Fluid Power Vehicle Challenge

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Abstract

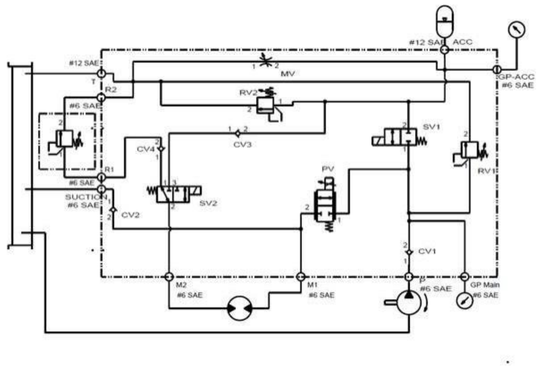
The Fluid Power Vehicle Challenge (FPVC) is an annual competition organized by the National Fluid Power Association (NFPA) in which teams from different universities compete to build a vehicle based on fluid power. The vehicle requires the use of hydraulics, electronics, and structural design where the vehicle will be judged based on its efficiency, speed, and endurance.

Introduction

The FPVC focuses on structural design, hydraulic system design, and electronics design. The hydraulic system must be able to store energy during vehicle operation, then utilize that stored energy to propel the bike forward. Propulsion is accomplished through hydraulics with human power serving as the prime mover in the system. There are two main modes for propelling the vehicle. The first is direct drive mode which works by flowing fluid straight through the motor while pedaling. The other mode is accumulator charge. This mode works by pedaling to charge the accumulator. The accumulator will then be discharged through the motor to propel the bike.

Methods and Materials

A recumbent trike was selected for the frame of the vehicle. The gear-pump linkage is located below the pedals and serves to convert human power into mechanical energy in the system. The fluid is then pumped through a manifold. There are 3 solenoid valves in the manifold that allow the flow path of the fluid to be changed for different functions.



Discussion

The biggest design decision for this project comes into question when choosing the top speed, you want your vehicle to achieve. There are many ways to increase the top speed of your vehicle including larger gears on the motor or smaller gears on your back wheel. When you try for a higher top speed, a greater torque is required at the pedal area. Therefore, there is threshold that you want to be within to maximize the speed of your vehicle while keeping the torque required to an amount that allows for continuous pedaling for around 10 minutes.

Conclusions

Every part of this vehicle needed a design overhaul to get the vehicle operational. For the hydraulics system, a whole new circuit was designed, and with the help of Bucher Hydraulics we were able to manufacture a manifold to reduce the amount of area the hydraulic system took up. For the frame, we stabilized the pedal area along with buying all new sprockets, gears and tires to help with any issues of the chain slipping off. We also 3D printed a few parts to help mount different components of the vehicle.

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