135-ENG

Optimizing Fluid Power for High-Efficiency Vehicle Propulsion

Fluid power is important because of its ability to produce high power in compact systems. It's applied in many types of equipment and vehicles because it can move a lot of power in a controlled way, however, these hydraulic and pneumatic systems aren't always energy-efficient since they lose energy through friction, heat, and leaks. As increasing focus is on making vehicles that are better for the environment that use less energy, improving the efficiency of Fluid Powered Systems (FPS) has become a big priority. This makes them ideal for industries where space is limited but power is necessary, such as excavators and bulldozers that rely on FPS to lift and move tons of dirt and debris efficiently as it offers a level of force and control that electric and mechanical systems cannot match in these types of applications. In this project the hydraulic and pneumatic systems that are already used in vehicles are studied. The proposed solution will improve endurance, efficiency, duration of use, and regenerate and reuse the dissipated energy in the resulting FPS vehicle. The hydraulic manifold is designed to reduce turbulent fluid flow by limiting the number of elbows and connection points, with check valves to prevent backflow and reduce pressure losses. The integrated FPS rely on several important engineering principles to function properly. Fluid dynamics principles are used to analyze the forces and motion that affect fluids. While Reynolds number helps in the determination of whether it's laminar or turbulent flow, fluid mechanics is used to find the factors like density, viscosity, and fluid velocity. Finite Element Method (FEM) computational technique is applied to determine the stress and pressure distribution within the structure to study how forces and loads affect each element so that the best materials are chosen to hold the resulting system. Finally, with Computer Aided Design (CAD) generated detailed models and simulations before a prototype is built and tested for improved design. The research focuses on optimized FPS that use less fuel, cost less to run, and produce fewer emissions. The design adheres to the regulations for safety and environmental standards.

*Keywords: manifold, finite element method, regenerate, prototype, laminar, turbulent

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