Performance Optimization and Verification of an Improved Transformer-rectifier Type Flux Pump for HTS Magnets Charging

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Introduction

As the applications with high-temperature superconducting (HTS) magnets appear frequently in a variety of fields, it's of particular importance to compensate the decayed current due to the losses in HTS magnets. Up to date, it is widely recognized that current leads, wireless power transfer and flux pump are three different effective methods for HTS magnets charging. Among them, the flux pump is gradually becoming the hottest issue, where transformer-rectifier type flux pump, especially, grabs a large quantity of attention due to its simplicity of rectifying component.

However, it is the principle of bridge rectifying that may lead to an unavoidable induced dc current which self-evidently would make a negative impact on the charging speed in the charging loop. To this regard, this paper proposed the means of combining the current-controlled transformer-rectifier type flux pump with a secondary resistor to achieve a better charging performance. With a verification experiment carried out, it was confirmed that the method proposed in this paper was viable. And there exists an optimal resistance, which is essential to improve the charging speed.

Principle and Structure of Original And Improved Flux Pump

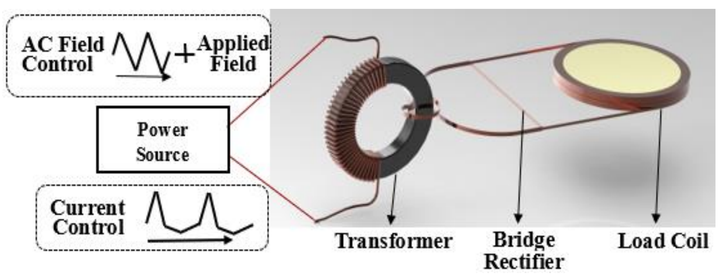


Fig. 1. Schematic structure diagram of transformer-rectifier type flux pump.

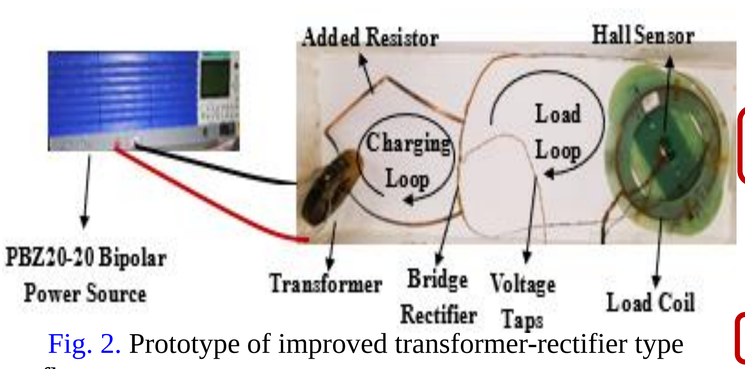


Fig. 2. Prototype of improved transformer-rectifier type flux pump.

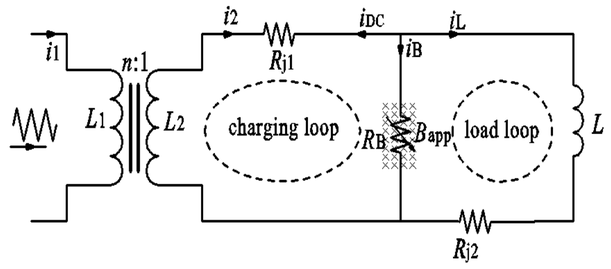


Fig. 3. Electrical schematic circuit of the original ac field-controlled transformer-rectifier type flux pump.

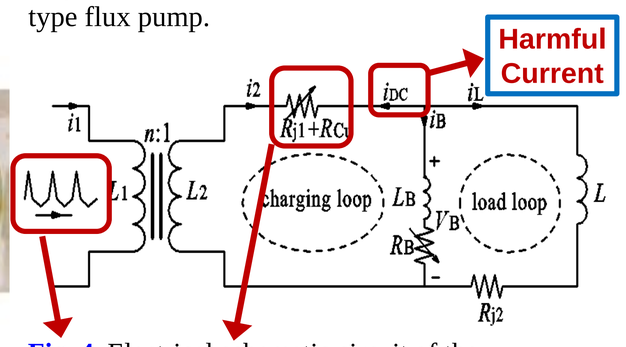


Fig. 4. Electrical schematic circuit of the improved current-controlled transformer-rectifier type flux pump.

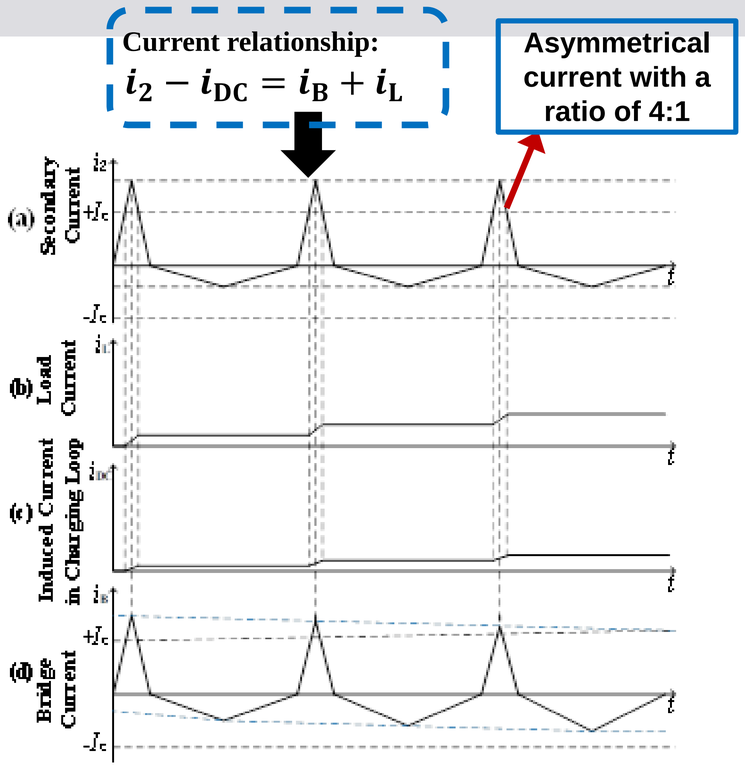
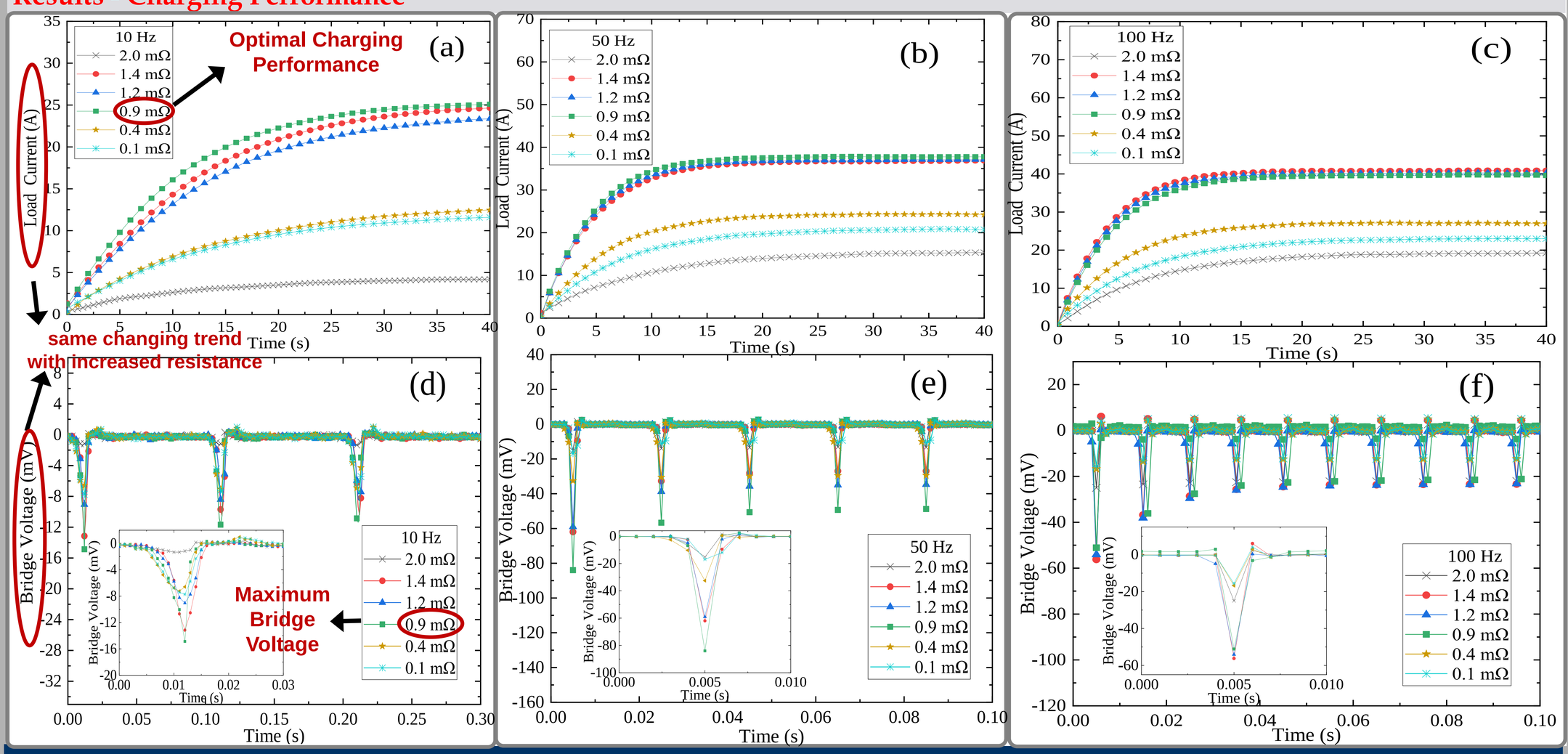


Fig. 5. Waveform diagrams of different current variables in the charging loop: a) secondary current; b) load current; c) induced dc current; d) bridge current.

Results - Charging Performance



Conclusion

We reach the conclusion that adding a small resistor to the current-controlled transformer-rectifier type flux pump does facilitate the charging speed of the system. Meanwhile, there exists an optimal resistance, which is essential to improve the charging speed. Also, a larger resistance decreases the charging speed on account of the negative impact on induced secondary current.

Acknowledgement

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