

Dental Hygiene- Human Powered Amalgamator Capstone project

Operation Manual and Assembly Manual

Team I

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Introduction

The manual was prepared by students to know how to operate the device and maintain it. It provides important information regarding the operation and maintenance of a manual dental amalgamator. The information, content, procedures and conclusions of this manual should not be relied on or utilized without thorough testing and verification.

Overview

A dental amalgamator is equipment which is used to mix the components of dental capsules before certain dental procedures can be done and are normally powered by electricity. This machine is normally used by dentists to shake and mix a capsule comprising of amalgam and glass ionomer sealant. The capsule contains liquids and metals used to fill teeth. However, the dental amalgamator in this case is a manual one which is generally a modification of the original electricity powered one so that it can be used in areas where there is no electricity. The changes are more user friendly especially for the student users who are finding it hard to cope with the existing dental amalgamator. The Dental Amalgamator meets the various engineering and customer requirements.

1.1 Specifications of the gear amalgamator

Part	Quantity
40 Teeth Gear	2
30 Teeth Gear	2
Steel Shafts	3
Housing	1
Capsule holder	1
Handle	1
Outlet arm	1
Outlet base	1
Low-Profile Mounted Ball Bearings	6

2 Manufacturing

Generally steel shaft which is an alloy of iron has been used since it is more quality than other materials and is rust resistant. Also, the steel 1/2in bore gears provide a less noisy environment during operation. It is also durable and is able to withstand tensile and compressive forces.

2.1 Capsule holder

This is made of sprig steel therefore making it light in weight. Also, spring steel is tough, hard, resistant and flexible to wear, self-lubrication, chemicals thus suitable for making the casing.

2.2 Cover

The cover is made up of Lexan polycarbonate which is thin and transparent to ensure good visibility and hence easy monitoring of the whole process. It is also resistant to scratching, not brittle, its density Lightweight, and stronger than glass.

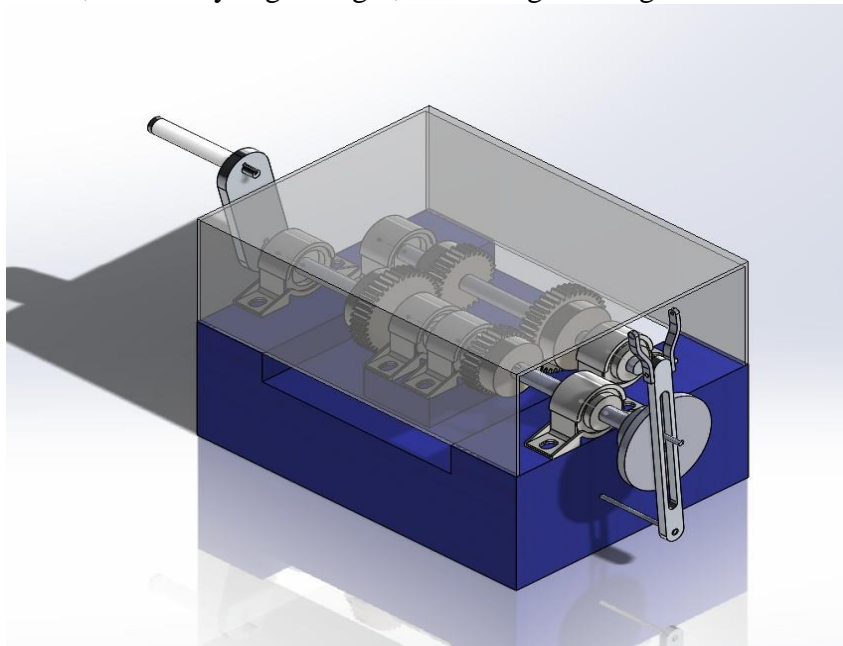


Figure 1 Isometric view of dental amalgamator

2.3 Housing

The Top housing of the device is made of Lexan, which is a polycarbonate which is light, tough, and resistant to chemicals and stresses from work fatigue. Bottom housing made of wood painted with spray blue color.

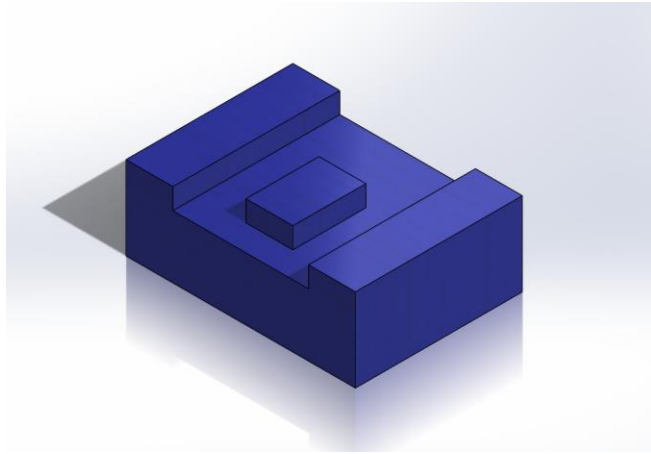


Figure 2 wooden base

2.4 Gears

They are made up of steel. Four gears are different in sizes two of them are NSSI 1640. The other two are NSSI 1630. The two different gears were used to insure the change of speeds on the system so the device can be operate on the required speed to shake the capsule.

2.5 Shafts

They are made up of steel. The shafts are 1/2 in diameter to be assembled to the gears. Three shafts were used the first shaft is assembled to the handle crank and to first drive gear which 40 teeth. The second shaft is driven by the first gear. The second gear which 30 teeth is attached to the second shaft and the second gear in this case is driven by the first gear. The third gear which is 40 teeth it's attached also to the second shaft. Shaft 3 which is assembled to gear 4 which 30 teeth and it's attached to outlet arm and capsule holder.

2.6 Handle

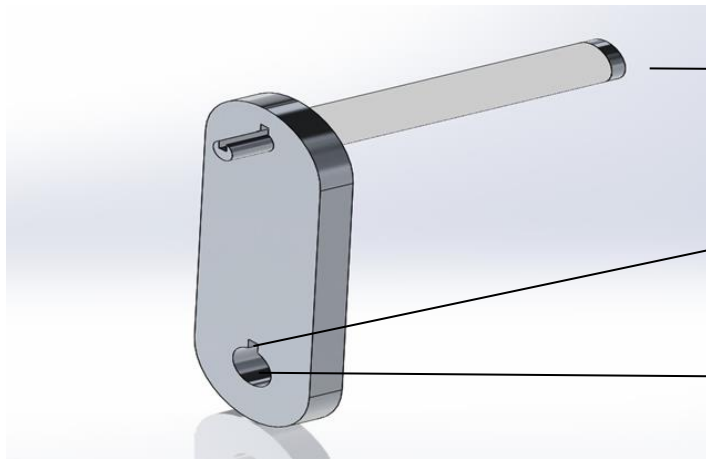
It is made of aluminum and the grip is made of polymer

3 Assembly

The assembly section of the dental hygiene team I covers the entire reconstruction of the Gear Box device as it was completely disassembled. The Gear Box device is made of six main sub-assemblies that create the final Gear Box assembly. We would discuss each assemble here to reach the final assembly easily, even without any of engineering knowledge.

3.1 Inlet

The Inlet power is the part that the user going to let his power in to transfer it to an outlet could reach the purpose. In the Gear Box device we choose the most appropriate material which is the Aluminum for the hand crank drive and it has two holes each hole has key lock. The above hole is assembled to the grip by the key lock, and the other one attaching the shaft.

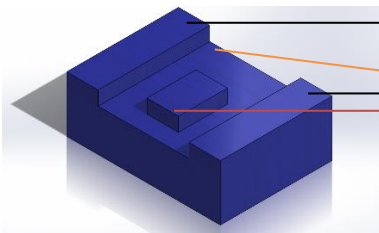


Polymer Grip Steel Key
 Lock
 This is the key lock
 And here is the shaft hole

Figure 3 handle crank and grip

3.2 Housing (Base and Cover Case)

The Housing is about the wooden base which will assembled with the bearings by the screws to holding the shafts and gears. This base is made of wood and it's about Four parts glued together, the bottom part is the real base and the other two parts will be on the sides on a high level (as shown on the below figure) higher than the real base to refuse the gears friction. And the fourth part would be the small rectangular on the middle, carrying the bearings.



These the two higher sides parts.
 This is the bottom part.
 This is the middle rectangular.

Figure 4 wooden base

Then these wooden base will attaches with the bearings as shown figure.

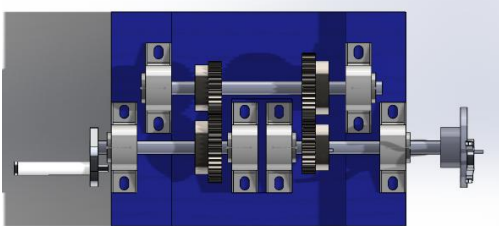


Figure 5 top view

The Cover Case is about three Lexan polycarbonate glued with each other, two on the sides and one on the top. Assembled on the bottom with the base. After assembled the Shafts, Gears and Bearings. It's the time to attach the cover case with the base by using 3M tape. As shown figure.

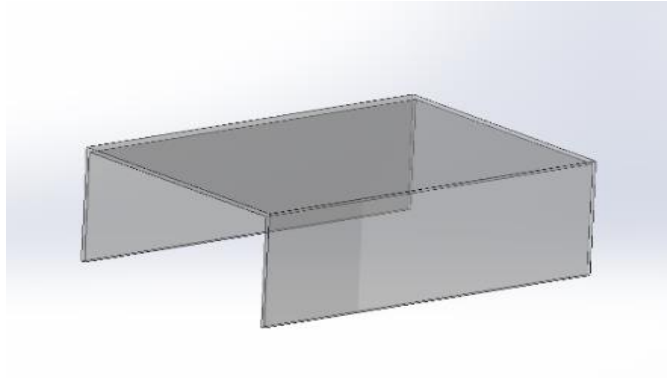


Figure 6: ISOMETRIC VIEW COVER CASE

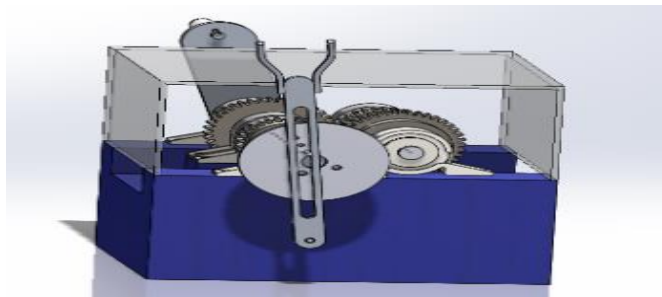


Figure 7: SIDE-VIEW

3.3 Shafts, Gears and Bearings

There are three shafts two are shorts and one tall. Each shaft is about an assembly and then they assembled to each other. Therefore we would describe each one alone.

a- The first one attached the handle crank with the 40 teeth Gear assembled by the bearings. There are two screws in the bearing and there are two key locks one in the hole of the handle crank and the other one is in the 40 teeth gear.

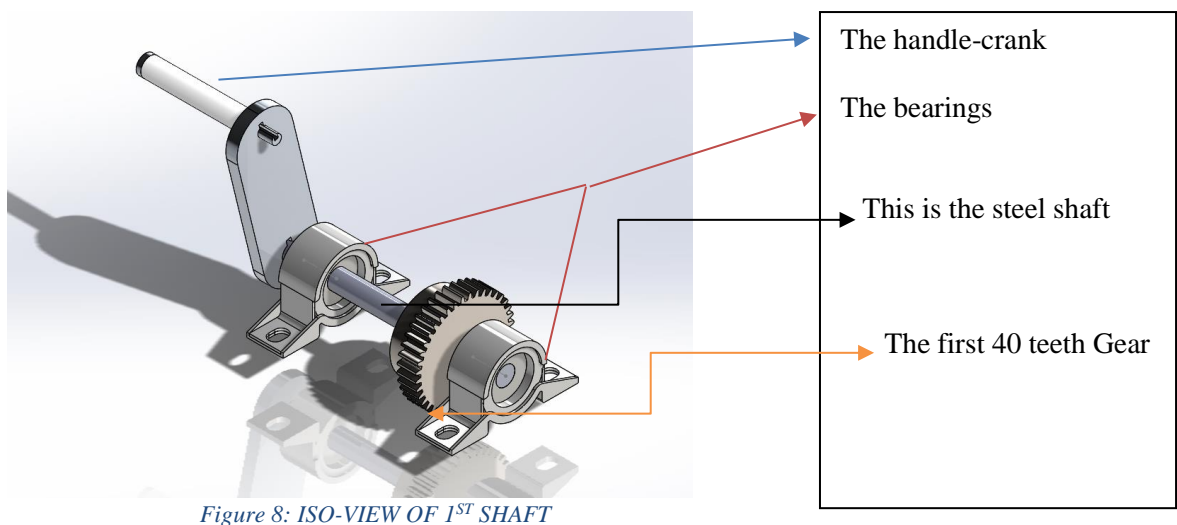


Figure 8: ISO-VIEW OF 1ST SHAFT

b- The Second one attached 30 teeth Gear to the 40 teeth Gear and each gear are assembled

with the shafts by key lock, the whole shaft is attached with the base by two bearings on the sides, each bearing has two screws.

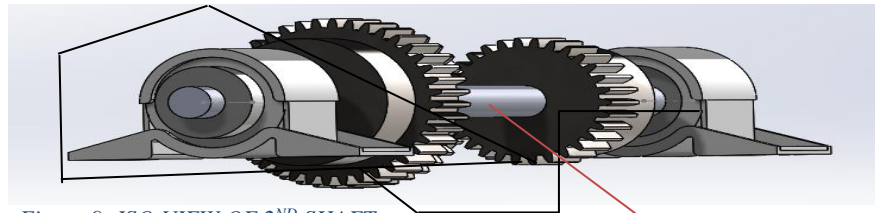


Figure 9: ISO-VIEW OF 2ND SHAFT

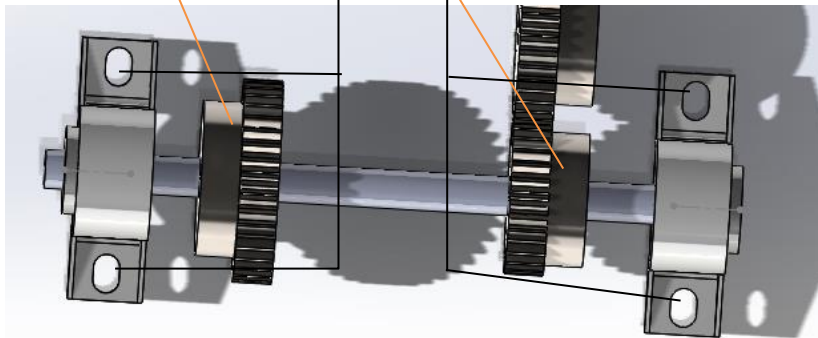
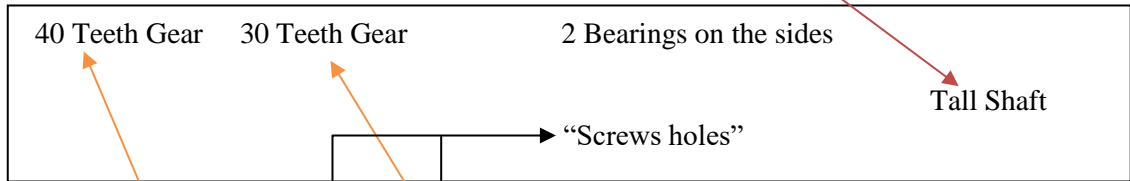


Figure 10: TOP-VIEW 2ND SHAFTS

c- The third shaft attached 30 teeth Gear assembled to outlet CD, sticking with the base by a bearing. There are two screws in the bearing and there are two key locks one in the gear and the other one CD.

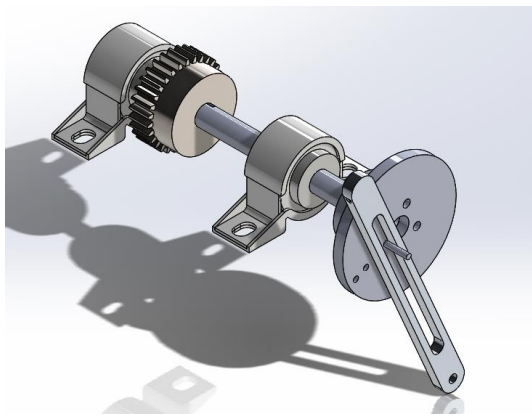


Figure 11: ISO-VIEW 3RD SHAFTS

d- Finally these shafts, gears and bearings assemblies will attach to each other, giving us this shape and this result.

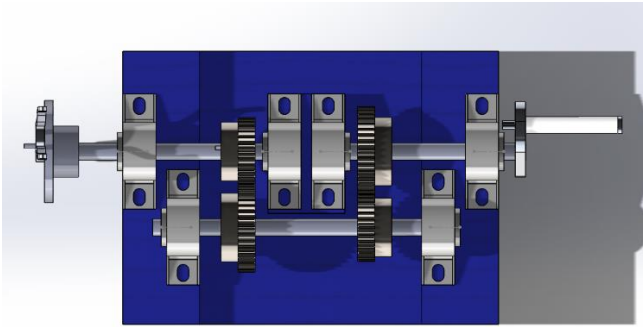


Figure 12: TOP-VIEW OF SHAFTS WITH BASE

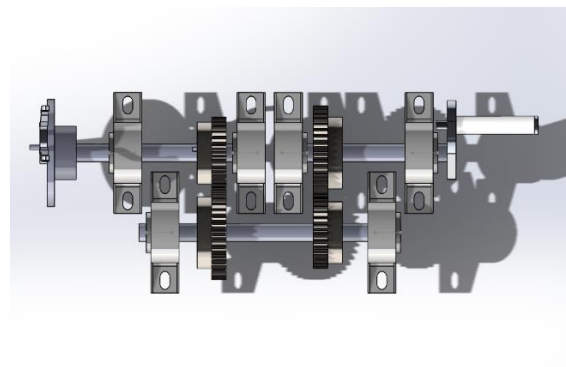
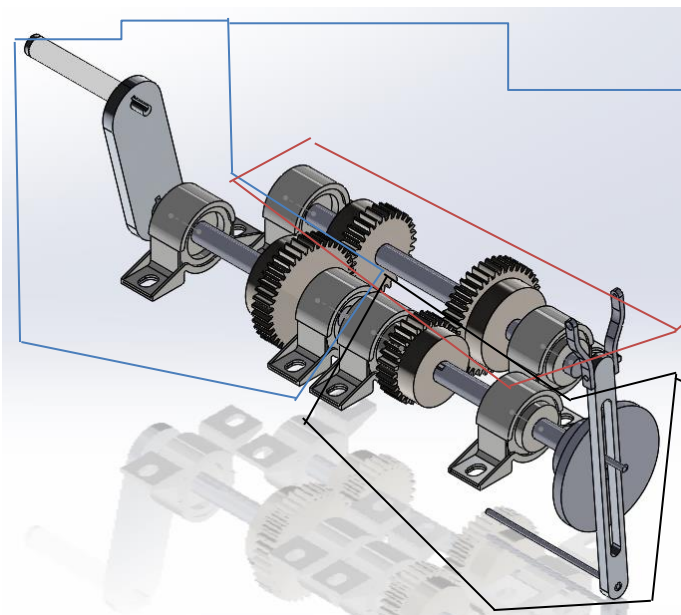


Figure 13: TOP-VIEW OF SHAFTS



As shown here, this is shaft 1 with the attached bearing, gear and handle crank.

And here is shaft 2 with 2 gears and bearings are attached.

This is shaft 3 with 2 bearings attaching the gear with the Outlet CD.

Figure 14: ISO-VIEW OF SHAFTS

3.4 OUTLET

This section of the assembly is concerning on the outlet assemblies, the outlet is about five parts attached to each other by four screws. Also there is a tall screws stick on the bottom base, to stick the outlet arm to not moving with the shakes. The five parts would be discussed separately.

a- Outlet base

This part attaching the shaft with the CD, and helping to attach the outlet arm with the CD very well.

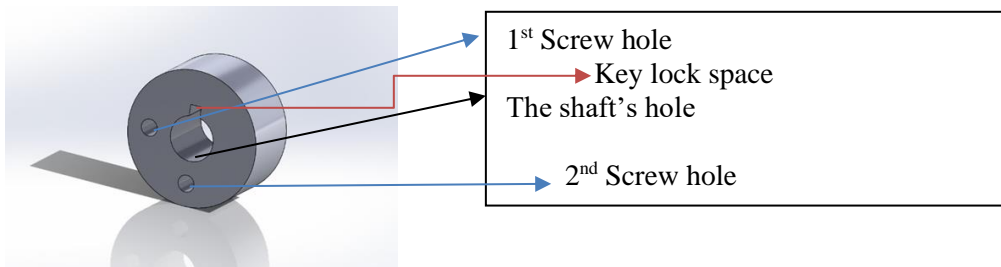


Figure 15: OUTLET BASE

b- Outlet CD

This part have two holes for the screws. One of these screws attaching the CD with the base only, and the other screw attaching base, CD and the outlet arm. In addition there are several holes in the same level sequentially under each other to change angles.

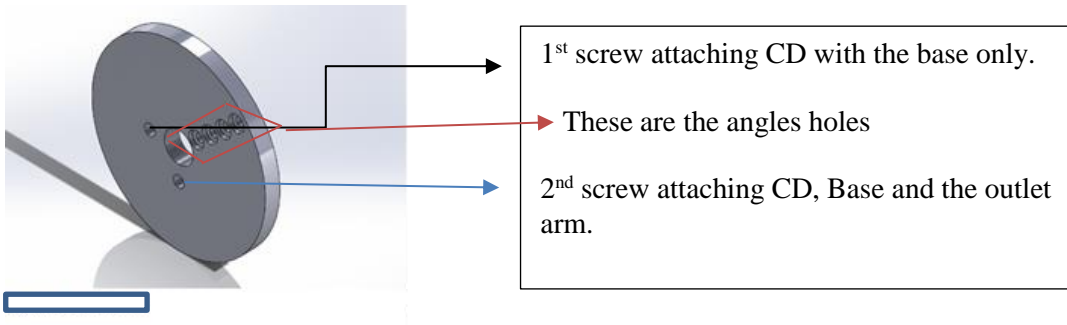


Figure 16: OUTLET CD

c- Outlet Arm

This part is the third part, it have one circle hole on the very bottom which stick the tall screw with the bottom base. And there is through all rectangular above this which would be attached with the base and CD by a screw. And on the top of this part the capsule holder is sticking.

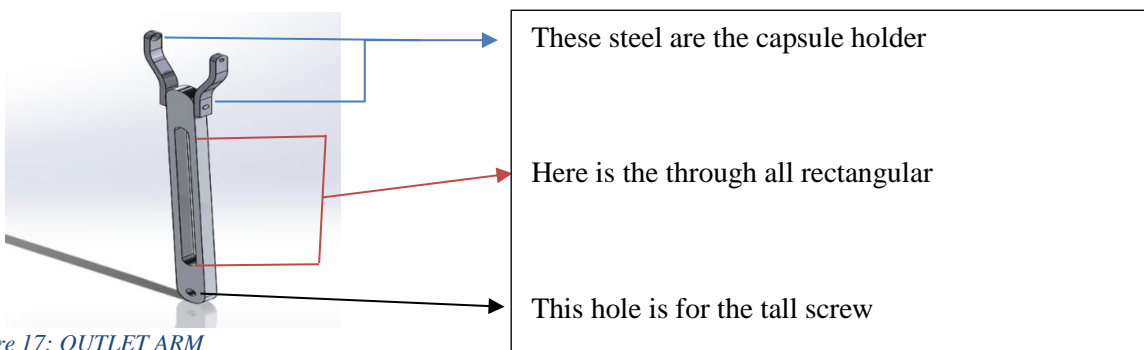


Figure 17: OUTLET ARM

d- Final Outlet assembly

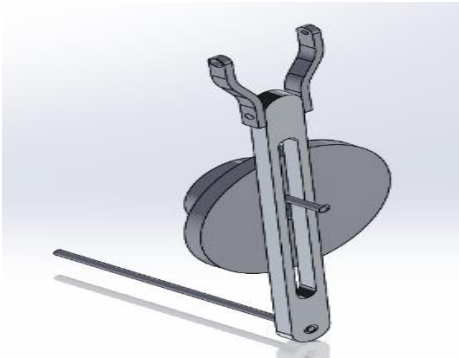


Figure 18: ISO-VIEW OUTLET ASSEMBLY

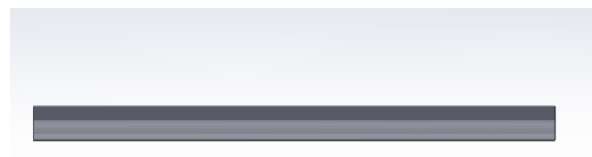


Figure 19: FRONT-VIEW TALL SCREW

* **Final Assembly**

Finally anyone will follow all the steps above he will reach for this final assembly.

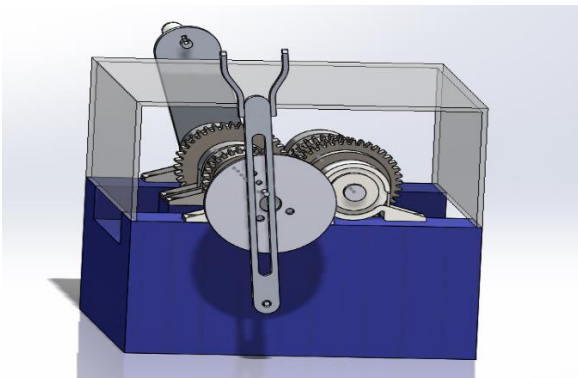


Figure 20: SIDE-VIEW FINAL ASSMBLY

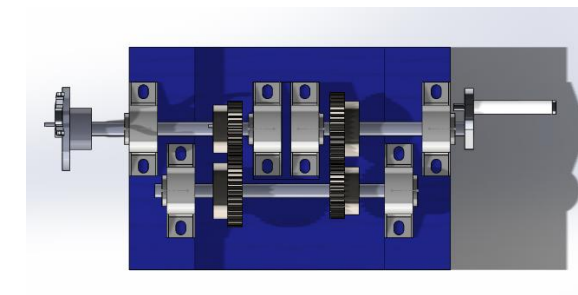


Figure 21: TOP VIEW FINAL ASSEMBLY

4. Operating the amalgamator

- The Gear Box amalgamator has four gears three shafts and a handle crank to move the gears and the driven gear will move the shaft outlet to rotate the capsule holder it will give as a linear motion.
- The Gear Box amalgamator is manually operated by rotating it using a hand which drives the first gear that is normally very large.
- As a result smaller subsequent gears are driven hence multiplying their speed all the way to the capsule holder.
- This gear amalgamator works on the principle of the gears that are attached on shafts that in turn transfer the circular motion to semi linear motion.
- In addition, the 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 rotate on it the capsule holder is placed on the output hence making it to move in semi linear motion and it will shake the capsule for 50 sec.



Figure 22: HUMAN POWERED AMALGAMATOR

5 Maintenance

This gear amalgamator is manually operated by hand and hence requires very minimal maintenance as its operations are not very hard.

5.1 Lexan Polycarbonate

Since most of the activity of mixing the capsules takes place in the cover. Lexan can be cleaned up with warm water and soft cloth. And the cover case can be replaced easily by takeoff with –screw drive from the edges of the Lexan cover that it have a clear double tape.

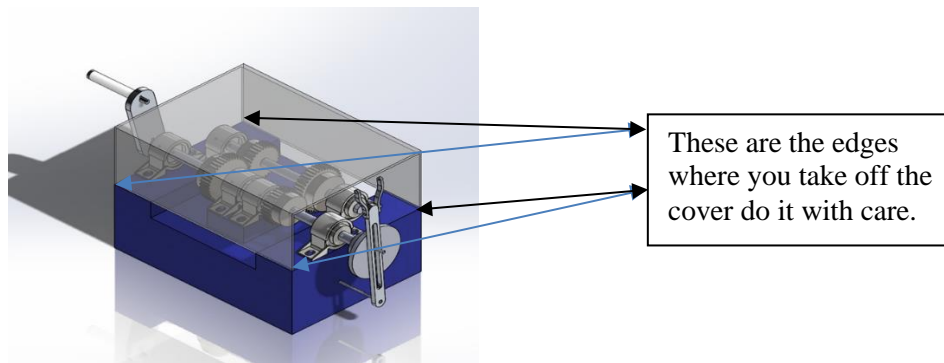


Figure 23: LEXAN POLYCARBONATE

5.2 Gears

The most important parts of this mixer are the gears which are in constant motion especially when the mixer is in use. The operator should regularly check the gears by removing the cover or by using an endoscope. The contacts between gear teeth should be check if there is high noise.

First step: put grease oil (WD 40). If the noise get low, is good don't do the second step.

Second step: use Allen Keys (inch size) to take off the gears from the shaft by lose the gear from the key way on the shaft.

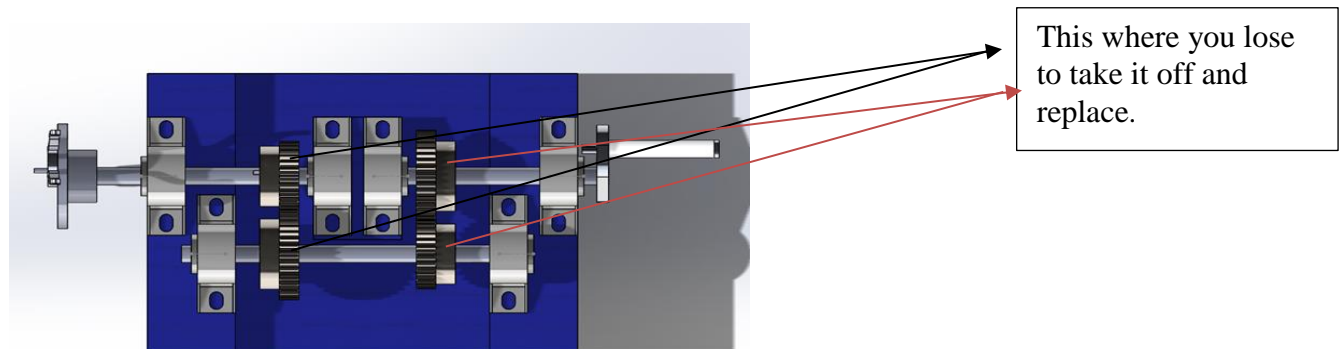


Figure 24: GEARS

5.3 Vibration Analysis

Vibration analysis should regularly be carried out and appropriate replacement be made to ensure efficient operation.

5.4 Aluminum handle

The handle should be checked regularly and in case there is tear and wear or it is worn out it should be replaced with a new one. The handle can be sprayed by high pressure spray and it can be cleaned by warm water and soft cloth.

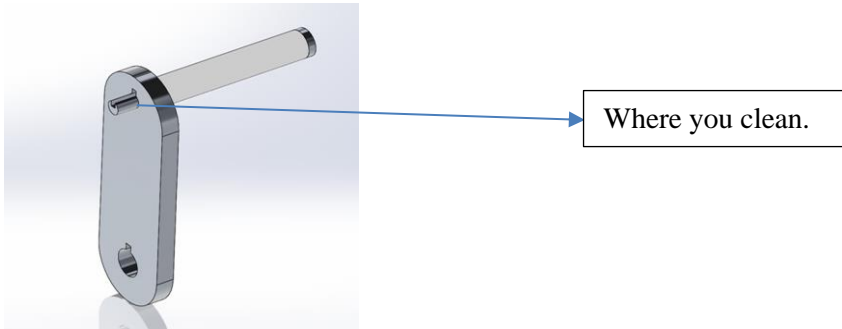


Figure 25: ALUMINUM HANDLE

5.5 Bearings

Due to frequent movement, the bearings should be oiled regularly so as to reduce the amount of friction which may arise and hence ensure efficient operation of the amalgamator. There is 6 bearings in the device and 12 screw holes 2 in each bearing.

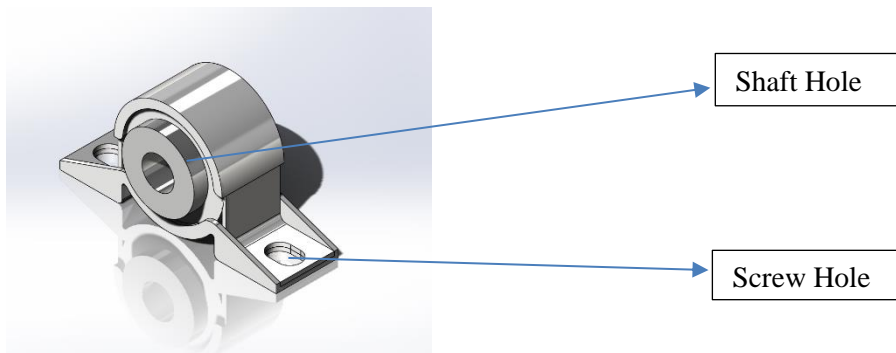


Figure 26: BEARING

5.6 Bottom Base

The base made from wood the holes through which the shaft passes so that it can be fixed to the bearing should be greased regularly so as to minimize friction and widening of the holes. The paint should be sprayed to keep the painting clean.

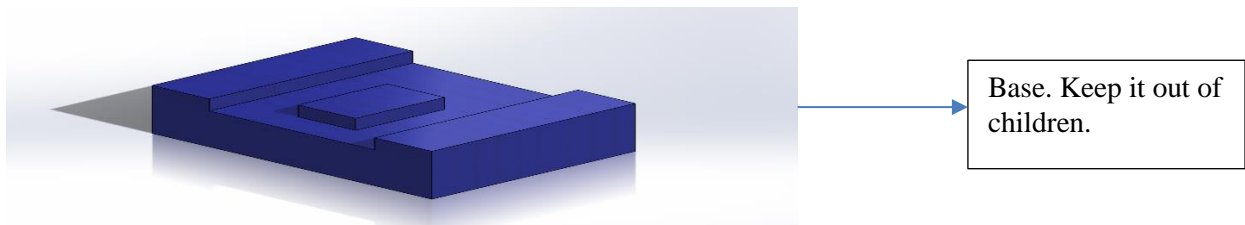


Figure 27: WOODEN BASE

5.7 Cleaning

The dental amalgamator should be cleaned after use to avoid accumulation of dirt and concentration of harmful bacteria and germs.

6.1 Friction

Gears move against each other, and hence experience friction to varying degrees. This is normal but in case the friction escalate to a point of damaging the structural components of the mixer or else interferes with its operations the gears should be replaced.

6.2 Noise

At times the amalgamator can produce noise which can result into loss of concentration and emotional disturbance. In case of this, engineering controls such as the use of sound-dampening materials can be used. Also if the gears are noisy a vibration analysis should be carried out to assess the extent of damage.

7 Appendix

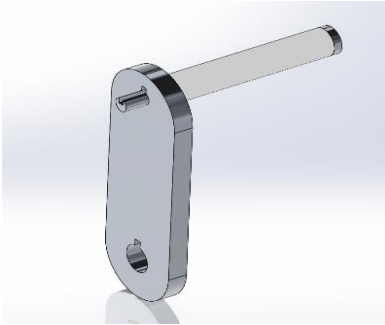


Figure 28: HANDLE CRANK

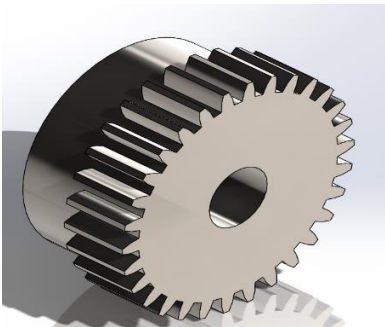


Figure 29: Gear 30



Figure 30: Bearing

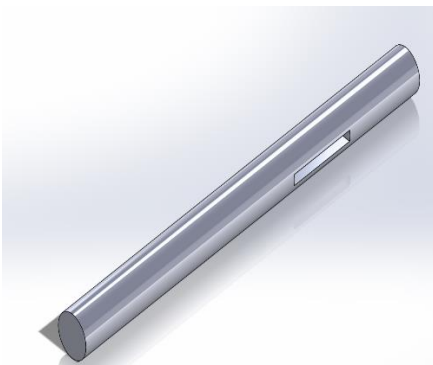


Figure 31: one of the small's shafts

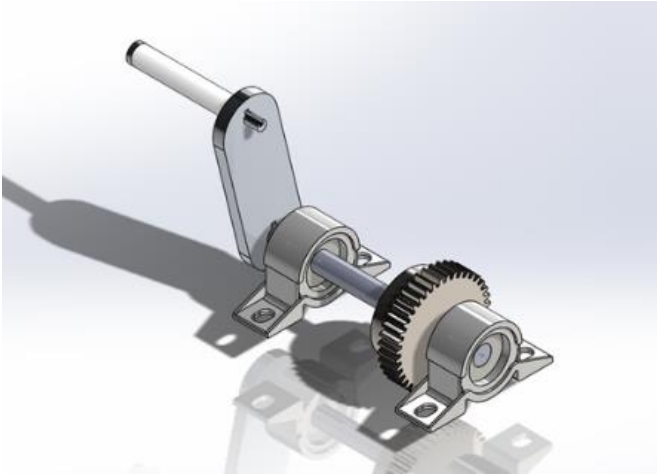


Figure 32: The 1st Shaft

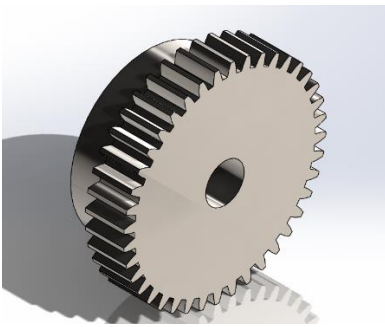


Figure 33: Gear 40 Teeth

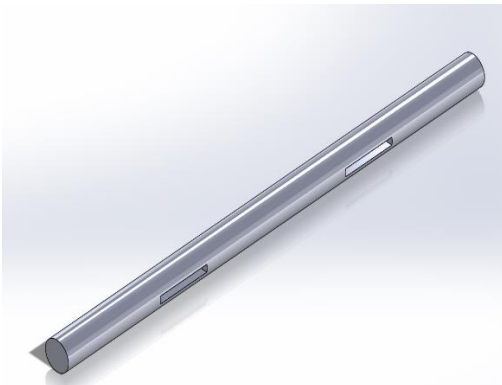


Figure 34: The Tall Shaft

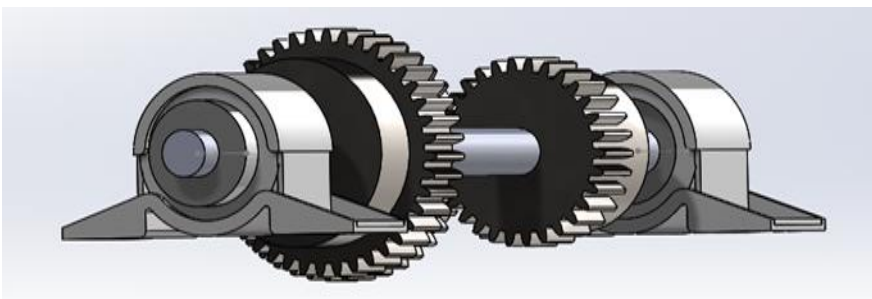


Figure 35: The 2nd Shaft

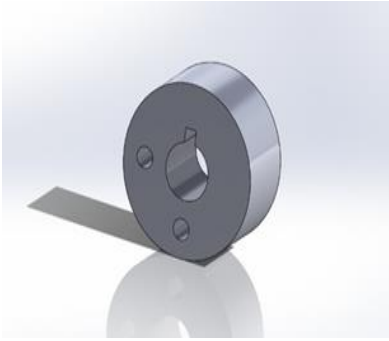


Figure 36: Outlet base

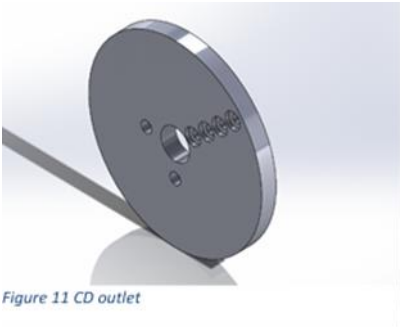


Figure 11 CD outlet

Figure 37: CD outlet



Figure 42: Outlet Arm

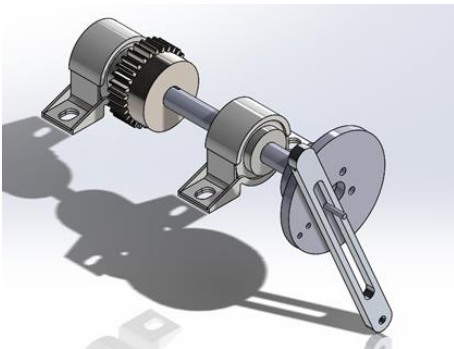


Figure 43: The 3rd Shaft

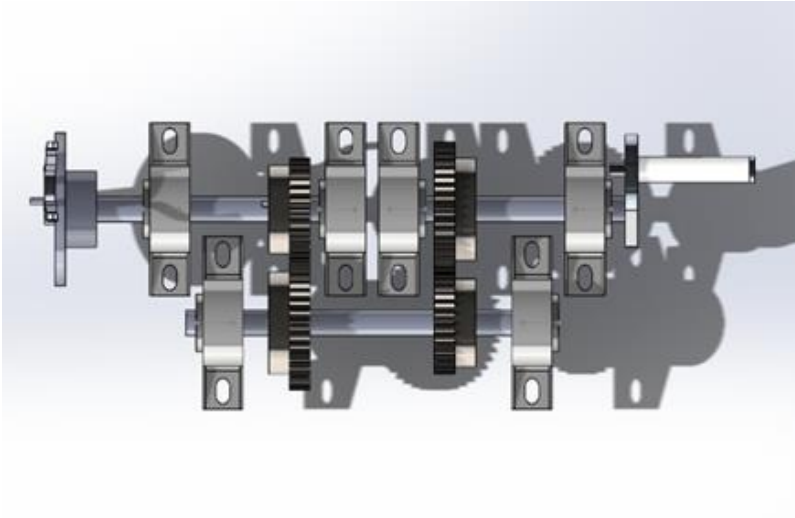


Figure 44: Top-view of shafts

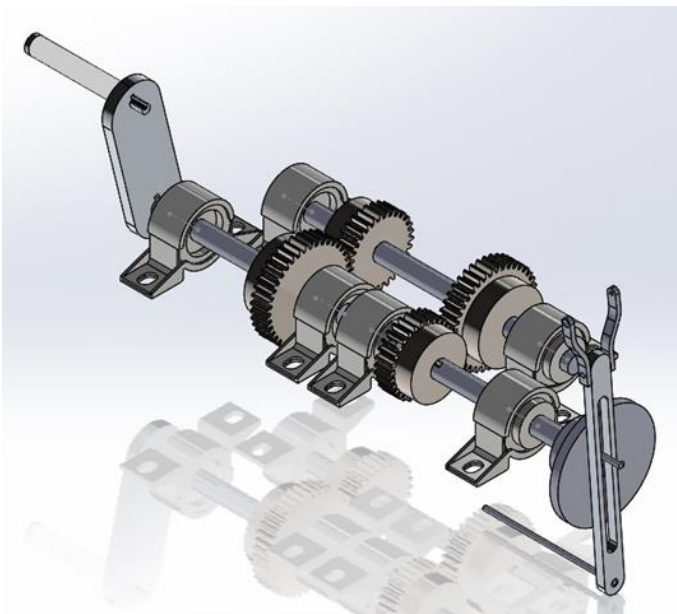


Figure 45: ISO-View of shafts

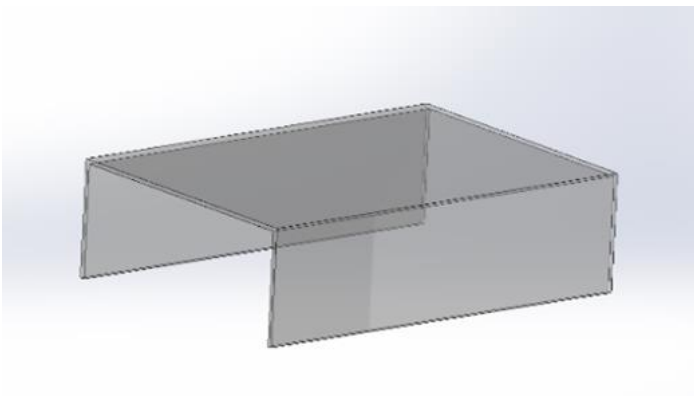


Figure 46: Cover Case

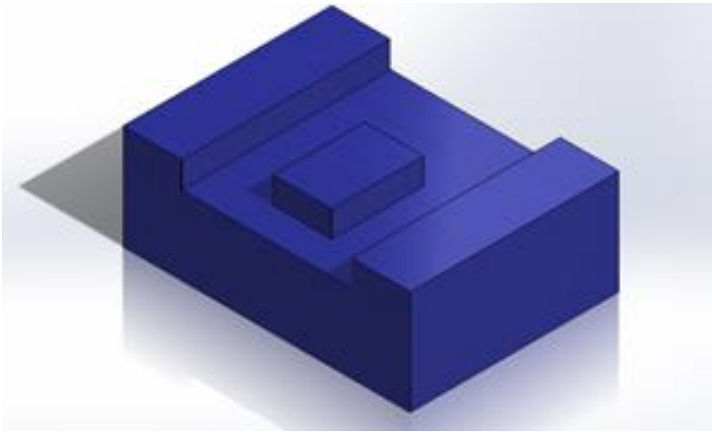


Figure 47: Wooden Base

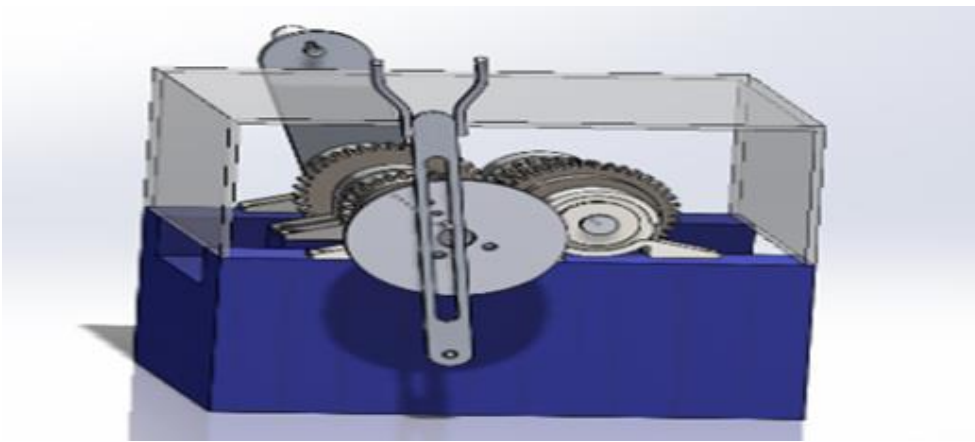


Figure 48: Final Design left-side view

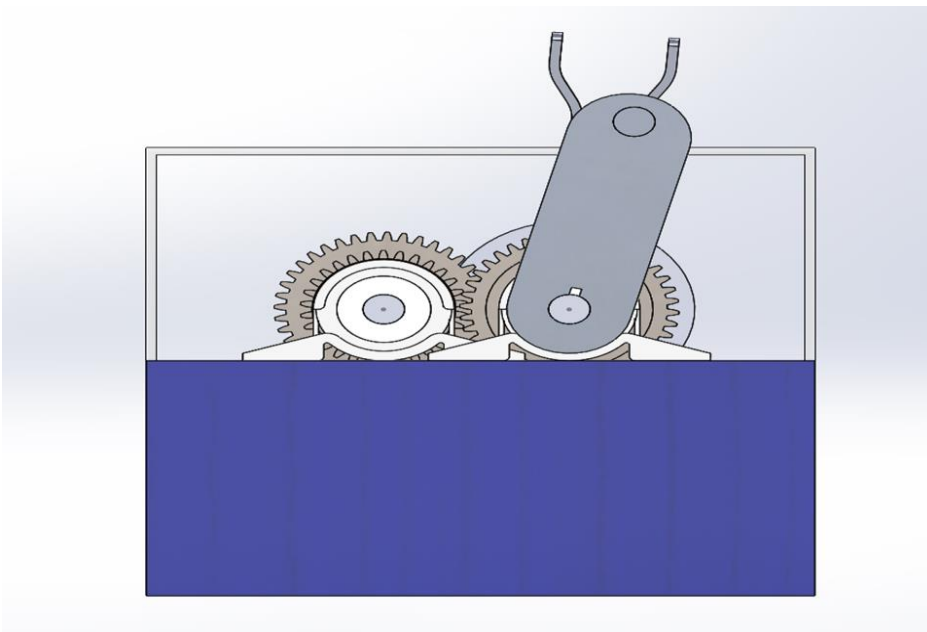


Figure 49: Final Design Right-side view

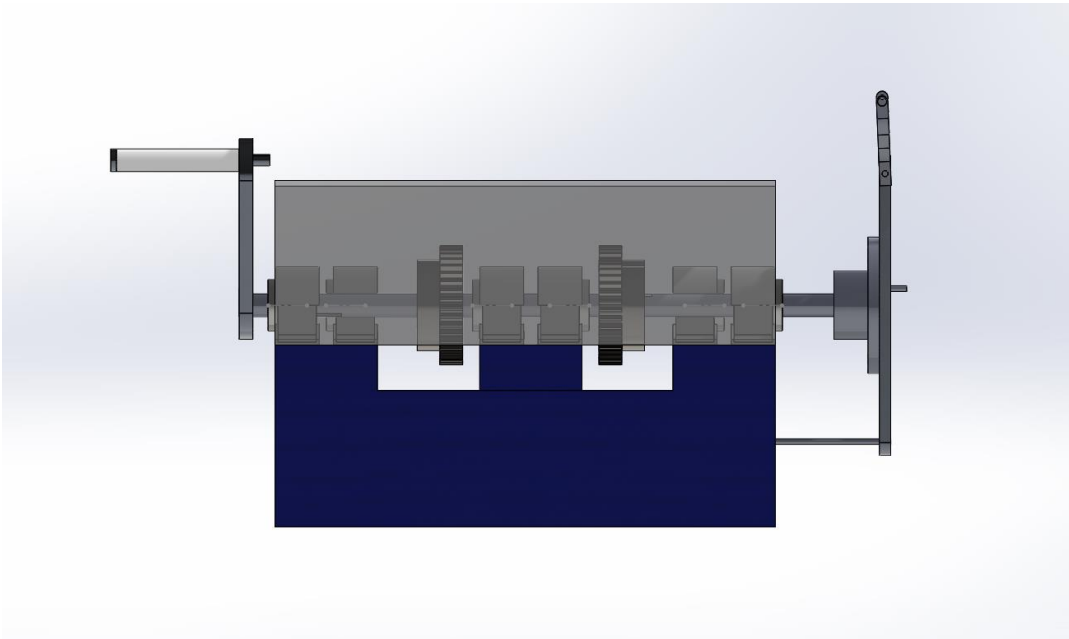


Figure 50: Final Design Front side view

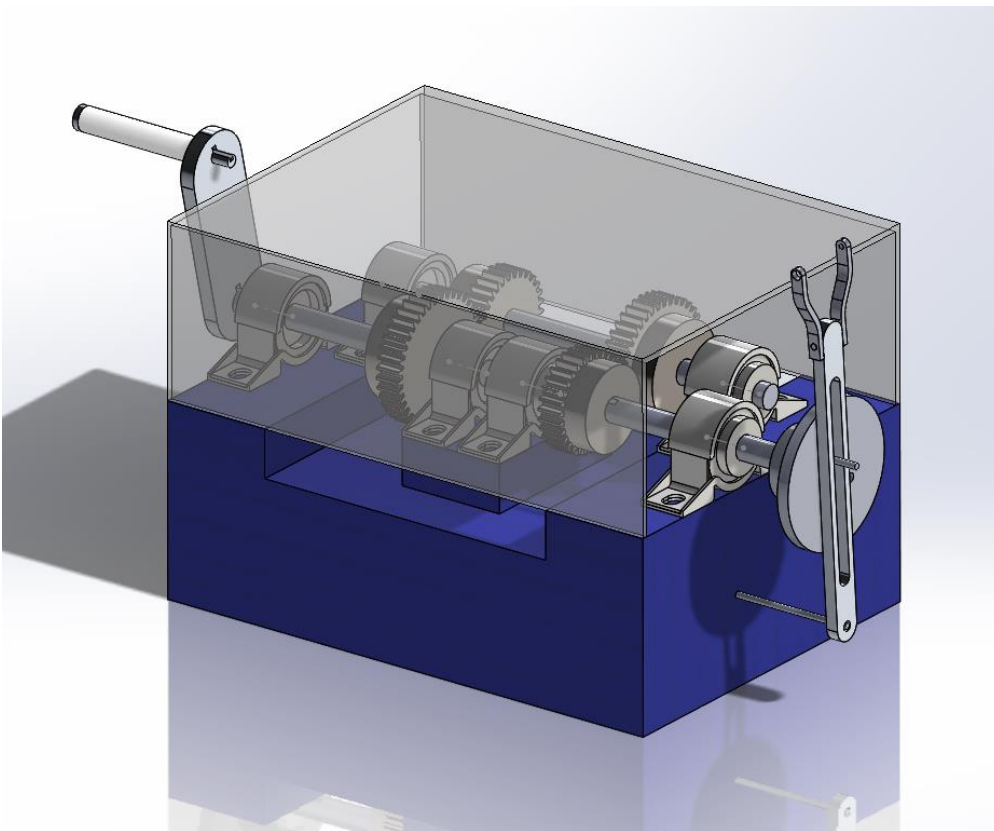


Figure 51: Final Design ISO-View

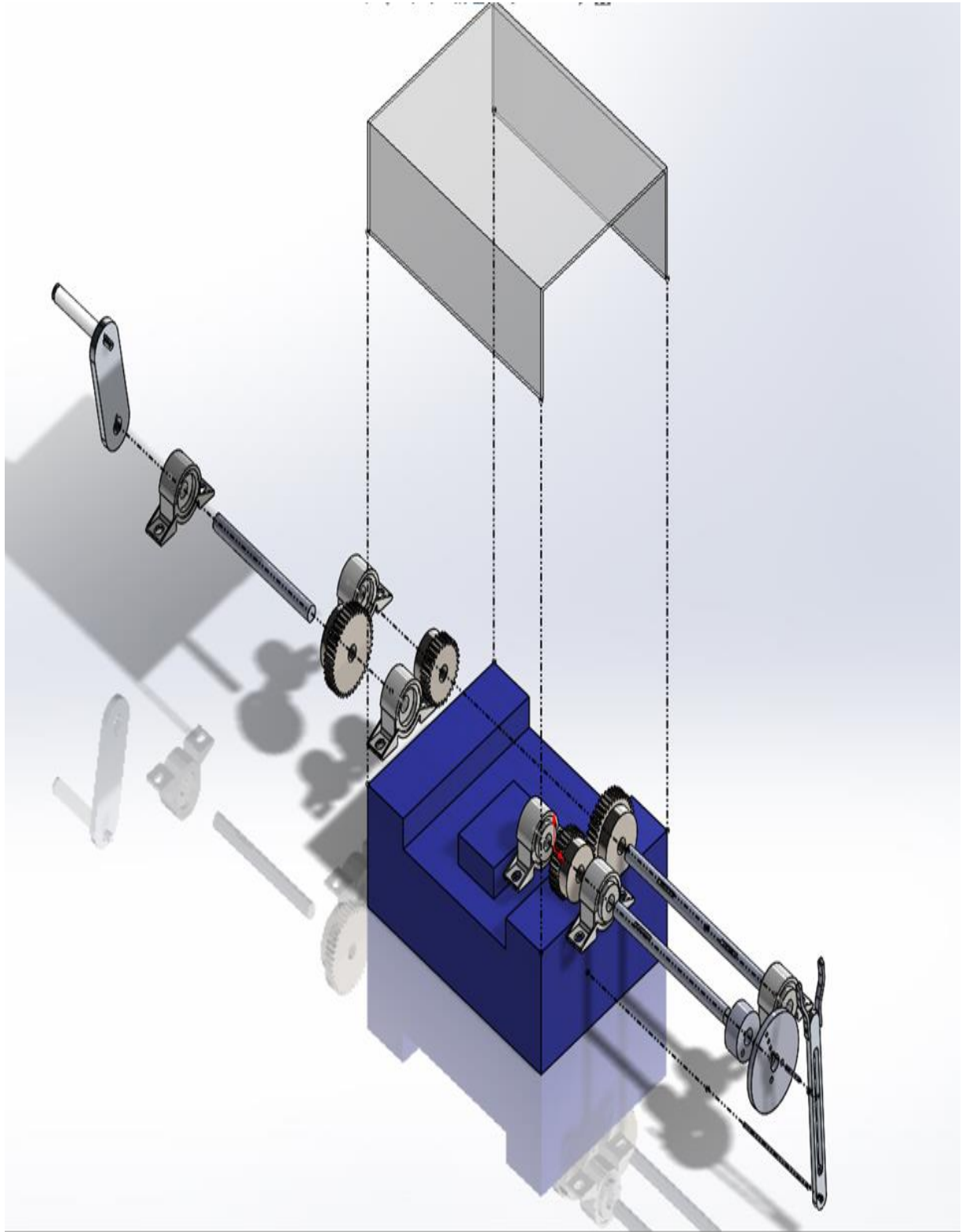


Figure 52: Exploded view

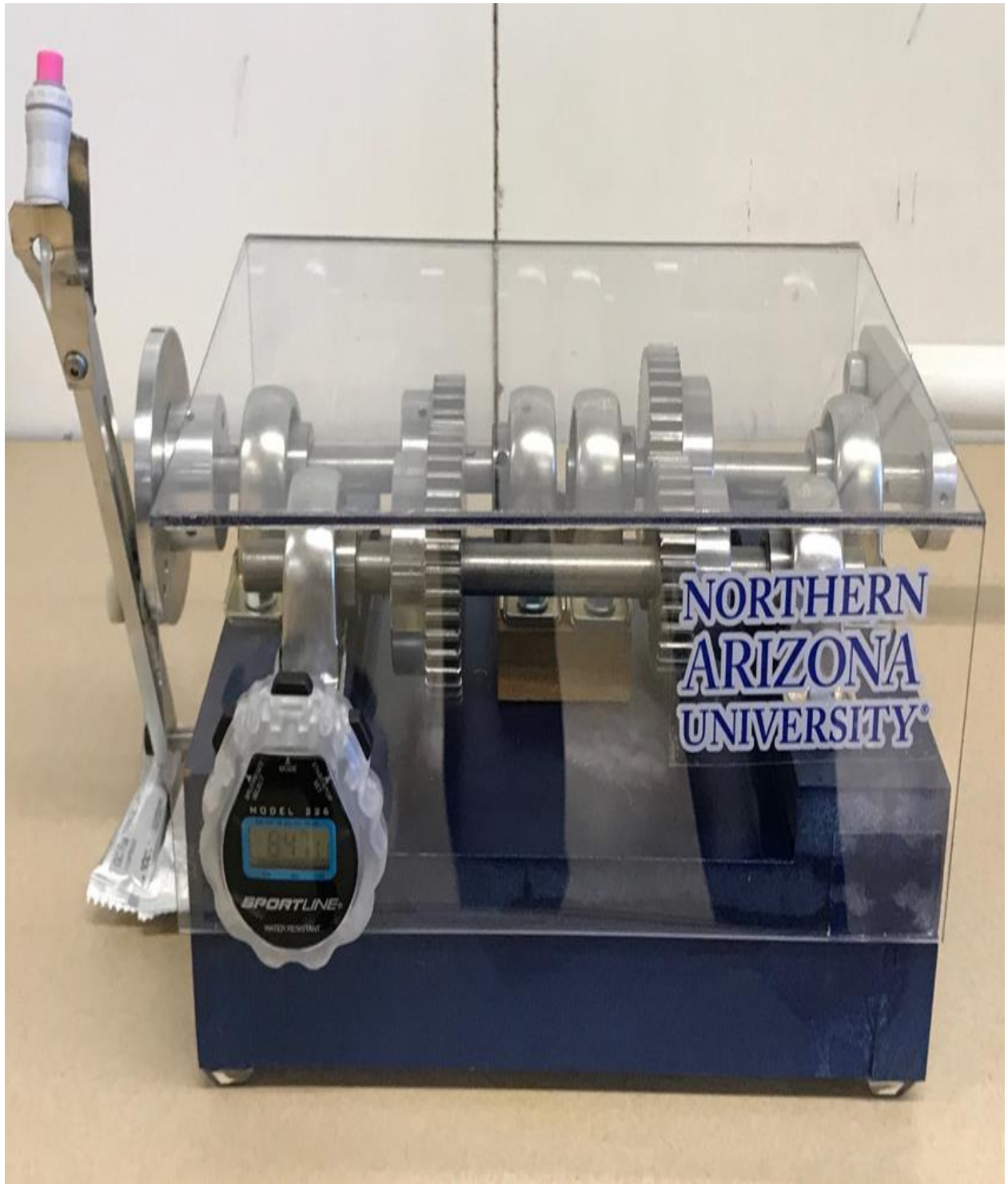


Figure 53: Actual Device

