Human Powered Amalgamator

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Abstract

This project is all about the schematics that go with the amalgamator and the efforts that the team has applied to make changes to this device. The changes the team have instituted are informed by a need to have a more user friendly amalgamator especially for the student users who are finding it hard to cope with the existing dental amalgamator. The team set out with the chief objective of making a hand driven Dental amalgamator. This also doubled up as the client chief concern. The other pressing objective was to make a device that was portable to be moved from one place to another. There other subsequent minor objectives that were informed by the customer needs.

After evaluating several possible designs, the team settled with the Gear Box mixer. This design works on the principle of the gears that are attached on shafts that will transfer the circular motion to semi linear motion. As it is able to multiply the initial torque by a scale that makes it able to meet all the requirements that were outlined as being important for the need that needs to be met. This design works on the principle of gear ratios in the manner that they interact with each other. The driver gear drives the other gears and in the process, as the gears will be rotating on it the capsule holder will be placed on the output and it will move in semi linear motion.

Problem Definition

The project is a collaboration work between NAU's Dental Hygiene (DH) Dept. and NAU Mechanical Engineering Dept.(CHHS and CEFNS) in creating this Spring 2017 capstone project for mechanical engineering students to create a human powered mixer that can shake a capsule for 10 seconds. Two conditions go with the above description. The first one is that the model that the team had to make was to be human powered. The second condition was on the time factor.

Table 1: Relative weight of the customer requirements

Customer requirement	Weight
Use of human power to power the device	5
Light weight	3
Smaller in size	5
Be durable	4
Speed between 3000 rmp to 4500 rpm	3
Easy to use	4
Transparent compartment	3
Takes 10 seconds to shake	3

Manufacturing

The cost of the implementation was dependable on 3D printing the device and ultimately manufacturing the device. Also, the team manufactured the housing of the gearbox and it was made out of plastic and wood. The team agreed upon using Aluminum to manufacture the handle and Steel to manufacture the shafts and gears. The estimated manufacturing cost was $800.

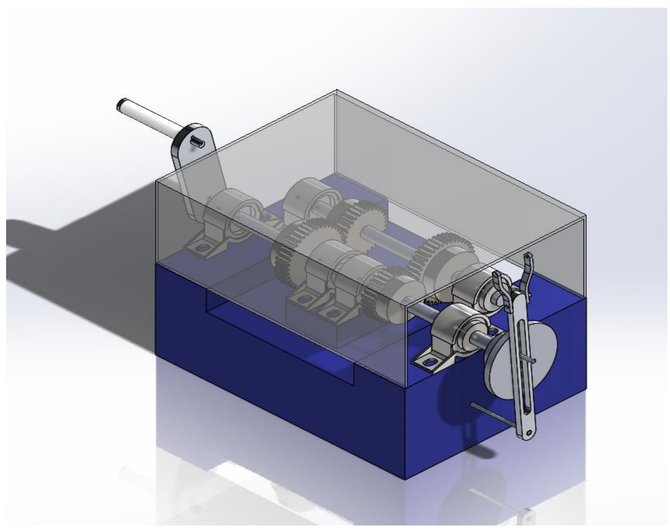
Table 2:The parts and total cost

Part	Quantity	Cost
40 Teeth Gears	2	$81.44
30 Teeth Gears	2	$63.11
Shaft	1	$15.19
Bearings	6	$65
Part manufacturing K&M Tools		$780
Wooden Base	1	$10
Cover case	1	$13

Construction Process

Team's first step was to have a complete and fully dimensioned CAD design, and this was the start. After making sure that the CAD design was successfully operated as intended, the team printed 3D design, and this was to actually investigate how the device physically operated. The step after 3D printing the device was to interact with a machine shop regarding the manufacturing of the device itself.

Figure 1: Device Final Design



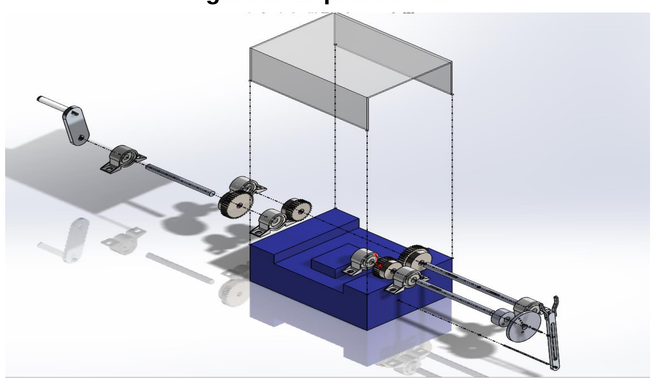
Gear Ratio Analysis

- To achieve the best gear ratio, a gear train was used to determine the amount of output kinetic energy.
- The equations were used to achieve precise calculations to determine the exact power and time needed to obtain the output.
- Since the device does not use electrical power, gears coupled with a handle were used to initiate the rotation that offered the sufficient power to realize the mixing required.
- The device was human hand operated to initiate the movement and rotations, which in turn, provided the required energy to triturate and give the capsule needed within the stated time frame.
- A gearbox was considered where systems of gears, with a different number of teeth, were used to change the speed and the motion direction in the components.
- The gears were connected to the holder of the capsule.
- The device obtained its initial drive from the gears that converted the circular motion provided by the human hand to a semi-linear motion, which was fed to the gear system.

Figure2: NSSI 1630 and NSSI1640 gears

Exploded View of device

Figure 3: Exploded View



Analytical Analysis

- The materials were analyzed and chosen carefully to insure the quality of the device.
- The shafts and gears are steel, Which is NSSI1640 and NSSI1630 spur gears[1] These gears are more strength than other gears with same size.
- The decision was made to use polymer plastic [3] for the handle because it has good weight and strength ratio and the handle drive is aluminum so it has high electrical and thermal conductivity.
- The shafts were analyzed to determine where the key ways needed to be placed to attach to the gear.
- Wood is a natural material which is a poor thermal and electrical conductor because of that it has been chosen as a base.
- The material that used for the output is Aluminum[2]. Which has less weight. The outlet screw covered with polymer material to avoid the friction that caused between the two aluminum objects.
- Polycarbonate[4] sheet cover added to the device to cover the gears for the safety requirement
- The result was the size was determined for the project. The results helped assist where the shaft and gears should be placed.

References

[1]www.mscdirect.com/product/details/35442367.

[2]www.ncbi.nlm.nih.gov/pmc/articles/PMC2048794

[3] http://www.sciencedirect.com/science/book/9780815514039

[4] http://pubs.acs.org/doi/pdf/10.1021/ie00039a007

Acknowledgments

- Dr. Sarah Oman (Facility Advisor)– Department of Mechanical Engineering, Northern Arizona University.
- Dr. Amy Smith (Client Contact)- Dental Hygiene Department, Northern Arizona University.
- Dr. David Trevas (Project Mentor)
- Project Sponsor: K&M Machine Tool Inc.

Final Design

Figure 4: The device without cover