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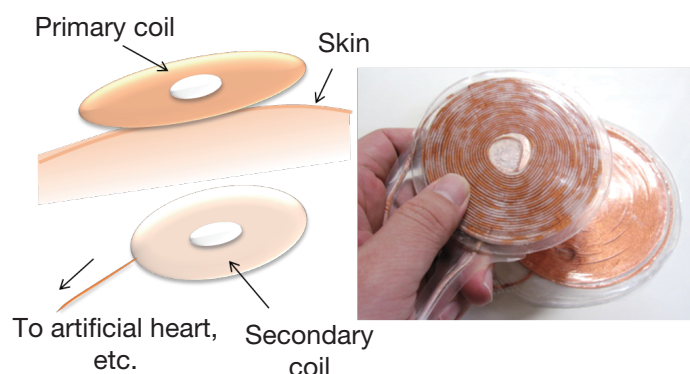
Purpose of Research

The wireless energy transmission using electromagnetic induction or magnetic resonance has already been put into practical use. However, this technology has the following problems: 1) output voltage is fluctuated depending on distance between coils, 2) transmission efficiency decreases depending on distance between coils, 3) output voltage is fluctuated due to load fluctuation, 4) electromagnetic radiation noise is high, and 5) safety to the human body is not confirmed yet. Thus it can be used on the limited condition. This study has a purpose to overcome such a conventional problem and to develop the technology for wireless energy transmission which enables safe and risk-free charging.

Summary of Research

This wireless energy transmission system offers excellent benefits including: being safe for persons nearby, high energy transmission efficiency (98%, coil to coil), constant output voltage (= electrical power) even under variable loads, constant output voltage even if the relative positions of the primary and secondary coils change, and low electromagnetic noise.

Flat air-core coil system



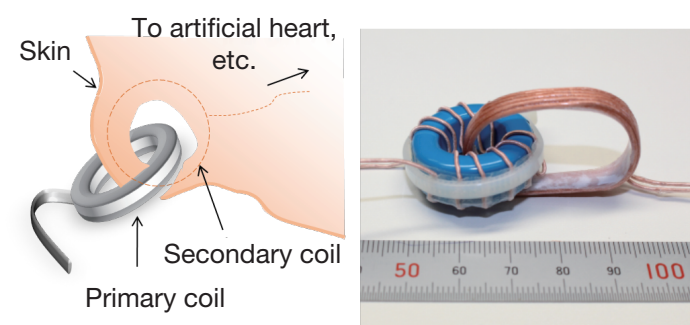
Comparison with Conventional or Competitive Technology

Two transformer systems (flat air-core coil system and externally-coupled coil system shown in the left figures) have been demonstrated. In either system, the secondary coils are implanted for long-term usage. Safety testing on experimental animals is underway.

Expected Applications

- Wirelessly charging household appliances with several tens- or hundreds-watt (charging mobile device, in particular mobile phone or smartphone, rechargeable vacuum cleaner, rechargeable electric power tools, etc.)
- Wireless energy transmission for implantable medical equipments (such as ventricular assist device)
- Charging connector for electric vehicle, etc.

Externally-coupled coil system



Challenges in Implementation

The implantable medical equipment has a main problem that the medical equipment requires design and manufacture of a specific medical packaging. When it is used for the household appliance or the electric vehicle, finally, dosimetry evaluation and EMC evaluation are also needed according to the output voltage.

What We Expect from Companies

Designing transformers requires consideration of coil materials, the number of turns, the number of layers, outer diameter, inner diameter, and use or non-use of ferrite cores. In addition, the intensities of the radiated magnetic field and electric field are related to regulations on electromagnetic interference wave and electromagnetic effects on living bodies, and transformers should be designed to suppress their intensities within the regulations' limits. These requirements are not easy to satisfy. Our laboratory can perform the design, taking these into account, and help our clients to design safe and high-efficient transformers.

Future Developments

We aim to design transformers that can transmit energy through a space as great as 1 m, recognizing the difficulties of doing so.

- Awards: JSOA Best Paper Awards (2001) in Circulatory System, etc.
- Intellectual Property: Japanese Patent Application No. 2014-146119 "Wireless Energy Transmission Apparatus and Electrical Device"
- Prototype: Present
- Sample: May be provided. Decision on this made after discussion with requester.