Abstract

Orbital rotor unit is found to have a very high magnitude of 'torque to inertia' ratio amongst different types of hydrostatic motors. Such an unit is more specifically termed as 'Epitrochoid generated **RO**tary **PI**ston **MA**chine **(ROPIMA)'** type *Low Speed High Torque* (LSHT) motor. Such units are geometrically related with the **Wankel Engine**. Very few literature on the analysis of such motors are available.

In the present work, an attempt has been made to analyze the dynamic as well as the steady state characteristics of Orbital rotor LSHT hydrostatic motor. Two types of *Hydrostatic Transmission* (HST) systems incorporating a large and stable source of supply, have been considered for analysis of the performance of the motor. A closed loop HST system consisting of the same motor and a variable displacement axial piston pump has also been studied in this work.

Modelling of these systems have been done through lumped parameter representation of various mechanical and fluid line characteristics. *Bond-graph* technique has been used for modelling these systems. Derivation of the system equations and their numerical simulations are carried out using the software **COSMO**.

The influence of various parameters on the transient response characteristics of the system are studied. Some non-dimensional parameters have also been introduced to present the computational results in a compact and generalized form. The performance of the motor has also been studied with reference to these non-dimensional parameters.

Owing to the high fluid bulk stiffness, low inertia of the fluid, and rapid opening and closing of the valve ports, the above solution became computationally stiff even for the steady state analysis, that is normally required for general purpose applications. A *tractable solution* has been proposed to overcome these difficulties. This solution provides a fair depiction of the characteristics of all its states with very little computational effort.

There are many factors which determine the performance of the motor. Some of them can be determined theoretically and others may be found from experimental investigations. However, it is difficult to estimate the inter-chamber leakage resistance, either theoretically or experimentally. A semi-empirical approach has therefore been developed to estimate this resistance.

In order to estimate the inter-chamber leakage, the overall bondgraph model has been reduced to a simplified form where various losses of the system have been lumped into three resistive elements. A reduced model thus obtained, has fewer adjustable parameters requiring lesser number of test runs to estimate them. The system nonlinearities are accounted for by allowing the loss coefficients to be simple functions of the state variables of the system. The results of the reduced model has been validated experimentally. The semi-empirical relation for the loss coefficient is established through experimental results and theoretical observations. The overall model of the motor, and its tractable solution obtained using the proposed estimation procedure, have been experimentally verified.

The dynamic as well as steady state analysis of an HST system consisting of the same motor and a variable displacement axial piston pump have also been performed in this work. Bondgraph technique has again been used to model the system. While modelling, the steady state solution of motor has been considered as an input to the system. Such a solution is termed here as the *Quasi-static solution.* The effects of various parameters of the pump and the motor on the overall performance of the system have been studied. Using the system equations derived from the bondgraph model, a simplified technique has been formulated for predicting the steady state behaviour of the system. These models have also been verified experimentally.