

The Impact of Electric Vehicle Wireless Charging Technology

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Abstract: Wireless charging technology is the future trend of electric vehicle charging, so more and more attention of the electric vehicle to the market has been widespread concerned in the community. Wireless charging is a new way of energy supply, this paper focuses on the way of the electric vehicles wireless charging, analyzing the advantages and disadvantages of the various methods, and the practical application in urban construction to give the reasonable suggestions.

Keywords: Electric vehicle; Wireless charging; Urban construction

1. Introduction

Low-carbon economy is the core application of new energy technology and energy saving technology, electric vehicle can solve the pollution of vehicle emission and the shortage of energy source in Chinese strategic emerging industries. As electric vehicles develop, the important prerequisite and basis for large-scale application of electric car electricity charging attracts wide attention. The development of new energy industries, in particularly, the rapid growth of pure electric vehicles, is better for the diversification of electric vehicles charging and more convenience of demand. Wireless charging technology as an emerging technology, currently mainly used in commercial operation such as charging cell phones, computers, music players and other low-power devices, but in electric steam, it is still a new concept. With wireless charging technology surgery getting mature, electric vehicles will be the most promising wireless charging device in the city field. It can be seen from the classification of wireless charging technology, the wireless charging technology clinical application works on electric vehicles has been analyzed, and the domestic and international electricity wireless charging of moving car technology has been introduced, at the same time, the electric steam application of car wireless charging technology has been in-depth thinking, put forward to some recommends that in order to facilitate the practical application of technology and industrialization.

2. Working Principle

At present, the wireless charging technology is broadly divided into three types: electromagnetic induction power transfer, resonant wireless power transmission, microwave radio transmit.

2.1. ICPT

Electromagnetic induction power transfer (ICPT), developing the most sophisticated wireless charging technology is a way to present the most important wireless charging. Electromagnetic induction current power transmission is mainly for short-range transmission, the transmission distance is less than 10cm. Electromagnetic inductive charging is limited by its distance, so now is more used in mobile phones, electric toothbrushes and other small devices. ICPT technology is used to transmit power via magnetic coupling primary and secondary side of the transformer. The basic structure is mainly shown in Fig.1:

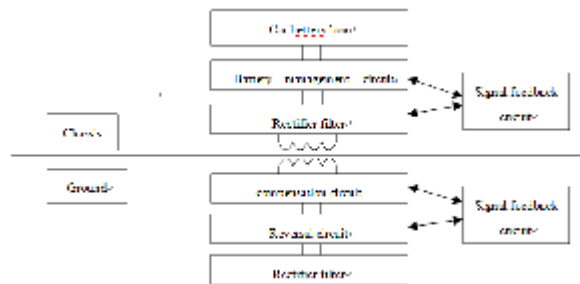


Figure 1. ICPT schematic

2.2. WPT

Resonant wireless power transmission (WPT), mainly used for medium-range transmission, the effective transmission distance 20cm-5m, ERPT technology through the coil and the resonant circuit capacitors to transmit power, because of its power transmission from the appropriate free degree is no electromagnetic radiation, it will be widely used in wireless charging of electric vehicles. But resonant wireless power transmission is in susceptible magnetic field, its high requirements of the original device needs the higher cost and lower resonant transmission efficiency, so improve power transmission efficiency is a key issue to be addressed next. The basic structure is shown in Fig.2:



Figure 2. WPT schematic

2.3. MPT

Microwave wireless power transmission (MPT), is mainly used for long-distance transmission, such as spacecraft and space development station, which works by converting electrical energy into microwave energy through the microwave transmission, to the load after the microwave into electrical energy , is charged.

3. The Advantages and Disadvantages of Three Operating Modes

A high energy transfer efficiency of electromagnetic induction type, generally up to 90%, but it's good enough from the past, it is relatively to the small electrical charge applied to, and is not suitable for wireless charging of electric vehicles. Development of electromagnetic induction type power transmission is more mature than the other two methods in terms of charging, even more in-depth study, and a better basis.

Transmission distance resonant energy transfer in the right way, and therefore it is the future of electric vehicle charging radio. Resonant power transmission is carried out according to the electromagnetic effects for discharge coil and capacitor, so a more cautious choice of components. The biggest problem facing to the future is how to improve the transmission efficiency according to the selection of electrical energy.

Microwave Power Transfer is to convert electrical energy into microwaves to transmit energy, although in this way, it can get more power transmission to distant places, but its low transmission efficiency, and the great harm to the human body, so much for the spacecraft and other non-daily life.

Advantages and disadvantages of three operating modes are shown in Tab.1:

Table 1. Advantage and disadvantage

Working way	advantage	disadvantage
ICPT	Transmission efficiency is up to 90%	only for small appliances
WPT	Suitable distance power transmission	Susceptible to magnetic fields, require better components
MPT	Not easily affected by the environment	Harm to human body, low transmission efficiency

4. The Practical Application

Currently the most mature development of electromagnetic induction, has been used in many large companies, such as Sanyo, Seiko Yipu Sen, Fulton Innovation, technology development of these enterprises in the application of light rail in the study was more thorough. And such as Sony, Qualcomm, TDK and other companies to use more resonant wireless power transmission, this wireless power transmission is the main form of future wireless charging technology for electric vehicles.

How to improve the efficiency of the resonant wireless power transmission will become the key impacts of electric vehicle wireless charging technology. Development of radio energy matures, and the radiation hazard to human is unknown. In practice, it should take measures to reduce radiation, such as in a car seat plus shielding materials, as far away from the body and other parts of the electromagnetic coupling.

References

- [1] K. W. Klonz, A. Esser, R. R. Bacon, D. M. Divan, D. W. Novotony, and R.D. Lorenz, "An electric vehicle charging system with universal inductive interface," in Proc. IEEE PCC-93 Conf. Record, 1993, pp. 227-232.
- [2] Friedman, H. W. 1994, "Near term feasibility demonstration of laser power beaming," SPIE Vol. 2121.
- [3] O. Adeluyi, S. Moh, and J. Lee, "PEARSH: A power efficient algorithm for raising sensor half-life with wireless battery recharge module," IEEE Sensors Application Symposium, pp. 194-199, 2009.
- [4] H. Zhai, H. K. Pan, and M. Lu, "A practical wireless charging system based on ultra-wideband retro-reflective beamforming," Antennas and Propagation Society International Symposium (APSURSI), pp. 1-4, 2010
- [5] Kundur P. Power system stability and control [M]. NewYork: McGraw-hill, 1994.
- [6] Guo Yongji. Reliability of power systems and power equipment[J]. Automation of Electric Power Systems,2001,27 (17) :53-56