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LOW LOSS TRANSFORMER USING ROTATING MAGNETIC FIELD

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1. Introduction

In order to reduce the iron loss, a new type transformer, in which semirotating magnetic field is applied, has been conceived[1]. However, the iron loss of this type of transformer was higher than that of the conventional transformer.

The construction of the transformer is improved. The iron loss of the new type transformer is reduced than that of the conventional transformer. The superconducting transformer of this type is also investigated.

2. Tube Type Rotating Flux Transformer

Figure 1 shows the construction of the new type transformer. It consists of a tubular core with toroidal windings which are wound outside of the core and poloidal windings which are wound inside of the tube. The wound core is made of non-oriented silicon steel (thickness : 0.2mm). The core has a slit in order to reduce the eddy current loss as shown in Fig.2. The numbers of turns of the toroidal and poloidal windings are 400 and 110 respectively.

Two methods of excitation: namely, (1) dc for toroidal and ac for poloidal, (2) ac for toroidal and dc for poloidal, are compared. Since the excitation of the type (1) is better than that of the type (2) from the standpoint of iron loss, the toroidal windings are excited from the dc source and the poloidal windings are excited from the ac source (50Hz). Semirotating flux is induced by this excitation as shown in Fig.2. B_{ac} and B_{dc} denote ac and dc components of the flux densities respectively.

Figure 3 shows the iron losses which are measured at constant ac field (B_{ac}=1.4T). The hysteresis loss and the eddy current loss are obtained using the two-frequency method (30 and 50Hz). The figure shows that when the dc magnetic field H_{dc} is increased, the total iron loss W can be reduced, because the hysteresis loss is remarkably reduced.

3. Ring Type Rotating Flux Transformer

Figure 4 shows another type of new transformer which uses a ring core and a dc solenoid. Since most of the iron loss of amorphous metal is the hysteresis loss, the amorphous metal core is favourable. In the case of the tube type transformer shown in Fig.1, the amorphous metal core cannot be available, because it is extremely difficult to produce the tube.

Figure 5 shows the behavior of the semirotating flux density. Since the open magnetic circuit needs large exciting VA, the dc superconducting excitation is recommended. In this case, the permanent current mode can be used instead of the dc power source.

Results obtained for this type transformer will be presented in the full paper.

Reference
[1] R.F.Krause and R.M.Del Vecchio: "Low Core Loss Rotating Flux Transformer", J. Appl. Phys., 64, 10, 5376 (1988).

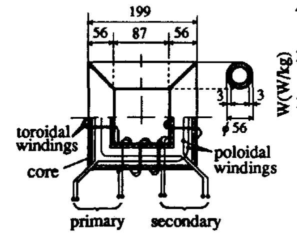

Fig.1 Tube type rotating flux transformer.

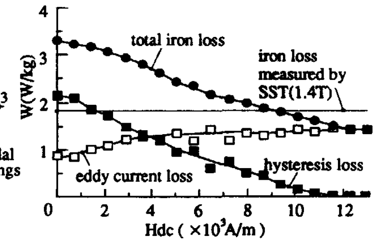

Fig.3 Iron losses (Bac=1.4T).

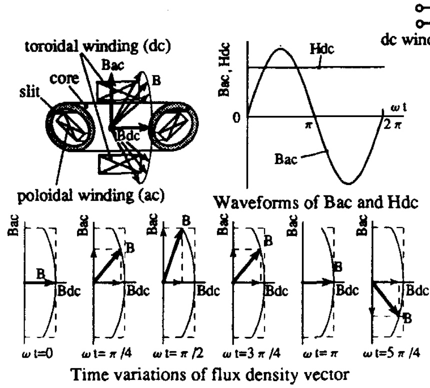

Fig.2 Explanation of rotating flux .

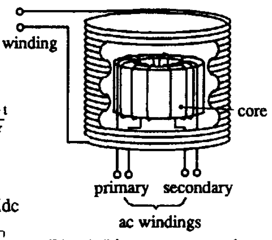

Fig.4 Ring type rotating flux transformer.

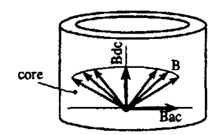

Fig.5 Rotating flux .