# 鉄心入り多層渦電流型交流強磁場発生装置の実用化とその応用研究


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# 1991 Fiscal Year Final Research Report Summary

## Developments of Multi-Laminated Eddy-Current Type AC High Magnetic Field Generator with Iron Yoke and its Applications

Research Project

### Project/Area Number

01850056

### Research Category

Grant-in-Aid for Developmental Scientific Research

### Allocation Type

Single-year Grants

### Research Field

電力工学

### Research Institution

Kanazawa University

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### Project Period (FY)

**1989 – 1990**

### Keywords

High Magnetic Field / Alternating-Current Magnetic Field / Eddy Currents / Electromagnetic Pump / Melting Metal / Biomagnetics

### Research Abstract

The purposes of this project are to develop the practical model of the multi-laminated eddy-current type high magnetic field generator with iron yoke proposed by the project member and to research and realize a new flux concentrating type electromagnetic pump which is used for transferring liquid sodium in the fast breeder reactor. The research results in the project are summarized as follows :

1. Multi-laminated eddy-current type high magnetic field generator with Iron yoke
(1) The production of the practical generator : By the new generator, we generated the flux density of 5.15T for 50 Hz and the 3. SST for 60 Hz in the volume of 40mm diameter. and 50= height when 3, OOOV AC voltage is applied. The values of the flux density are identical to the design values.
(2) We have made the biomagnetic experiments for small animals (fishes and Insects) and observed the motor functions of animals. Until now, we could not obtain any remarkable effects. We will change the conditions of the duration time, the number of time and the strength of flux density and then continue to make experiments in future.
2. Flux-concentrating type electromagnetic pump
(1) We made the small model of the flux-concentrating type electromagnetic pump which use the flux-concentrating effect by eddy currents and then investigate the fundamental characteristics and the structure. Our new device has 1.7 times thrust force more than the previous annular type pump.
(2) The shape of the conducting plate for concentrating flux and the iron yoke are investigated by numerically analyzing tie 3-D axisymmetrical model of the electromagnetic pump. Based on investigation, we design and product the electromagnetic pump (OND-1000) for liquid sodium as a practical model.
(3) We plan and prepare for testing the electromagnetic pump (OND-1000) as transferring liquid sodium as cooling material in a fast breeder reactor. We will obtain the result within this year.

## Research Products (23 results)

All Other

All Publications (23 results)

[Publications] T.Yoshimoto,K.Bessho,S.Yamada: "Three dimensional flow of eddy current in flux concentration opparatus" IEEE Transaction on Magnetics. MAG-26. 1007-1010 (1990)

[Publications] 別所 一夫,山田 外史,榎園 正人: "鉄心入り多層渦電流型コイル" 日本応用磁気学会誌. 14. 459-464 (1990)

[Publications] S.Yamada,K.Bessho: "Finite element analysis of monlinear dynamic magnetic field with dc component in the harmonle domain" IEEE Transaction on Magnetics. MAG-26. 2199-2201 (1990)

[Publications] M.Enokizono,K.Bessho: "Laminated eddy-current type solenoid coil for alternating high magnetic field" IEEE Transaction on Magnetics. MAG-26. 2759-2761 (1990)

[Publications] K.Bessho: "Application of eddy-current and saturation curve of core" Proceeding of Japan-Polish Joint Seminer. 147-150 (1991)

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[Publications] K.Bessho,S.Yamada: "Characteristics of a new flux concentration type electromagnetic pump for fast breeder reactor" Proceeding of Electromagnetic Field in Materials. (1991)

[Publications] K.Bessho: "New electromagnetic based on the eflect of magnetic flux concentration" Proceeding of conference on Soft Magnetic Materials 10. (1991)

[Publications] J. Lu, S. Yamada, K. Bessho: "Time-periodic magnetic field analysis with saturation and hysteresis characteristics by harmonic balance element method" IEEE Transactions on Magnetics. MAG-26, 2. 995-998 (1990)

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[Publications] M. Enokizono, T. Tadokoro, S. Hasebe, K. Bessho: "Laminated eddy-current current type solenoid coil for alternating high magnetic field" IEEE Transactions on Magnetics. MAG-26, 5. 2759-2761 (1990)

[Publications] T. Yoshimoto, K. Bessho, S. Yamada: "3-D analysis of a cylinder-type flux concentration apparatus" International Journal of Applied Electromagnetics in Materials. 1-2. 293-304 (1990)

[Publications] M. Enokizono, T. Todaka: "Three-dimensional boundary element method using a time-dependent fundamental solution" International Journal of Applied Electromagnetics in Materials. 1-2. 327-333 (1990)

[Publications] J. Lu, S. Yamada, K. Bassho, K. Hirano: "Development and application of harmonic balance finite element method in electromagnetic fields" International Journal of Applied Electromagnetics in Materials. 1-2. 305-312 (1990)

[Publications] K. Bessho: "Application of eddy-current and saturation curve of core" Japan-Polish Joint Seminar. C1-4. 147-150 (1991)

[Publications] K. Bessho, S. Yamada, M. Nakano, K. Nakamoto: "Characteristics of a new flux concentration type electromagnetic pump for fast breeder reactor" Proceeding of Electromagnetic Field in Materials. (1991)

[Publications] K. Bessho, S. Yamada: "Flux-concentrating typo electromagnetic pump and its characteristics" Japan Society of Applied Magnetics. 15. 539-542 (1991)

[Publications] S. Yamada, P. P. Biringer, K. Bessho: "Calculation of nonlinear eddy-current problems by the harmonic balance finite element method" IEEE Transaction on Magnetics.

[Publications] J. Lu, S. Yamada, K. Bessho: "Harmonic balance finite element method taking account of external circuit and motion" IEEE Transaction on Magnetics.

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[Publications] K. Bessho, A. Krawczyk, K. Nakamoto: "New electromagnetic based on the effect of magnetic flux concentration" Proceeding of Conference on Soft Magnetic Materials. 10. (1991)

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