IPRO 321

Improving the Efficiency of a Paper Shredder

Summer 2007
Introduction

Force Sub-team:
• Joey St.Clair
  Computer Science
• Adam Stultz
  Biomedical Engineering
• Sebastian Zielinski
  Computer Engineering

Noise Sub-team:
• Kelly Bergren
  Applied Mathematics
• Erik Dill
  Computer Info. Systems
• Michael Kim
  Computer Engineering
• Daniel Mendez
  Electrical Engineering
• Mithun Michael
  Electrical Engineering

Gears Sub-team:
• Yemi Babatola
  Mechanical Engineering
• Luke Cho
  Mechanical Engineering
• Saul Esparza
  Electrical Engineering
Background

- The Paper Shredder Industry
  - multi million dollar industry
  - fast growing

- Why use a paper shredder?

- The industry today:
  - highly competitive, increasing consumer demand
  - extensive research to improve design

- The Manhattan group
  - Mr. Seth Lewis (sponsor)
  - improve Royal brand paper shredder
Mr. Seth Lewis approached our team with the following tasks

- Determine force
- Optimize the gear train
- Reduce noise
Obstacles

- Shortened semester
- Research time vs. mandatory activities
- Tools
- Inability to contact previous semesters’ team members
- Unavailability of professor expertise
The IPRO 321 team shall conduct its business in a manner that best serves the community, the sponsor, and all affiliates with the project while acting within the bounds of the laws set forth by any governing board.

- Questioned sponsor about which ethic guidelines should be respected.
- It is an accepted industry standard to take a current product and reverse engineer it in order to make a new product or make the current product operate differently.
- Assured by sponsor that no ethic guidelines were violated.
- The IPRO team is under no contractual agreement. However, the IPRO team would strive to satisfy the sponsor’s demands.
- Provide a professional environment in which all teammates would be treated with the utmost respect.
Measurements done on Royal and leading competitor shredders

Noise primarily comes from the gear train

The frequency of the noise affects the perception of loudness

Placement of sound dampening material has a larger effect on noise reduction
Gear Train

- Gear Ratio?
  - Ratio of input to output speeds
  - Calculated and confirmed using RPM Readings
- 225:1 vs. 400:1
- Shred Speed
Motor Speed

- Higher RPM: Source of High-Frequency Noise
- Royal brand vs. Leading Competitor
  - Stroboscope Test – Measure RPM
  - RPM $\propto$ Frequency
Torque

- Recommended optimum gear train requires more torque
- More powerful motor required
Conclusions

- Gear train not the motor makes the noise
- Higher gear ratio is ideal
- Higher frequency noise “sounds” louder
- More torque is needed
Recommendations

- Modify current gear train
- Reduce frequency of noise
- Use higher end motor
- Isolate vibrations of motor assembly
We would like to express our great thanks and appreciation for the help of:

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- Professor William Maurer, faculty advisor
- Dr. Sheldon Mostovoy, MMAE professor
- Russell Janota, lab technician
- David, Staples’ store paper shredder expert