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Design of hybrid thrust magnetic bearing for heavy rotating shaft considering self-weight compensation according to axial load

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Hybrid thrust magnetic bearing(HTMB) for heavy rotating shaft should be considered axial load at initial design stage since as the load increases, the force is generated asymmetrically. Therefore, the force acting on the upper part and the force acting on the lower part must necessarily be designed in different ways. In the case of a vertically driven shaft with a heavy impeller mounted vertically, because of the axial weight always acts as a load in the downward direction, the forces acting in the same air gap cannot be balanced, and the greater the weight of the shaft, the greater the imbalance of the axial force of the HTMB. Therefore, the position of the axial collar has to move further upwards or downwards in order to maintain the balance between the upper directional force and the lower directional force. The thrust collar must be located at position that the force of the upper and lower parts is in equilibrium for flexible control, but the closer the thrust collar is to the upper and lower core, the smaller the mechanical air-gap and the shaft may be damaged, or a lot of HTMB loss occurs since the current for HTMB control increase when the magnetic bearing force is imbalanced. In this paper, The first part focuses on the design of HTMB which use a finite element method (FEM), deals with a general design that does not consider self-weight according to axial load. The second part is based on the validation of the initial designs by experiments using a manufactured HTMB, and deals with the influence of self-weight that changes according to the axial load. Finally, redesign of HTMB for compensation self-weight with axial load, and validation of the results by the two-dimensional FEM, and then by experiments using a manufactured model.

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