Bicycle Rear Hub Wheel Transmission and Testing Dynamometer

Gordon Hansen (Hans Cycles)

PROBLEM STATEMENT

Team 17's project builds off a previous years Capstone to optimize and test a rear hub transmission that was prototyped by the rapid center and compare the results with a normal chain-driven bike. The Team's main objective was to prototype a testing apparatus to compare the two bikes and reduce friction within the transmission.

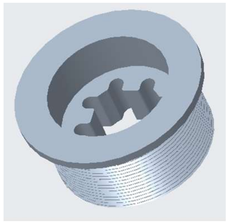
REQUIREMENTS

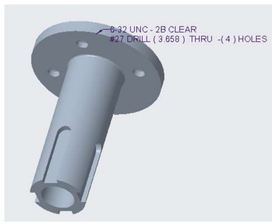
The transmission needs to be able to reach speeds between 8 and 12 MPH while supporting forces caused by an average rider.

#	Description
1	Testing apparatus must measure speed and torque
2	Testing apparatus and transmission must withstand forces caused by a 200lb rider
3	Must reach speeds between 8 and 12 MPH
4	Must fit within a standard bike rim (team is using a 26" rim)

CONCEPTS

- Initially the team focused solely on optimizing the transmission and researching the school owned dynamometer
- Several key weak points were identified and redesigned to be machined
- The team found that the school owned dynamometer would not gather the desired data and began designing a customized testing apparatus

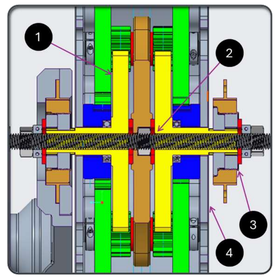




Cad models of machined parts:

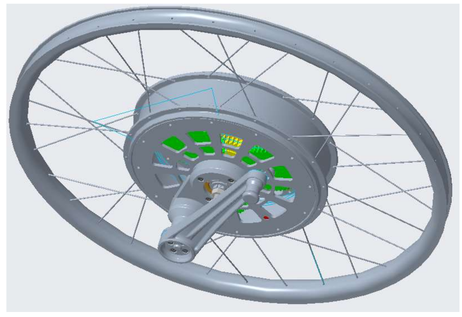
FINAL DESIGN, APPROACH, PLAN

The team started by locating weak points and then redesigning them for machining and eliminating unnecessary components. Friction points were located and UHMW friction rings were added to the crank gears to help reduce friction within the transmission. The team then focused on prototyping a customized testing apparatus that would be used to gather speed and torque data. The test stand would utilize a magnetic bike trainer, a 10kg load cell, a proximity sensor, and some custom 3D printed components.

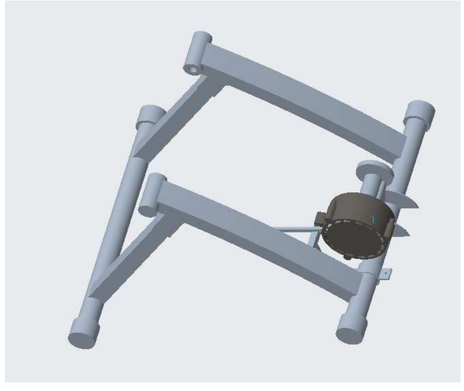


- Washers in RED
- Planetary Gears in Green
- Driving/Crank Gears in Yellow
- Hub Gears in Blue

Friction Points



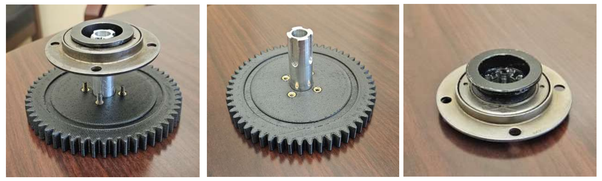
Assembly



Testing Apparatus

RESULTS

The team has been able to make good progress this semester. The prototype for the testing apparatus is complete (aside from setting up the load cell), reprints have been completed, and parts have been machined. Unfortunately, there was a mix up when ordering test stand components which delayed the teams progress with performing tests. However, the team is confident in being able to perform testing before the end of the semester.



Machined Parts

Sub-Assembly

Test Stand Prototype

SUMMARY AND CONCLUSIONS

Team 17 was able to machine key weak points, implement friction rings, and develop a prototype (proof of concept) testing apparatus. Unfortunately, due to time constraints, the team was not able to optimize both the hub and test stand as much as desired. However, the team is happy with what has been completed and is going to continue to improve as much as possible in the last week of the semester.

FUTURE WORK

There are more components that should be machined, if this transmission were to be manufactured, and parts such as the spline that could potentially be redesigned to fit with an off the shelf component which would reduce machining cost (the adapter shown in the concepts section, is an off the shelf component which mates with the spline). There is potential to redesign the spline to mate with the adapter with no modifications (this approach was not taken due to time constraints). Additionally, with more time, the test stand could be further optimized to collect better data.

TEAM & ACKNOWLEDGEMENTS

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- Simon Faulkner – BS Mechanical Engineering
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