

Application of Linear Magnetic Gears to harvest Wave Energy

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Abstract

This article, using a linear magnetic equipment, recommends a linear permanent magnet (PM) machine for direct-drive wave energy harvesting. The slow reciprocating motion of the wave is caught straight by the gear's low-speed mover and then amplified in velocity via the gear to power the generator, resulting in greater voltage output. The steady and dynamic performance is analyzed using finite element analysis, which confirms that the machine proposed can offer higher power density and higher efficiency than its corelative.

Key words: linear magnetic equipment, wave energy, generator, finite element analysis.

Introduction

In the future energy scheme, renewable energy can be seen having a crucial role. The wave energy[1] is promising but immature among those feasible clean and renewable energy resources, namely hydro, wind, solar, geothermal, and wave energy. One of the primary issues is the absence of appropriate generators to harness wave energy efficiently and effectively.

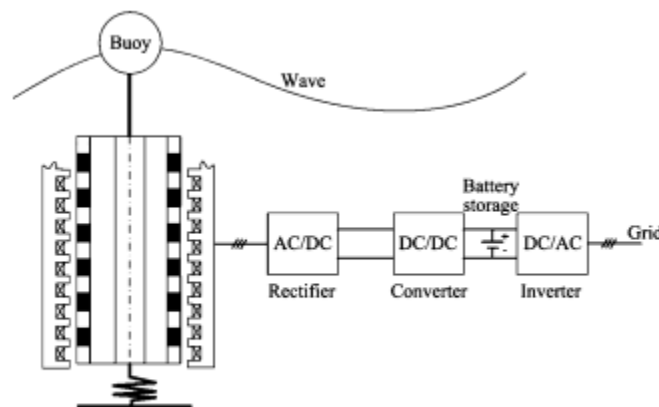


Fig. 1. Configuration of heaving-buoy wave energy harvesting system.

This article proposes a new linear embedded PM machine for direct-drive wave power generation that skillfully integrates a linear magnetic equipment and a linear PM generator[2]. The slow

reciprocating movement of the wave can therefore be caught straight, while the generator can embrace high-speed design to maximize its power density and minimize its cost of raw material.

Methodology

1. Linear PM Synchronous Generator:

Due to its elevated effectiveness, the linear PM generator has been recognized as feasible for direct drive wave energy generation. The force density can be analytically obtained for a standard PM synchronous generator.

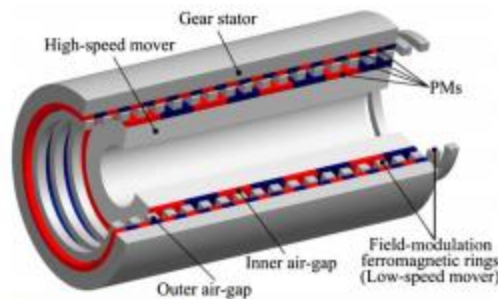


Fig. 2. Configuration of linear magnetic gear.

2. Linear Magnetic Gear:

The magnetic gear is an electromechanical device that can perform tasks of the mechanical equipment such as transmission of torque and decrease of velocity. Because of the non-contact function, no mechanical wear and tear, low acoustic noise, physical insulation between moving components and intrinsic overload[3] protection are required.

3. Linear Magnetic-Geared Machine

Fig. 3 demonstrates two methods in which the linear magnetic equipment can be combined with the linear PM device, namely series integration[4] and parallel integration[5]. The equipment and the machine share the same shaft in series integration, and it is possible to design their magnetic circuits separately.

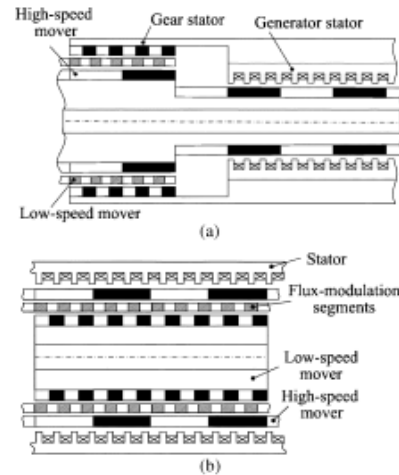


Fig. 3. Linear magnetic-geared machine. (a) Series integration. (b) Parallel integration.

Conclusion

The paper provided an embedded linear PM synchronous machine with a linear magnetic equipment for generating direct drive wave power. By carefully combining the linear magnetic equipment and the linear PM generator, the device can capture the slow reciprocating wave movement straight and take the high-speed generator design.

References

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