decreased load capacity is obtained if the field strength at the boundaries is higher than in the active area.

4. With increasing value of the magnetic field parameter, β, the extent of the load-carrying region becomes larger. This effect, together with the increased pressure, contributes to higher load values.

5. For an axial symmetric applied field, the pressure resultant reaches a maximum value at a definite value of β, beyond which the carried load remains constant.

6. The bearing stiffness and stability are influenced by the magnetic suspensions, and a first qualitative estimate suggests that an improvement of both can be expected.

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DISCUSSION

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This paper carefully analyzes the flow field of a short hydrodynamic bearing to account for the presence of magnetic fluid lubricant and applied magnetic field. The principal new features taken into account over and above conventional bearing analyses are the existence of magnetic field gradient forces, magnetic interfacial stress difference when a normal component of magnetization is present, and magnetically induced changes of the fluid viscosity.

A general discussion includng some analysis of broad types of new bearings made possible with magnetic fluids is available in the literature [1]. Recognized configurations are either hydrostatic or hydrodynamic in nature, with monofluid and bifluid types in both categories. State-of-art load support of 0.15 psi in a hydrostatic monofluid bearing and 4 psi in a hydrostatic bifluid bearing has been demonstrated; "ultimate"capability of 120 psi and 960 psi are estimated. Both hydrostatic types operate passively. The hydrodynamic types are capable of greater load support but don't support loads passively. This is probably not important except in instrumentation. The hydrodynamic types can be useful in applications where the magnetic fluid is attracted back to the working gap thus eliminating mechanical means to achieve recirculation.

Studies such as the present one are important in quantifying the effects to be obtained and for providing a systematic methodology. A direction for further refinement of the analysis is to account for the field of antisymmetric stress in the ferrofluid and the influence of shear rate on it. [2]

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Author's Closure

The author would like to thank Dr. Rosensweig for the valuable comments. He agrees with the fact that refinements of the existing theories can be obtained by a closer look at the rheological properties of ferrofluids. The momentum and the moment of momentum equations may be complemented by the introduction of the particle spin vector and the couple stress tensor, as for micropolar fluids.[1] However, the effect that the applied magnetic field and the resultant particle orientation have on the freedom of the particles to spin has to be analyzed. To complete the analysis, new material parameters are then introduced, whose experimental determination presents serious challenge.

In the general case, this may lead to developments too long to be practically used in applications. In this paper, an attempt is made to present a theory of hydrodynamic lubrication under the usual approximations and existing data, since the author feels it is still a little explored domain.

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