Parker Hannifin Chainless Challenge 2015/2016

Cal Poly SLO

Presented by:

Grace Cowell - Jeffrey Powell - Emmett Ross

(Not Present: Meagan Buck, Benjamin Kraw)

Mechanical Engineering
CAL POLY

Problem Statement

To design a human powered vehicle that does not use a solid mechanical drive while overcoming obstacles in manufacturing, efficiency, weight, and rideability

Mechanical Engineering
CAL POLY

Project Background

Project was a tech-elective

Doing a full re-design of the bike was not within our scope

Focused on working clutch and electronic control system

Mechanical Engineering
CAL POLY

Competition Objectives

Req. #	Parameter Description	Requirement	Risk
1	Life Span	+50 miles	H
2	Improvement Cost	< $1000	M
3	Safety	ASTM Standards	L
4	Overall Weight	< 125 lb	L
5	200 m Sprint	< 29.9 sec	M
6	Efficiency distance @ 500 psi pre-charge	> 200 meters (Previous year at 181 meters)	H
7	Can the rider control bike with both hands on the handlebar?	Yes	M

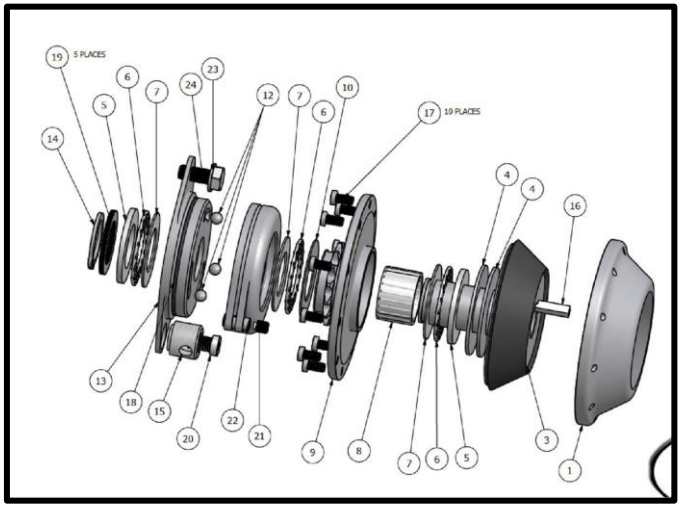
Mechanical Engineering
CAL POLY

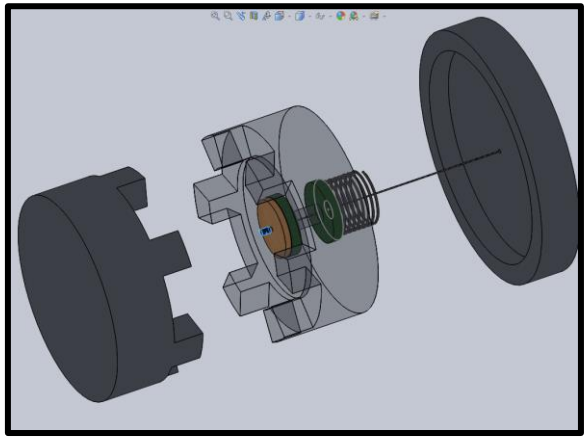
Design Analysis - Clutch

- Previous year was unsuccessful in operating their clutch
  - Cable housing split when actuated
- Hand calculations found that clutch must provide 32 ft-lb
- Needed a new system
  - Supports a high torque output
  - Easy enough to actuate by hand

Mechanical Engineering
CAL POLY

Clutch Development Process





Mechanical Engineering
CAL POLY

Design Analysis - Clutch

New Clutch: 3D Manual Clutch

Provides 26 ft-lb with original springs

Requires 2 lb to actuate

We improved the torque output

3dmotorsport.net

Mechanical Engineering
CAL POLY

Design Analysis - Control System

Solenoid Valves

To control the state of the bike's hydrau
system

Pressure Transducer

To measure the pressure of the
accumulator

Microcontroller (Arduino UNO)

To actuate the valves, read the pressur
and provide the user with input via the
display screen

www.arduino.cc

Mechanical Engineering
CAL POLY

Design Analysis - Control System

LCD Display

Display the state of the bike's hydraulic circuit

Display the accumulator pressure

www.hwkitchen.com

Battery

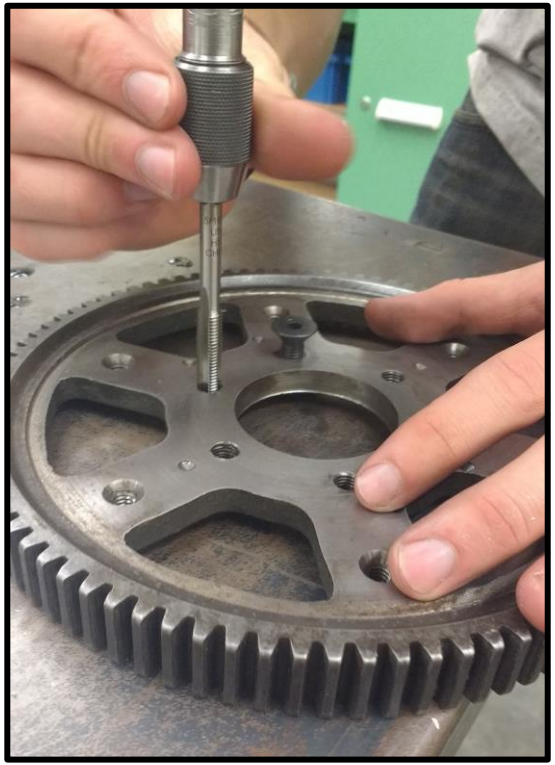
To provide power

Reed switch with magnet

To measure RPM of the front wheel

Mechanical Engineering
CAL POLY

Assembly- Clutch

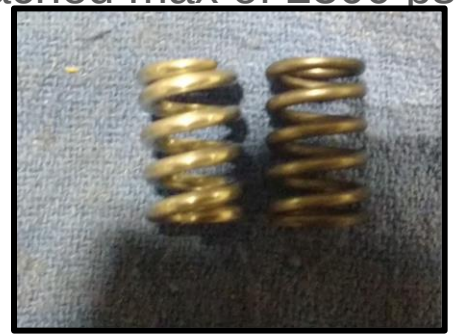


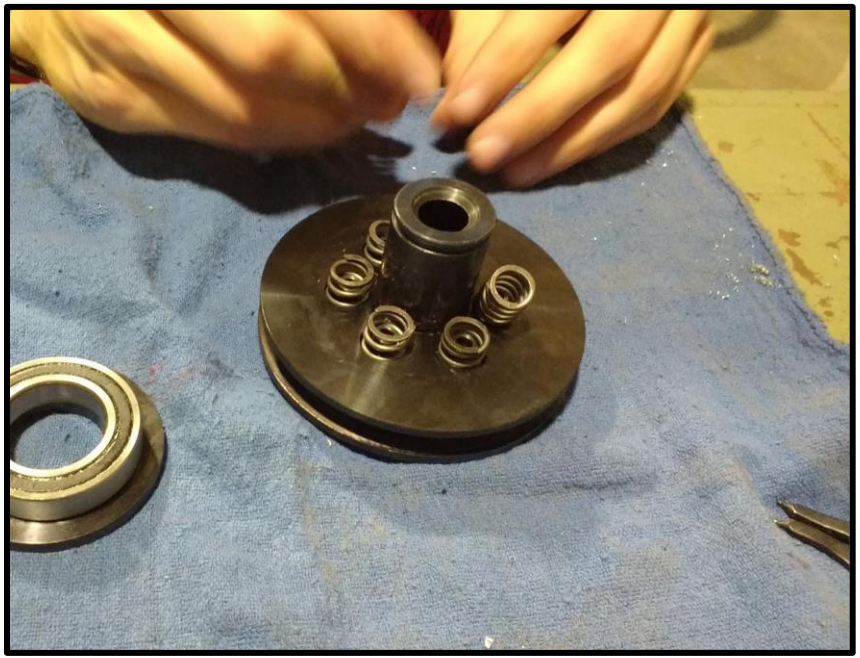
Mechanical Engineering
CAL POLY

Testing - Clutch

After installation of new clutch, bike accumulator reached a maximum of 1000 psi

After installing new springs (297 lb/in), bike accumulator reached max of 2300 psi





Mechanical Engineering
CAL POLY

Testing - Control System

Pressure Transducer

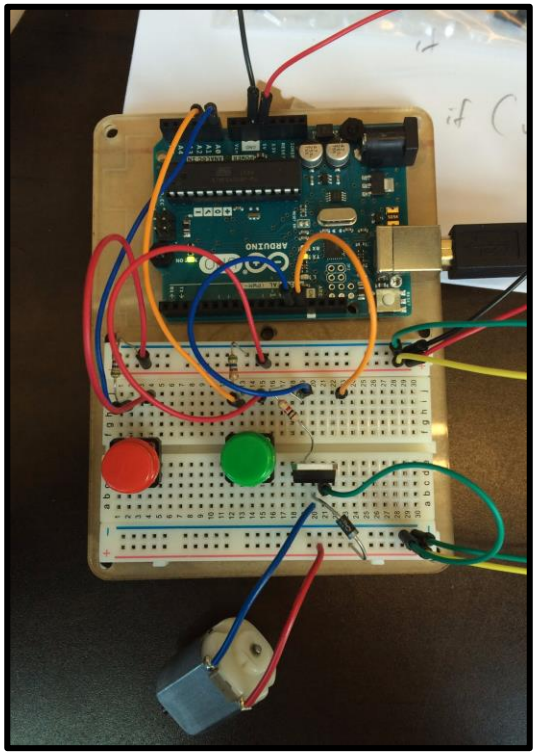
Successfully read the pressure transducer using the Arduino

Solenoid Valves

Created a transistor circuit to operate the solenoid valve (function properly for toggling a DC motor on and off)

Display screen

Communicated with the display screen using the Arduino



Mechanical Engineering
CAL POLY

Results

Req. #	Parameter Description	Requirement	Results
1	Life Span	+50 miles	So far so good
2	Improvement Cost	< $1000	$973.14
3	Safety	Meet ASTM Standards	No major failures
4	Overall Weight	< 125 lb	123 lb
5	200 m Sprint	< 29.9 sec	35.5 sec
6	Efficiency distance @ 500 psi pre-charge	> 200 meters (Previous year at 181 meters)	125 m
7	Can the rider control bike with both hands on the handlebar?	Yes	No

Mechanical Engineering
CAL POLY

Lessons Learned and Future Recommendations

Stainless steel tubing with fittings are expensive and difficult to assemble.

Clutch did not provide enough force to reach maximum pressure

Bike’s weight could be optimized by reducing fittings and cutting other unneccessary components

A gear system would be a good addition for the endurance race.

Mechanical Engineering
CAL POLY