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油气弹簧环形节流阀片大挠曲变形分析与试验

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摘要 提出了一种研究油气弹簧环形阀片大挠曲变形的方法。分析了通过钱式摄动法推导出解析式的误差，运用最小二乘原理重新拟合了解析式中的摄动参数，并与有限元数值解对比验证了其精确度。提出了环形缝隙节流的一种研究方法，运用边界层理论推导了紊流状态下缝隙的流量表达式。根据自主研发的油气弹簧的结构形式，通过上述推导公式以及实际气体状态方程建立了单气室油气弹簧的数学模型。仿真分析了系统弹性力与总输出力随位移的变化关系，将其与试验数据相比较验证了数学模型的正确性，为油气弹簧的设计提供了参考。

关键词 工程力学,油气弹簧,节流阀片,大挠曲,缝隙,紊流

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Experiment and analysis of large deflection of throttle slice of hydro pneumatic spring

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Abstract A research method of the large deflection of the throttle slice of the hydro pneumatic spring was presented. The deviation of the analytic equation deduced using the Qian perturbation method was analyzed. The perturbation parameters in the equation were refitted through the least square technique and the precision of the results was validated by comparison with the numerical solution from the finite element analysis. A method to study the throttling by the annular aperture was suggested and the flow equation through the aperture under the turbulence state was deduced using the boundary layer theory. A mathematical model was built for the self developed hydro pneumatic spring configuration with a single air chamber by the equation mentioned above and the real gas state equation. The relationships of the elastic force and the total force output versus the displacement in the system were analyzed by the simulation. The correctness of the model was validated by the comparison between the simulated results and the experimental data,providing a reference for the design of the hydro pneumatic spring.

Key words engineering mechanics hydro pneumatic spring throttle slice large deflection aperture turbulence

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