3D-printed RV-Reducer Assembly

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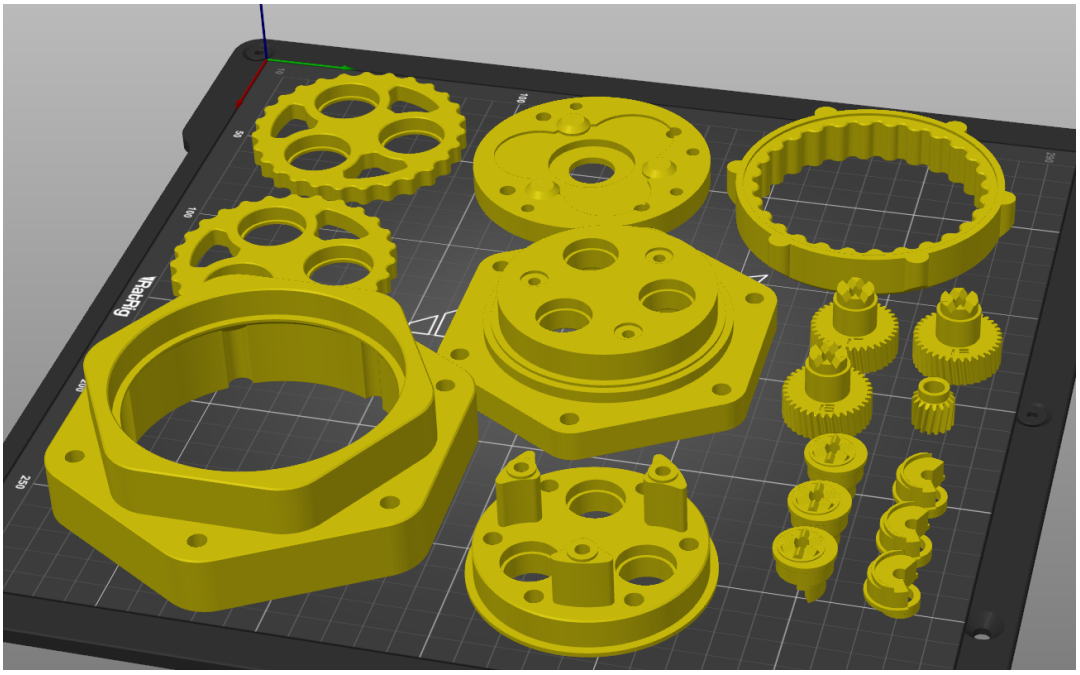
Required parts

The design requires multiple 3D-printed parts. The design of each part has been optimized to be easy to print and best account for printing inaccuracies. The ideal printing orientation should be clear, but this is also shown in the figure below. The gears and shaft pieces are more complex and need to fit together. I originally did these on a resin printer, but it should also be possible on a good FDM printer with a .4mm nozzle or smaller. The other parts can all be printer with a larger nozzle to speed things up and improve strength. Supports are required for some of the parts.



Listed below are all the parts and hardware that is required to assemble this gearbox. Additionally, a NEMA23 stepper motor and the related electronics are required to have a functioning input.

3D-Printed parts:

- 1x "Base - Gear Housing"
- 1x "Base - Motor Mount"
- 1x "Base - Top Cap"
- 2x "Cycloidal Disk"
- 1x "Input Gear"
- 1x "Output – Output hub"
- 1x "Output – Outer Cycloid Gear"
- 1x "Shaft - Gear - Large 1"
- 1x "Shaft - Gear - Large 2"
- 1x "Shaft - Gear - Large 3"
- 3x "Shaft - Middle piece"
- 3x "Shaft - Top piece"

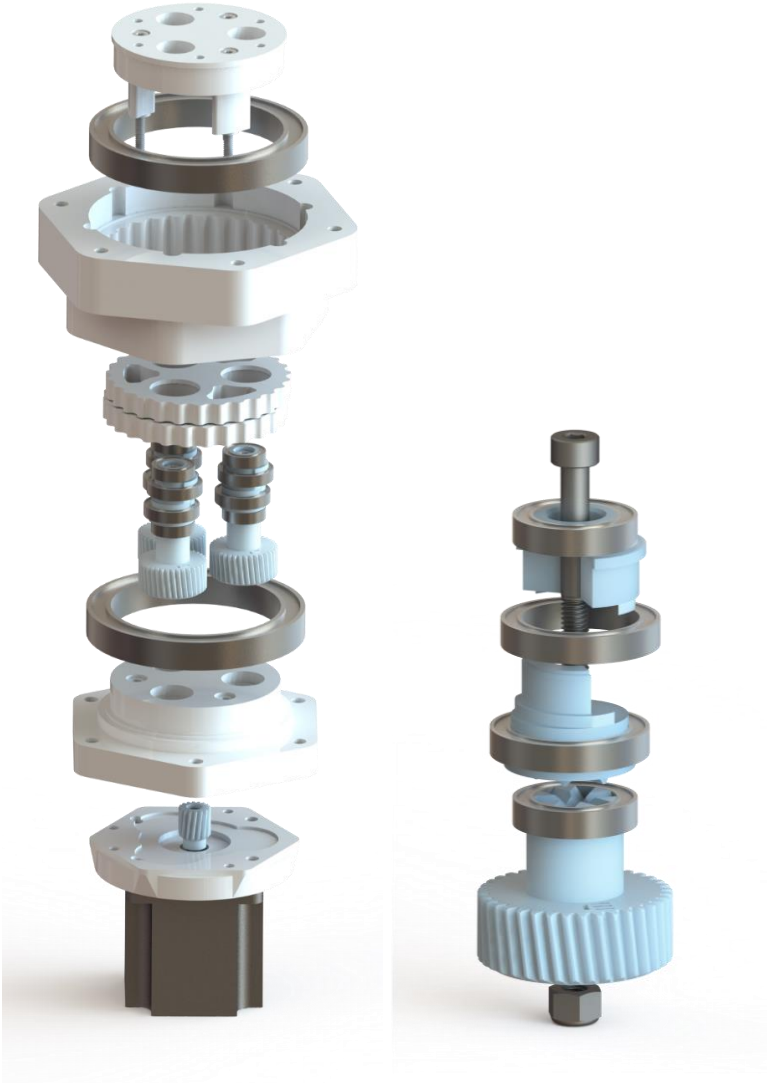
Hardware:

- 6x M4x60 socket head screws
- 8x M4x12 socket head screws
- 3x M4 Lock-nuts
- 11x M4 Threaded heat-set inserts
- 2x Ball Bearing 6814
- 6x Ball Bearing 6701
- 6x Ball Bearing 6703

Assembly

The large step of the assembly will be described here. Additionally, the exploded view and the attached Parasolid (".x_t") of the full assembly might be useful.

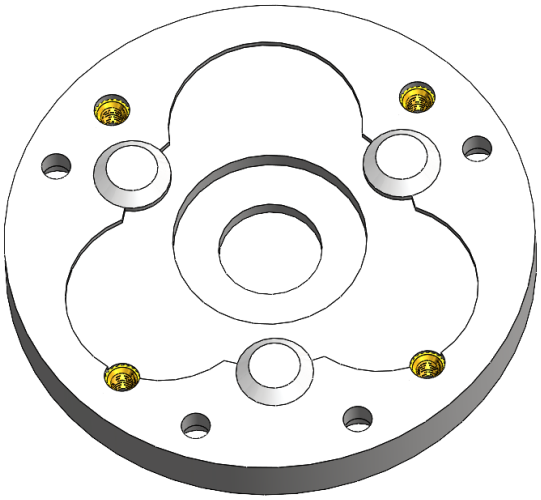
Note that I made some slight improvements int the design that I did not yet print myself. Therefore, the new part design might be slightly different from the ones shown in the images.



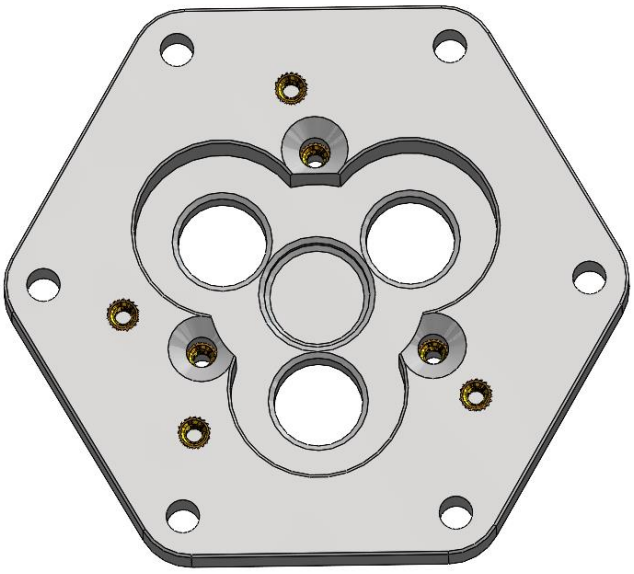
Step 0: Preparation with Heat set inserts

Threaded inserts are used to strengthen the threads on some of the parts. Those need to be installed beforehand. This is best done using a soldering iron to heat the inserts while pushing them into place.

Inset 4 Heat set insert into “Base – Motor Mount” in the locations shown:

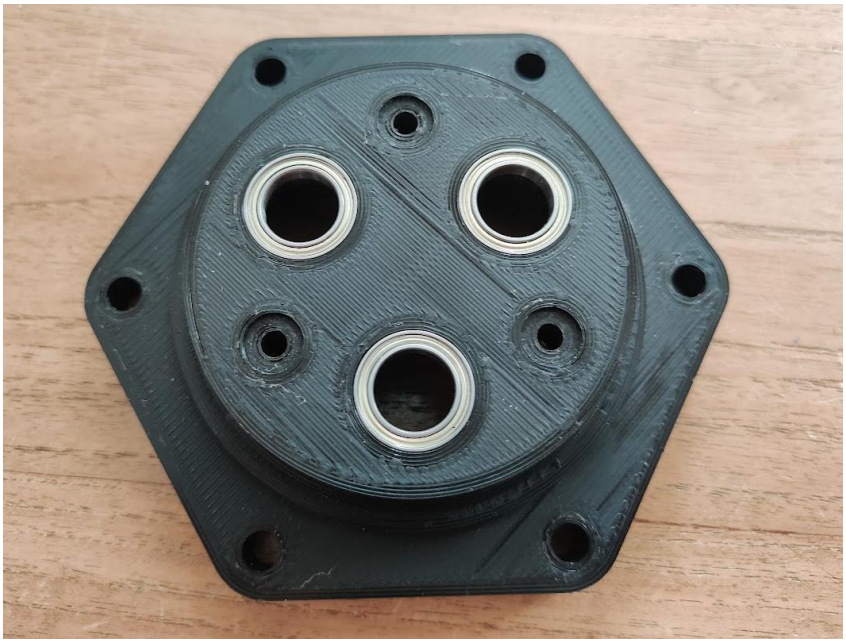


Insert a total of 7 Heat set inserts into “Base – Gear Housing”



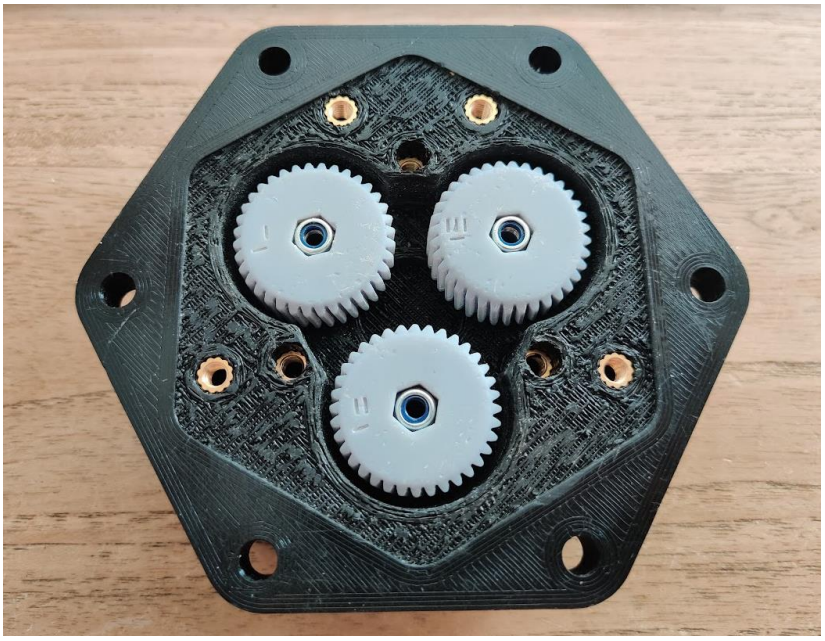
Step 1: Adding the gears

Take the “Base – Gear Housing” an insert the three 6701 bearings from the top side.



Next, add the three large gears (“Shaft – Gear – Large n”) from the other side. Note that the gears are numbered. They should be added in the order 1, 2, 3 in the **Counter-Clockwise** direction. This ensures the teeth line up correctly later on.

During this step, the three M4 lock nuts can also be inserted into the large gears.



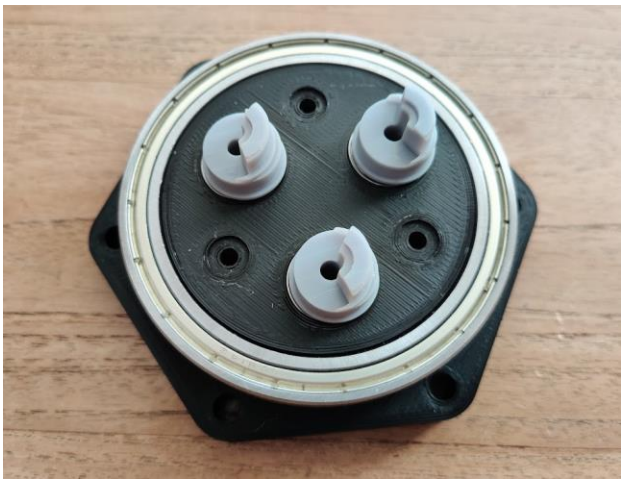
Step 2: Prepare cycloidal disks

Insert the “Bearing – 6703” into the “Cycloidal Disk”. Do this twice to prepare both cycloidal disks.

Step 3: Add the Cycloidal Disks

First, take the assembly from step 1, turn it over and add the large bearing (“Bearing – 6814”).

Now, add the three “Shaft – Middle Piece” on top of each of the small bearings.



Add the first cycloidal disk. Note that it should be installed with the **flange pointing Up**. This prevents it from sliding down too far.

Add the second Cycloidal Disk. This time with the **Flange pointing Down**. Note how it sits on the shaft. It should be offset from the first cycloidal disk.

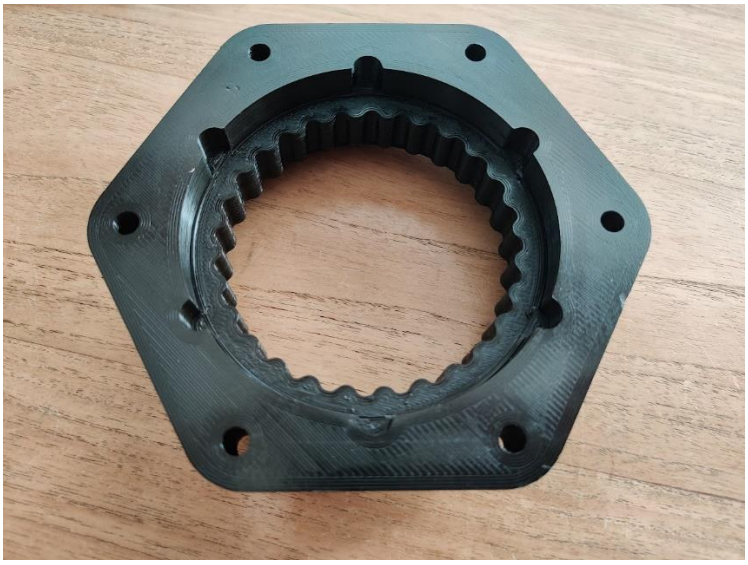
Step 4: finish the eccentric shafts

Insert the three “Shaft – Top Piece” on top. They should fall into the three bearings and lock everything in place.

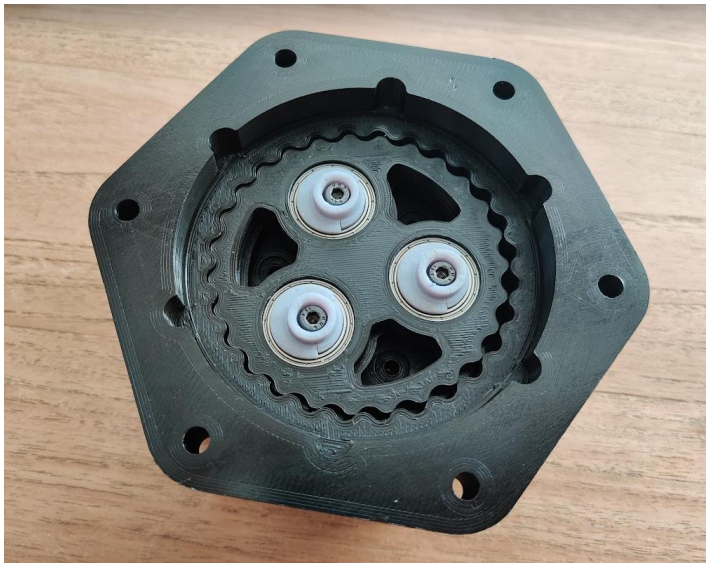
Use three of the “M4x40 Hex Socket Screws” to hold the shafts together. It should screw into the lock nut that was inserted in the large gears at the bottom. This will squeeze everything together and might cause the cycloidal disks to press together and cause friction. In that case use something like a knife to separate the cycloidal disk again. Doing so will push the bearings into the correct places.

Step 5: add the output

Assemble the Output Assembly. Do so by pushing the “Output – Outer Cycloid Gear” into the “Output – Output Hub”. The side with a slight angle should go in first, matching with the angled bit in the output hub.

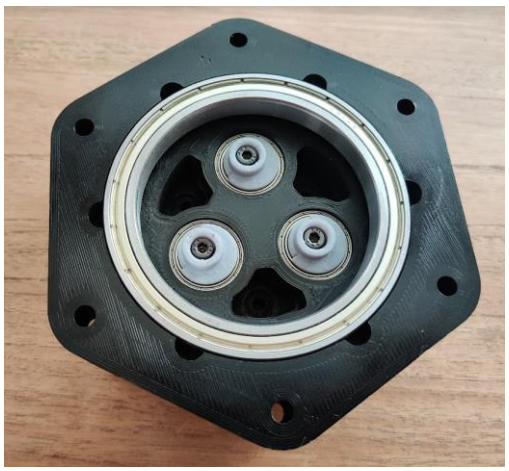


Slide the Output Assembly over the assembly with the cycloidal disks.



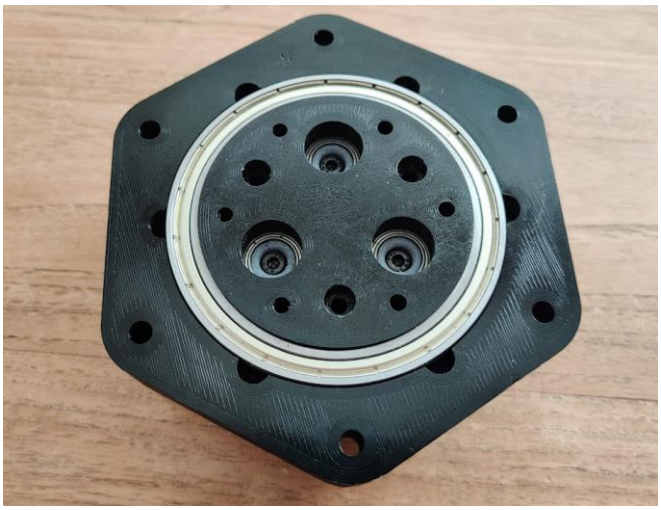
Step 6: Closing it up

Insert the second large “Bearing – 6814” into the previous assembly.



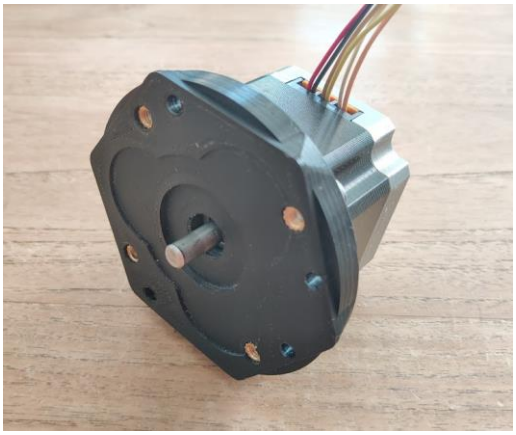
Insert three of the “Bearing – 6701” into the “Base – Top Cap”

Add the Top Cap with bearing on top of the previous assembly and fasten it using three “M4x40 Socket Head Screws”. Do not overtighten this as it can damage the parts or cause the gearbox to lock up.

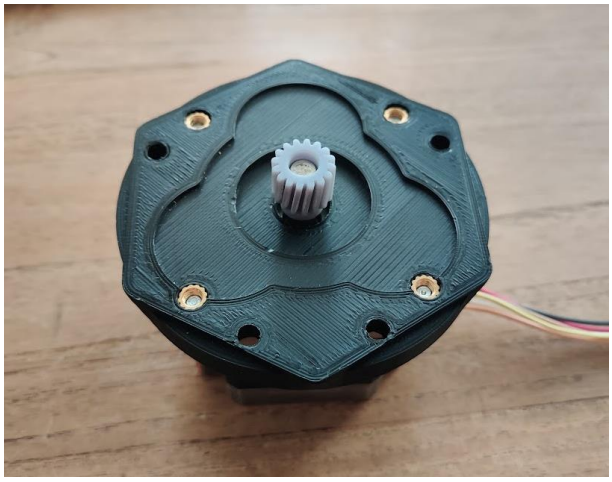


Step 7: Adding the input motor

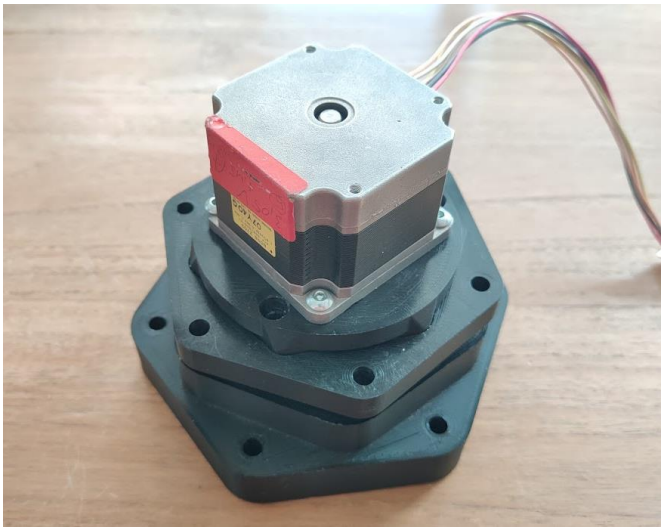
Take the “Base – Motor Mount” and attach the NEMA23 Stepper Motor using four of the “M4x12 Socket Head Screws”. Note the orientation of the motor mount piece in the image.



Add the small “Input Gear” onto the motor. This should be a tight fit. On my test this was actually the first part to slip. So, consider adding some glue or locktight here. A motor with a D-shaft and fitting gear would be a good improvement.



Use the other four “M4x12 Socket Head Screws” to fasten the Motor mount to the Gearbox assembly from the previous step.



That’s it. The 6 holes around the Motor Mount can be used to fix the gearbox to some kind of base. The Output Hub has another set of holes for fixating a output, like the arm of a robot or a wheel of some sort.