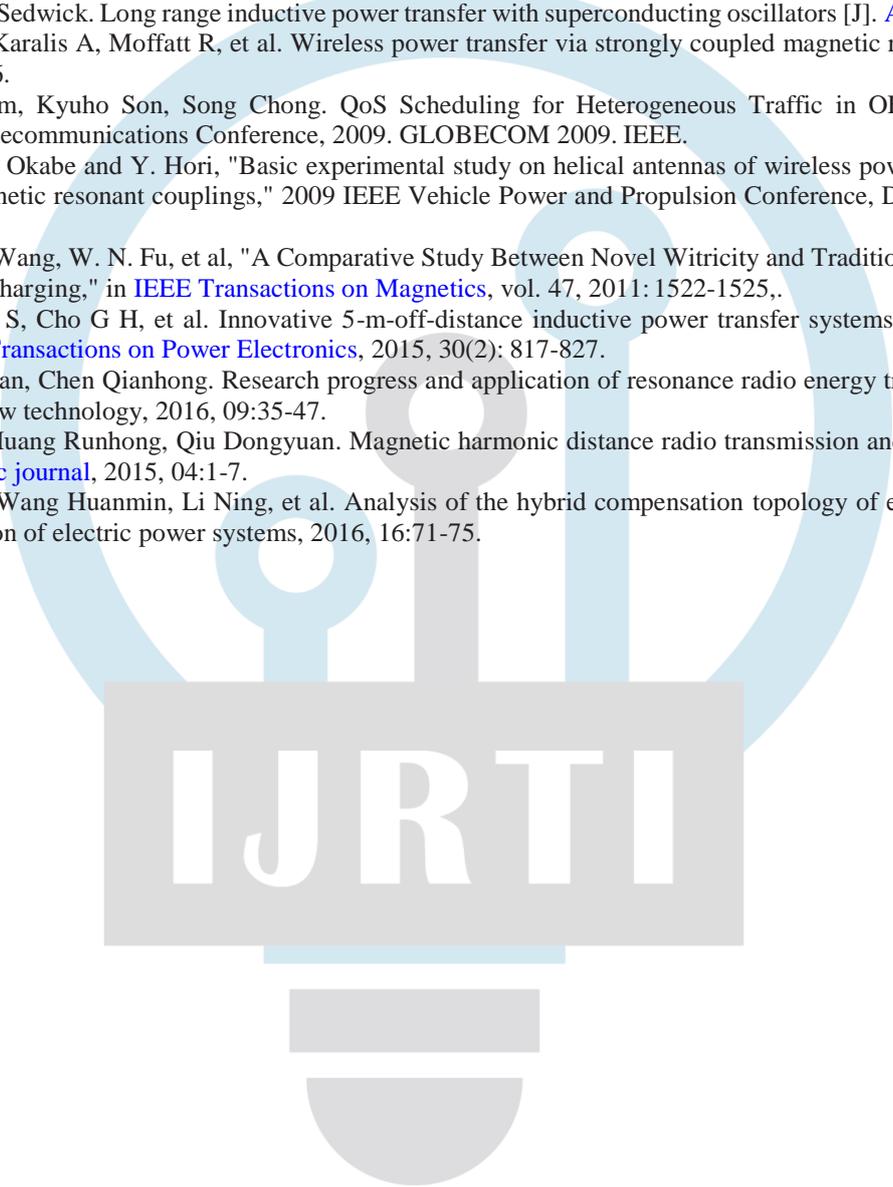
According to the above considerations, it is not difficult to find, to achieve efficient power transmission depends on the power supply, circuit, but also related to power frequency, transmission distance, transmission distance and size distribution of electromagnetic space needs to consider the power density, and the electromagnetic transmission direction of magnetic leakage about beam will have a significant impact. Magnetic leakage can also affect the biological safety of the outside world, at the same time, the use of advanced materials can further improve the transmission efficiency, realize the direction constraint electromagnetic environment protection function. Therefore, all aspects of WPT technology in the whole body, to achieve further development need to be fully integrated consideration.

CONCLUSION:

The concept of wireless power transmission offers greater possibilities for transmitting power with negligible losses. In the long run, this could reduce our society's dependence on batteries, which are currently heavy and expensive. As wireless technology is getting popular now a days, the demand of battery is also decreasing. For the long range power transmission power can be sent from source to receivers instantaneously without wires, reducing the cost. Batteries need to be recharge or changed eventually, hence the need for this kind of work.

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