PREFACE

The work presented in this thesis is based on the researches which I have been carrying on under the supervision of Dr. C. M. Patel since March 1975 at the M. S. University of Baroda during my tenure as Reader in Mathematics in the University College of Science and later, as a lecturer in the Post-Graduate Department of Mathematics and Statistics, Sardar Patel University, Vallabh Vidyanagar.

It treats some aspects of fluid film lubrication; primarily, hydrodynamic lubrication, hydromagnetic lubrication, the effects of non-homogeneity and anisotropy of the porous housing, the effects of rotating fluid inertia and axial current induced pinch on porous and non-porous bearings for steady and quasi-steady operating conditions. This thesis consists of five chapters the contents of which are presented below.

The first chapter is divided into three parts. In the first part we give a description, advantages and disadvantages and applications of porous bearings. In the second part we give the derivations of modified Reynolds equations for hydrodynamic and hydromagnetic lubrication, and for hydromagnetic lubrication of a porous bearing with anisotropic permeability and slip velocity. A brief historical review of related topics is presented in the third part.

In the second chapter we discuss the hydrodynamic lubrication of some porous bearings. In the first part, we consider an infinite composite slider bearing. The slider consists of a plate inclined to the stator and another plate parallel to the stator, both plates being rigidly connected. The stator has a porous facing which is backed by a solid wall. The results are obtained in closed form. It is seen that the composite porous slider bearing has more load capacity than the corresponding inclined porous slider bearing. In the second part, we take the slider to be in the exponential form. Pressure and friction are obtained in closed form, load capacity and centre of pressure are obtained in integral form. Values of load capacity show that the exponential porous slider bearing can support a load slightly more than the plane inclined porous slider bearing for large values of a. In the third part, we analyse the curved squeeze film between two circular plates, the upper plate being curved and with a porous facing and the lower one flat. It is seen that the load capacity, computed by using Simpson's rule, rises sharply in the case of concave pads.

The first half of chapter three studies the squeeze film between two parallel rectangular plates, the upper one with a two-layered porous housing with different permeabilities, in the presence of a uniform transverse magnetic field. Results are presented for dimensionless load capacity and squeeze time in tabular form for various values of the parameters k_2/k_1, H_2/H_1, ψ_1 and for large Hartmann numbers. While the increases in load capacity and time of approach due to the applied magnetic field are significant, those due to the double layer are not so significant. In the second half we analyse an infinite inclined porous slider bearing in the presence of a uniform transverse magnetic field. Expressions for pressure distribution, load capacity, frictional drag and the centre of pressure are obtained for small as well as large Hartmann numbers. Results are presented in graphical and tabular forms and discussed for large Hartmann numbers. It is seen that substantial increases in load capacity and friction occur for large Hartmann numbers in the open circuit case.

The chapter four deals with a study of the lubrication of a parallel plate porous slider bearing under a non-uniformly applied transverse magnetic field. The optimum magnetic field profile is found to be a step function. Results are presented in tabular form for various maximum Hartmann numbers and for various values of the permeability parameter. It is seen that the magnetic step location can be increased by increasing the permeability parameter or the maximum Hartmann number.

The first half of the chapter five deals with a study of the effect of axial current induced pinch on the squeeze film behaviour between two annular disks and two circular disks, when the upper disk has a porous facing and the lower ~~disks~~ disk rotates with a uniform angular velocity. As a special case the lubrication of rotating porous circular disks without axial current is discussed in detail. In the second half of the chapter, we study the effect of axial current induced pinch on the curved squeeze film between two circular plates, the upper one which is curved, moving normal to itself and approaching the lower plate which is fixed and flat. Increases in pressure, load capacity and time of approach do not depend on the concavity or the convexity of the pad.

These chapters are followed by a fairly complete bibliography of the publications to which reference has been made in the body of the thesis.

A part of the above work, viz. first half of chapter 3, chapter 4 and chapter 5, has been accepted for publication in WEAR in the form of the following research papers :

1. Axial pinch effect on the squeeze film action between curved circular plates.
2. A study of the hydromagnetic squeeze film between two-layered porous rectangular plates.

3. The effect of axial current induced pinch on the lubrication of rotating porous annular and circular disks.
4. Optimum profile for the MHD parallel plate porous slider.

The remaining part has been communicated for publication to various journals abroad.

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