POWER TRANSMISSION WITH ALTERNATING FLOW HYDRAULICS

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The vibratory hydraulics system for the power transmission has received considerable attention because the vibratory type is more efficient in view of the energy transmission effect than the conventional hydraulic driving methods which make use of continuous pressure and flow source This paper presents theoretical investigation of the synchronization between the drive and driven machines connected with three phases Alternating Flow Hydraulics (AFH) piping. Both machines incorporate three slider crank mechanisms that generate pseudo-sinusoidal motions of medium fluid in three transmission lines. Synchronization of the motion between medium fluid and three pistons of the driven machine may result in synchronizing the motion of the driven unit to the drive unit. In this report the theoretical formulation of the synchronization of the two rotating machines is presented. Taking account of an interaction between the drive and driven units under limited power source, the non-linear differential equations were formulated for the two slider-crank mechanisms connected wit AFH. The condition of synchronization in the rotating motion of two machines is determined by averaging the equations. It is shown that the synchronizing phase and angular velocity are possible only when the fluid torque transmitted by AFH is greater than the sum of torques in load and dissipation of the unit system. The stability analysis of the stationary synchronized motion shows that one of the two sets of synchronized phase angles is unstable for the oscillating rotation, while the other is stable for the uniform rotation. The influence of the initial conditions of phase angle and relative angular velocities on the stability of the equilibrium point was examined by phase plane analysis. The stable motion was found to be oscillatory convergence, i.e. stable focal, while the unstable motion corresponds to the monotonous divergence, i.e. saddle point. A mechanical model in the laboratory also confirmed the synchronized solutions. The limitation of synchronized rotating motion was predicted.

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