

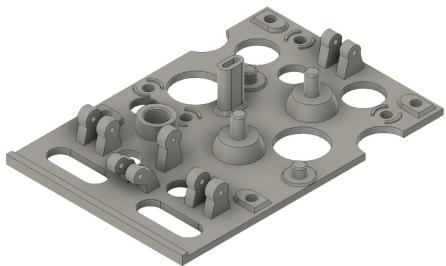
# The 7-Segment Counter

## Assembly

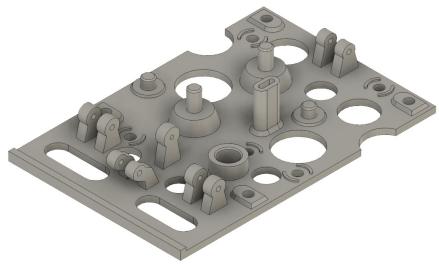


# Parts list

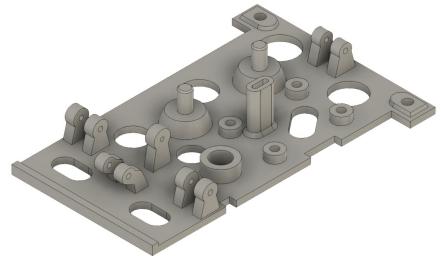
3x base



3x base\_m(irrored)



1x base4



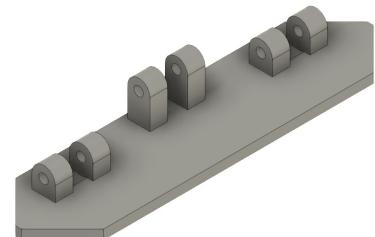
1x cover



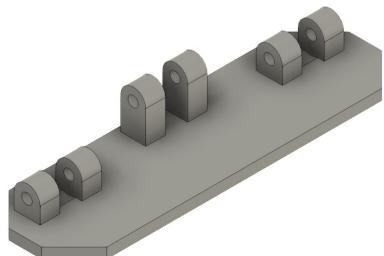
1x cover\_m(irrored)



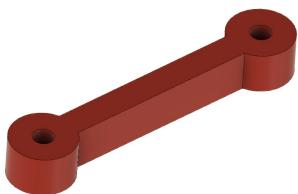
6x segment



1x segment4



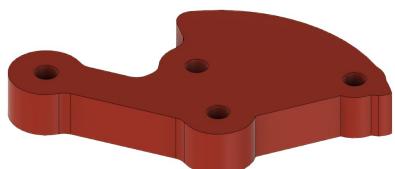
14x pivot\_arm



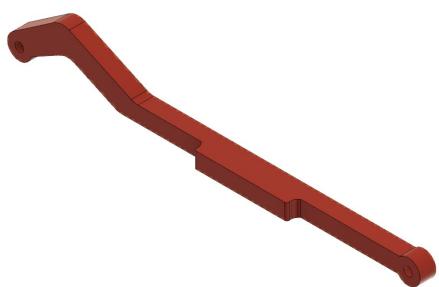
7x hinge\_arm



7x rest\_arm



3x slider



4x slider\_m(irrored)

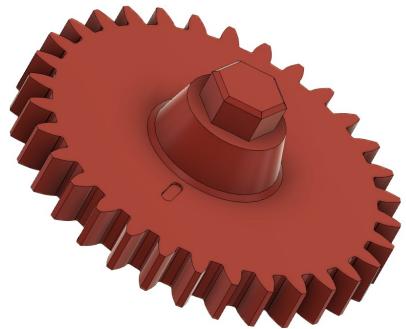


## Parts list

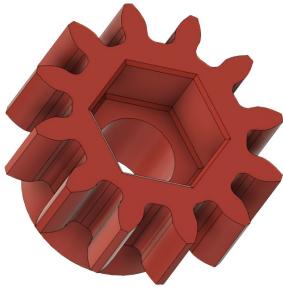
7x spring



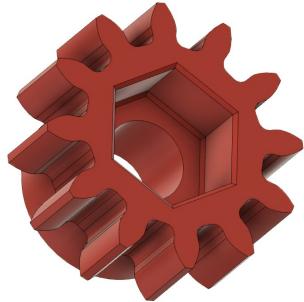
1x connectA2



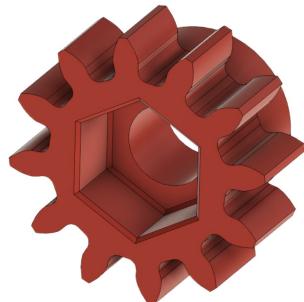
1x connectA1



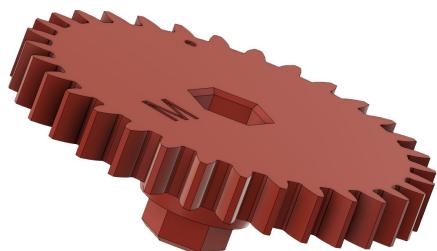
1x connectB1



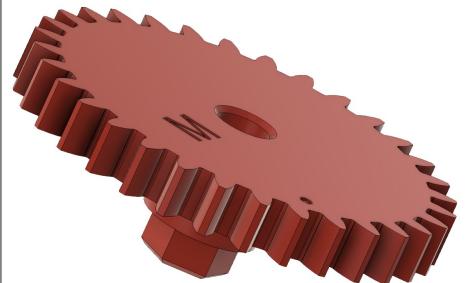
1x connectB1\_m(irrored)



1x connectA2\_m(irrored)



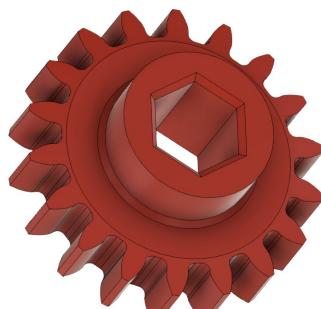
1x connectB2\_m(irrored)



1x connectBD



1x connectC

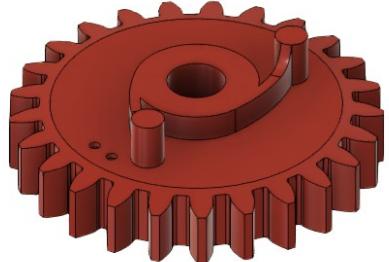


2x connectC\_m(irrored)

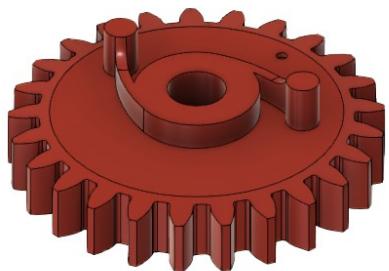


## Parts list

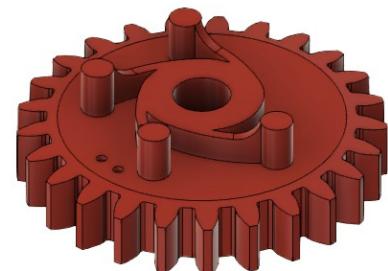
1x Gear1A



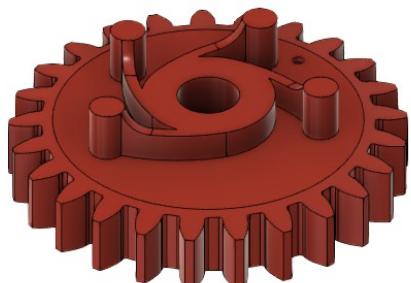
1x Gear1B



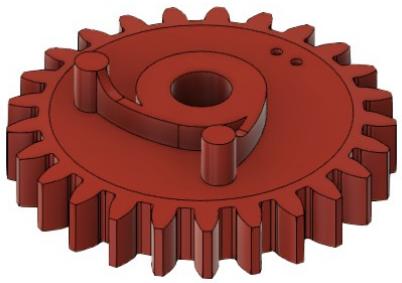
1x Gear2A



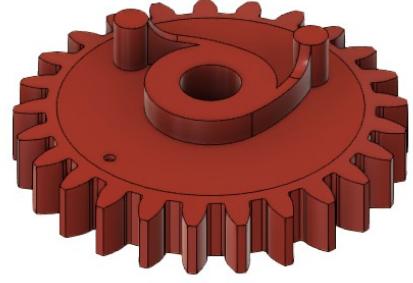
1x Gear2B



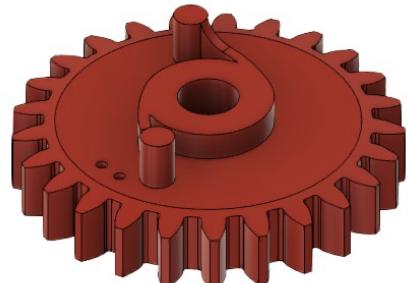
1x Gear3A



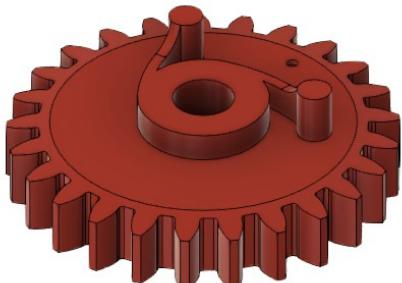
1x Gear3B



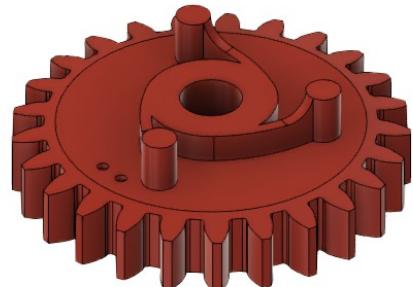
1x Gear4A



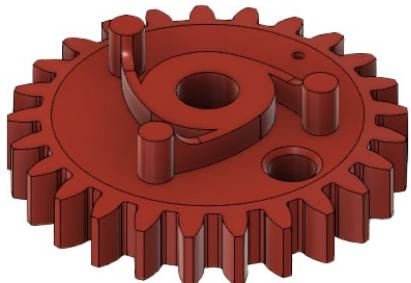
1x Gear4B



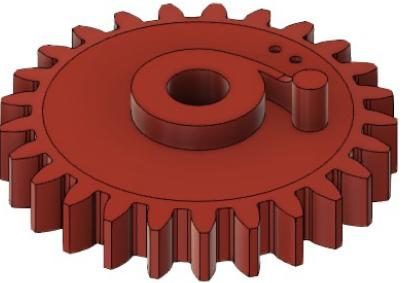
1x Gear5A



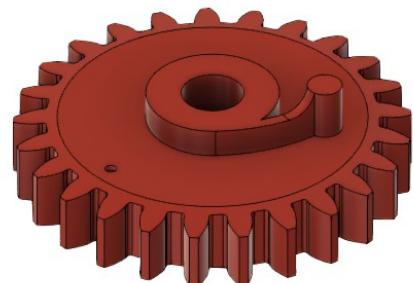
1x Gear5B



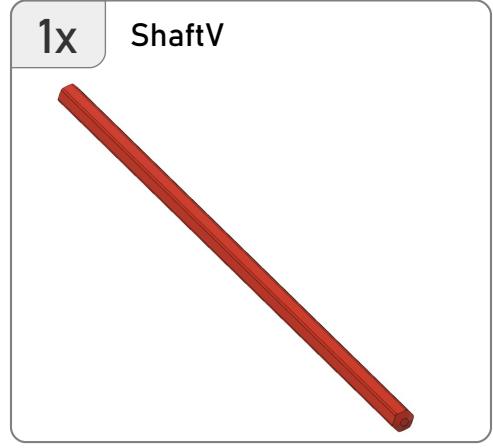
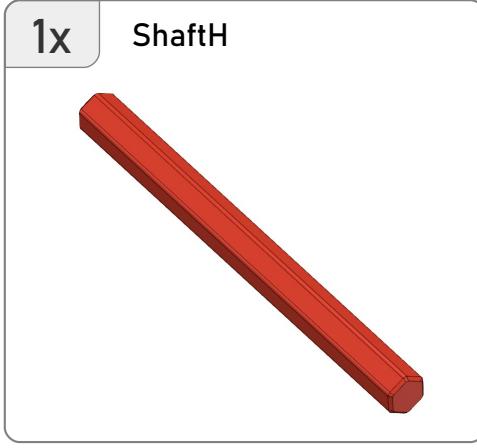
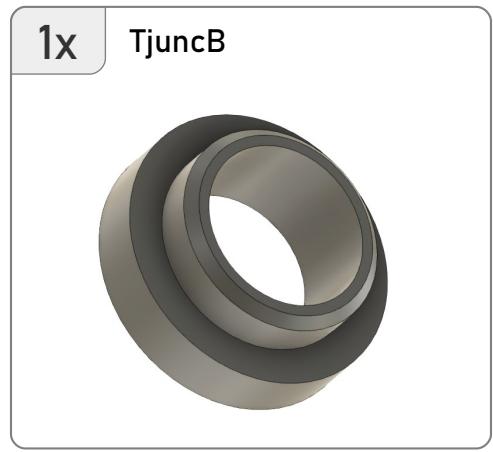
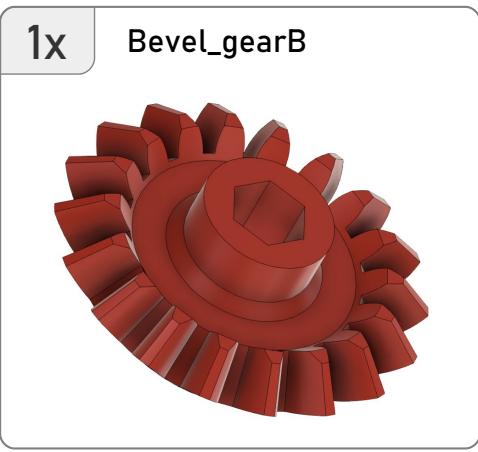
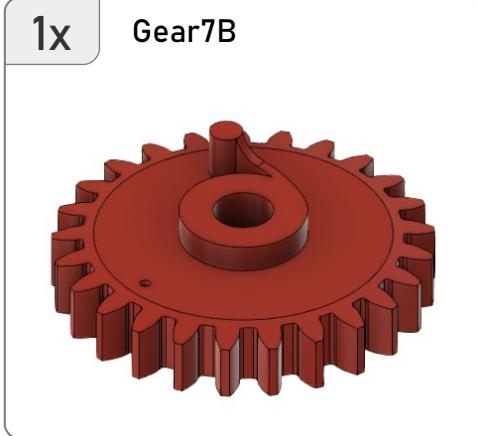
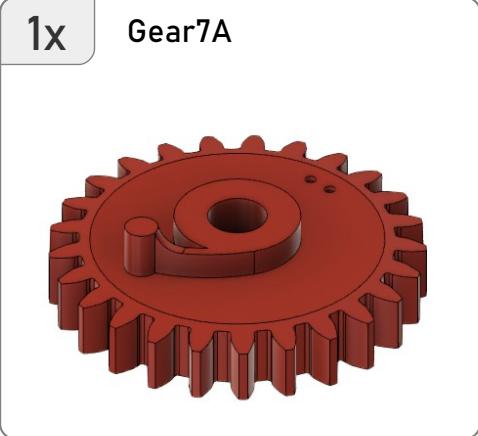
1x Gear6B



1x Gear6B

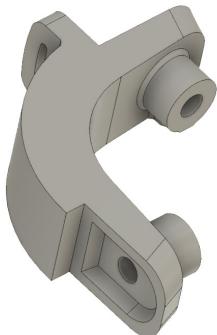


## Parts list

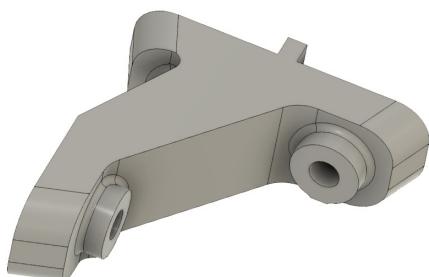


## Parts list

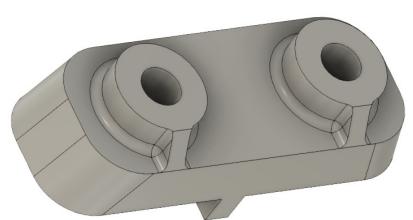
8x Corner



2x Tconnect



2x Iconnect



1x case



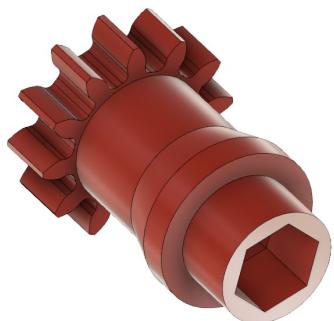
1x back\_panel



# Parts list

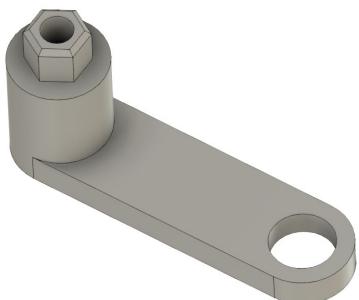
1x

Crank\_gear



1x

CrankA



1x

CrankB



1x

CrankC



1x

Crank\_collar



1x

Motor\_mount



1x

Pinion



1x

MM\_spacer



1x

Pcb\_spacer



The counter can be build in two ways. Motor driven or hand crank driven.

For the motor driven version you don't need the parts in green.

If you build the hand crank version you won't need the parts in red.

The motor parts are dimensioned for the popular **28BYJ-48** 5V stepper motor.

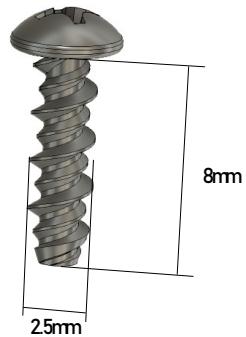
Also, there is a version of the case with an opening for the hand crank and one without, as well as a version of the back\_panel with holes for cables and one without.



# Additional required hardware

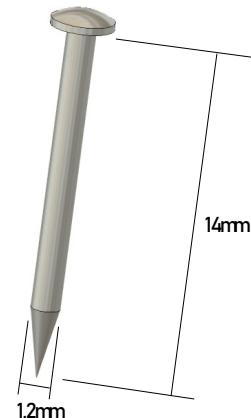
**46x** Screws

2.5x8mm self-tapping screws  
(also called no. 3 gauge).  
The length can vary but should not exceed 12mm.



**77x** Nails

1.2x14mm finishing nails.  
I used round-headed escutcheon pins.  
They look very nice and have a smooth shank without any riffling.  
The shorter the better.



CA glue (super glue)



(Needle nose) Pliers



Screw driver



## Optional tools that will drastically improve your results

Drill for tight fit,  
(based on chosen nails  
eg. 1.2mm)



Drill for loose fit  
(eg. 1.4mm)

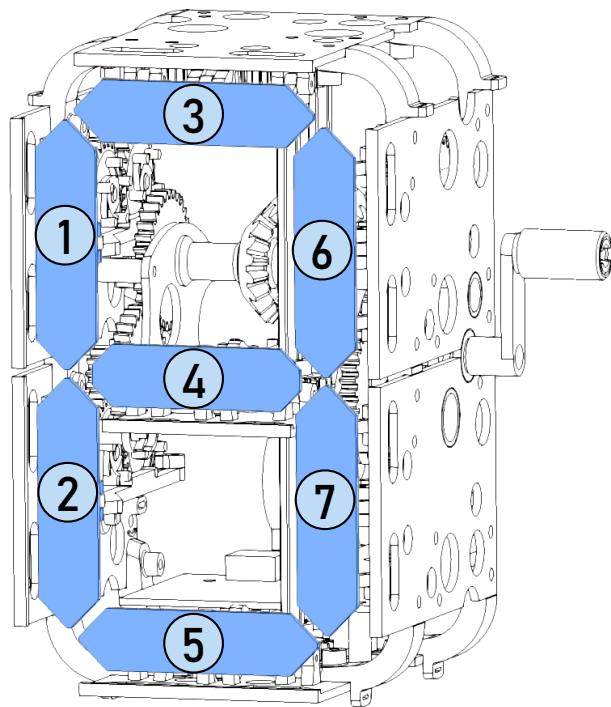


4mm hand reamer



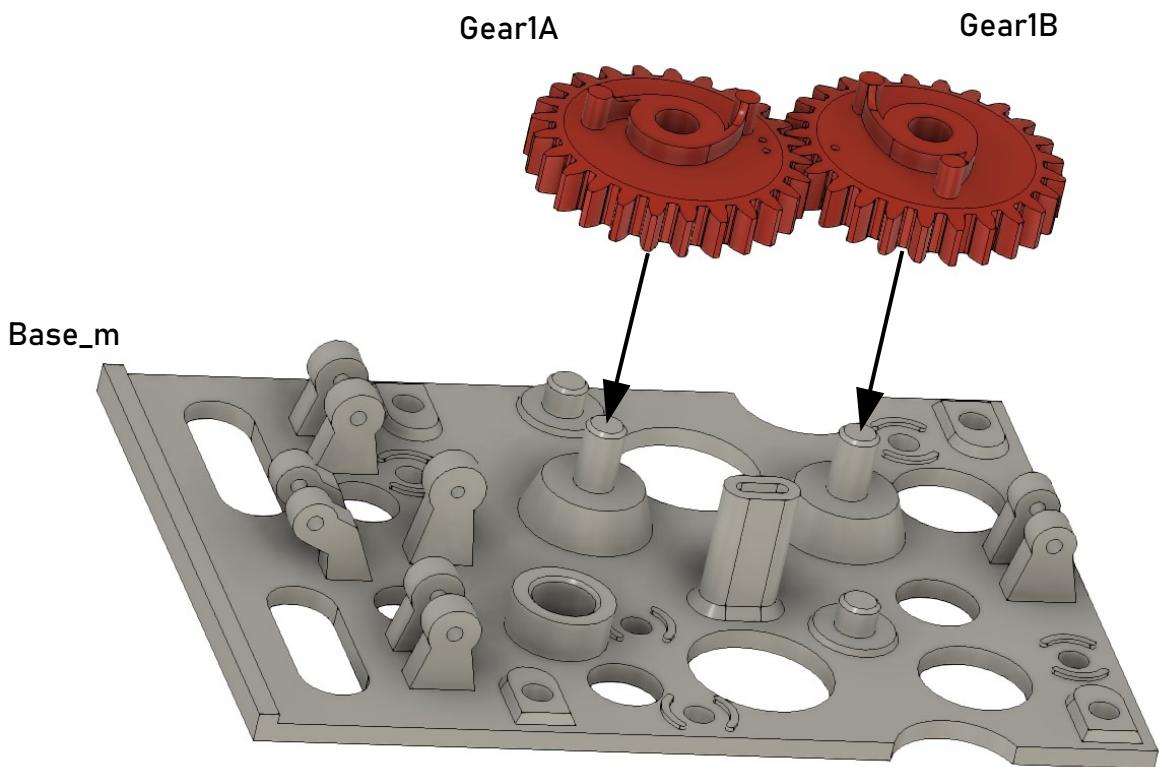
# 1. Assembling the segments

Segment positions



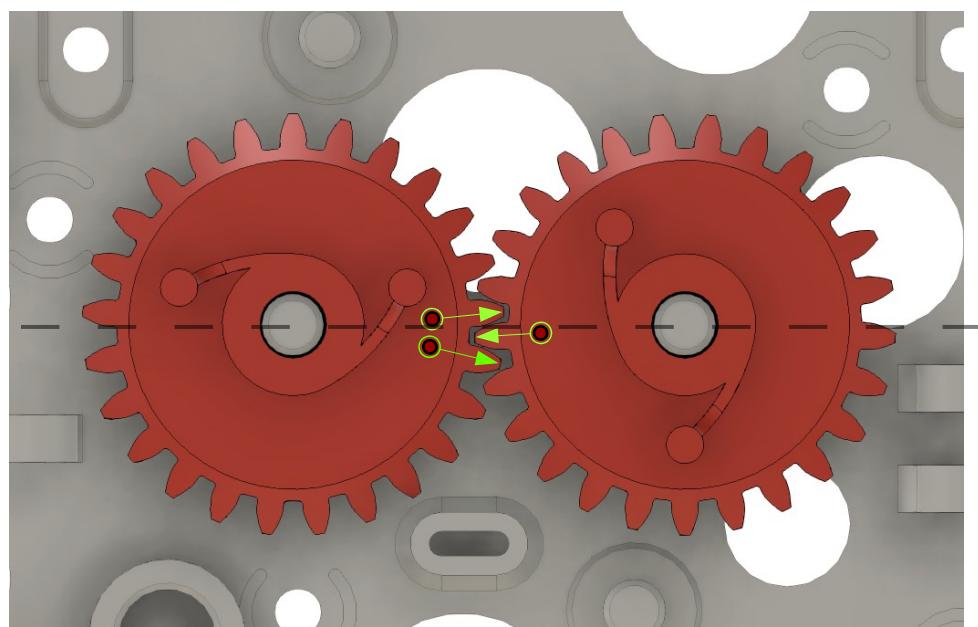
# 1. Segment no. 1

## Step 1

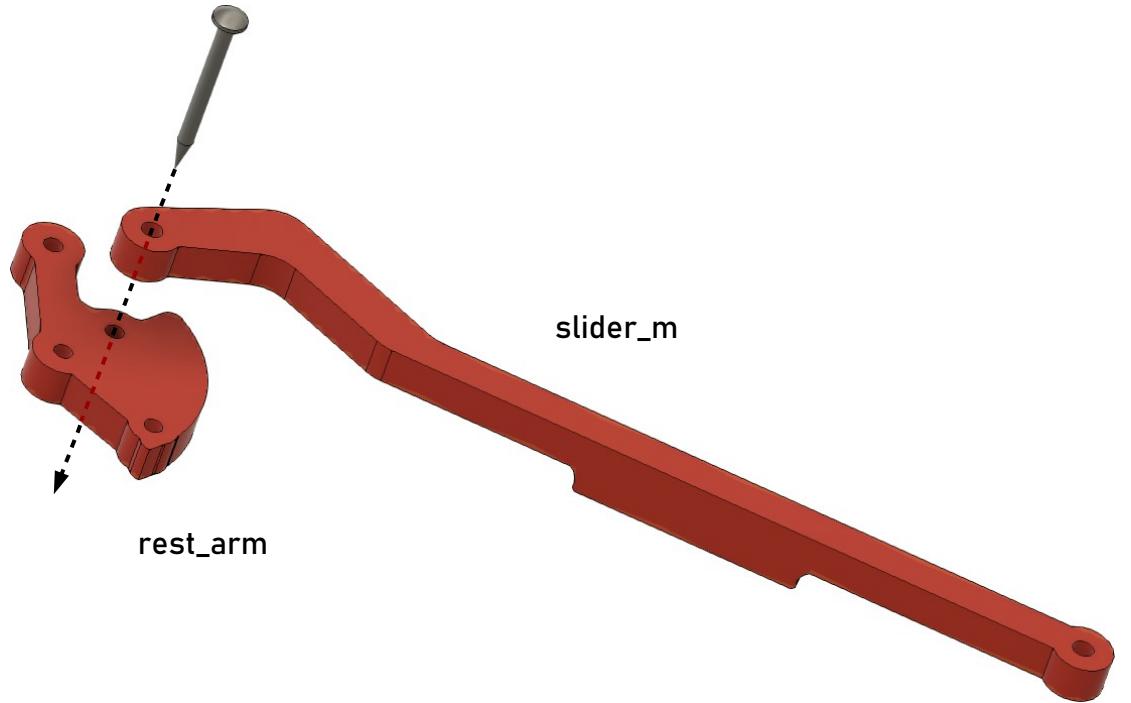


Mesh the gears by lining up the marks on them as seen in the picture.

During the assembly process, try to keep all the gears aligned to each other. Marks oriented between the two axles.



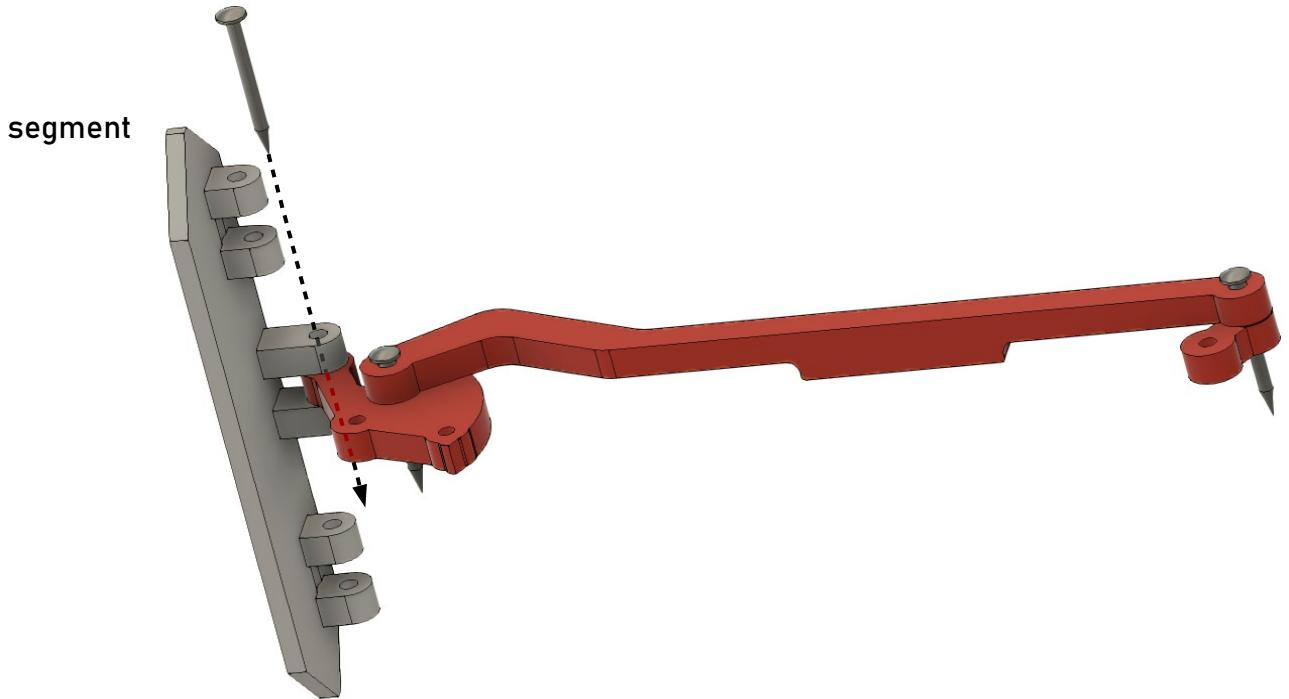
## Step 2



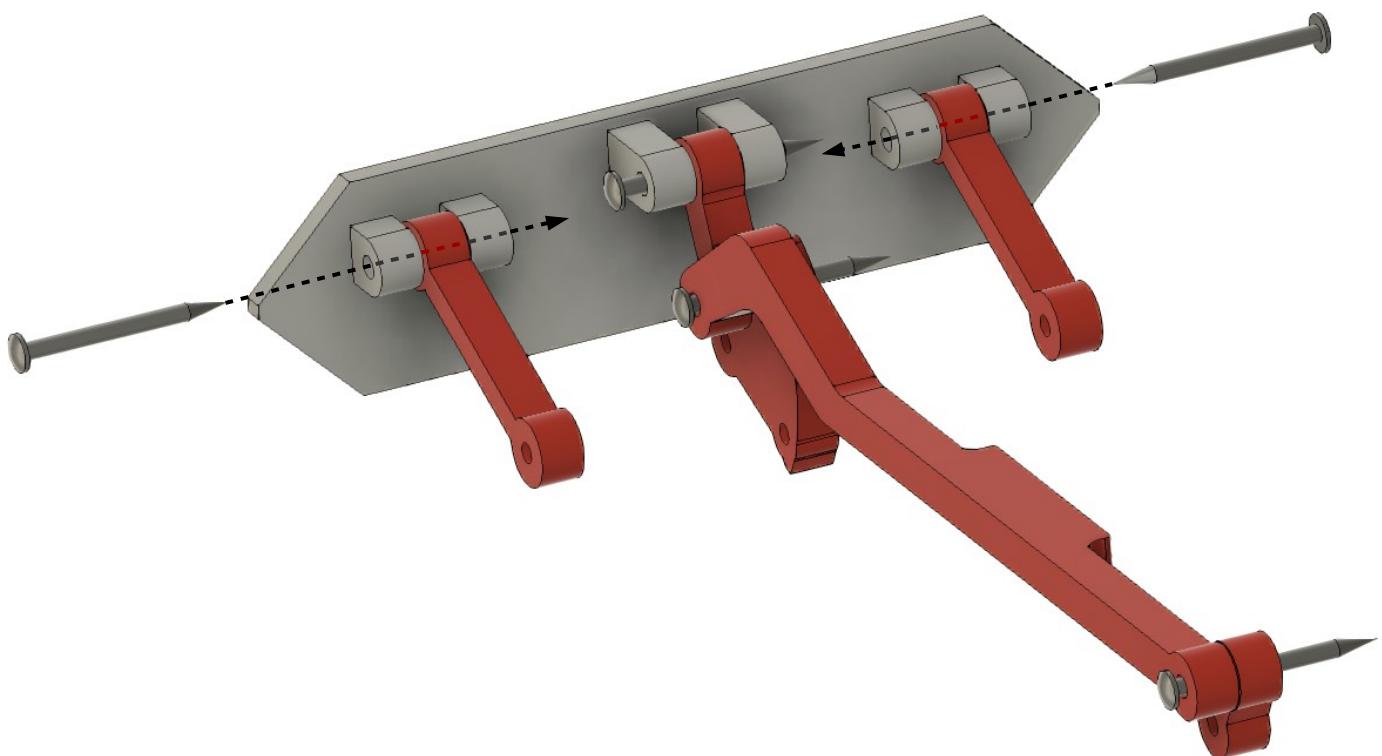
## Step 3



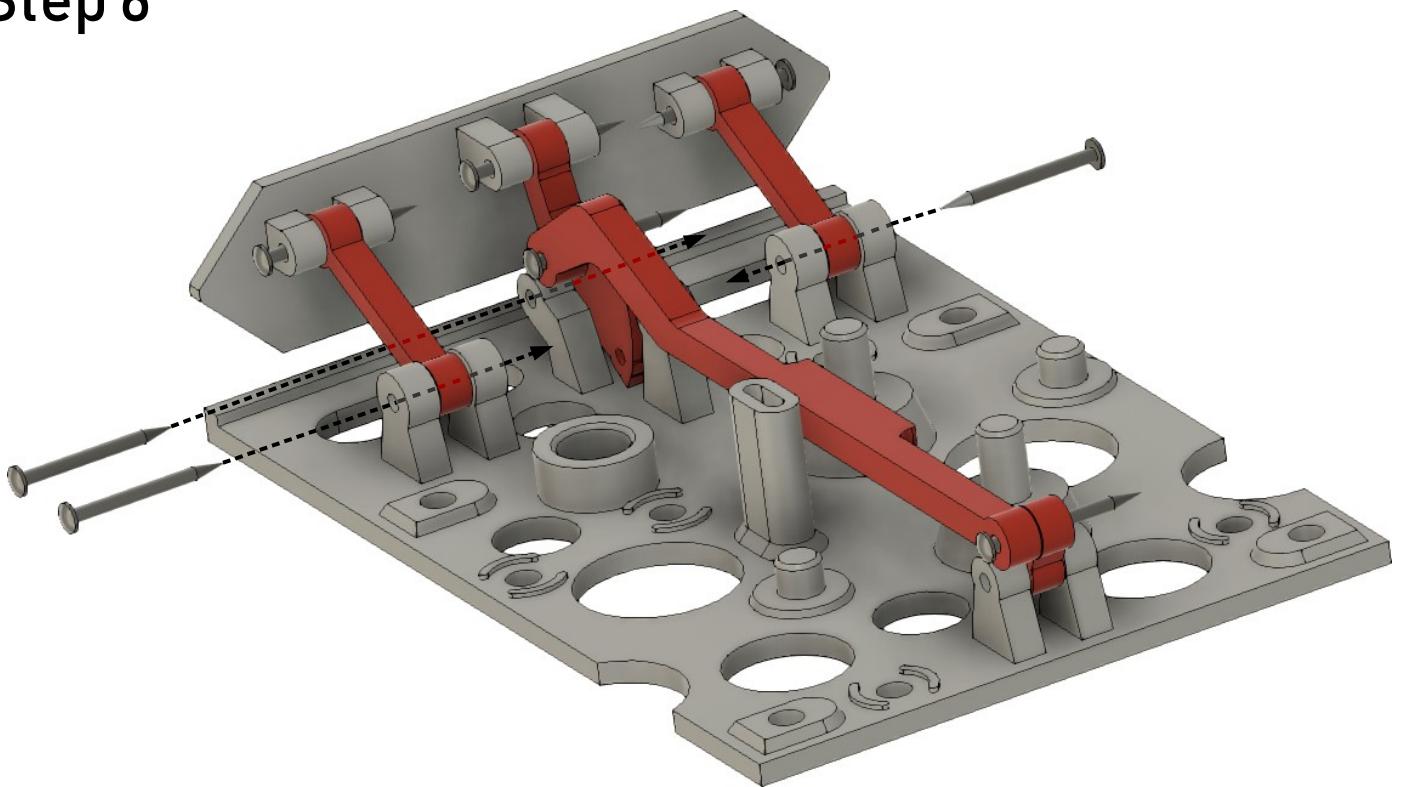
## Step 4



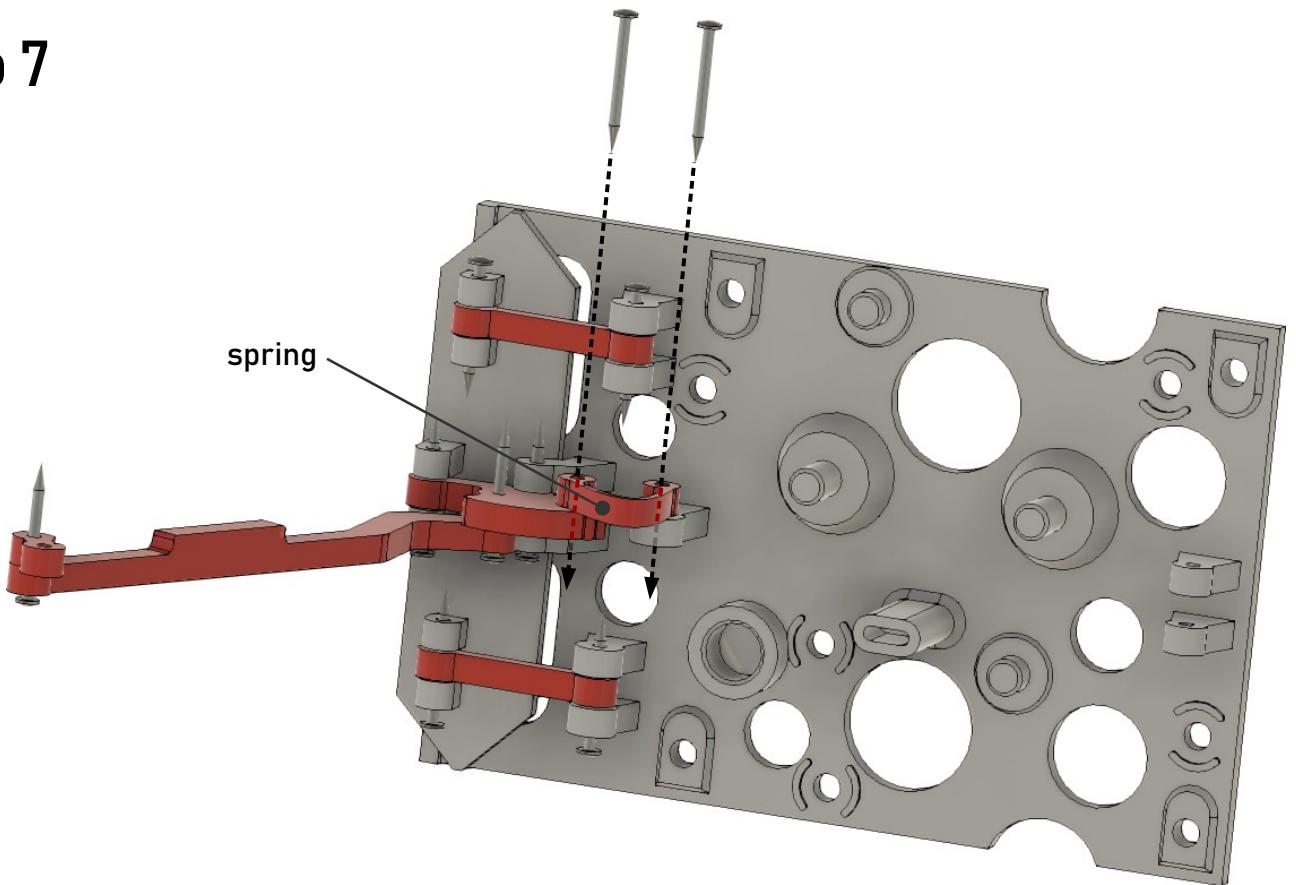
## Step 5



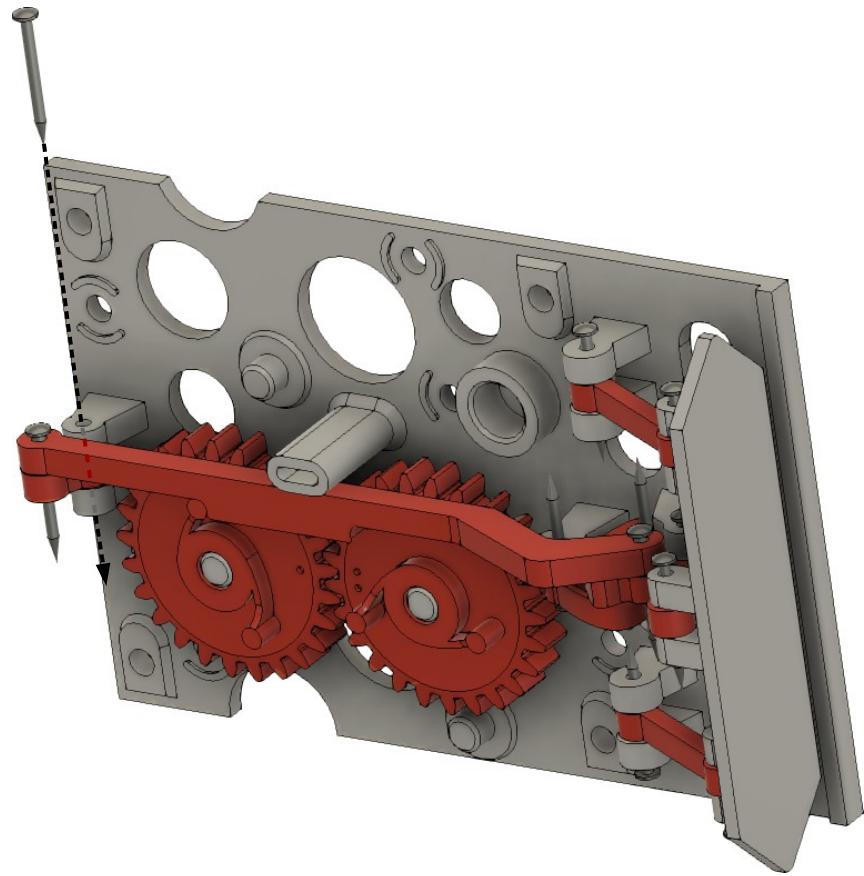
## Step 6



## Step 7

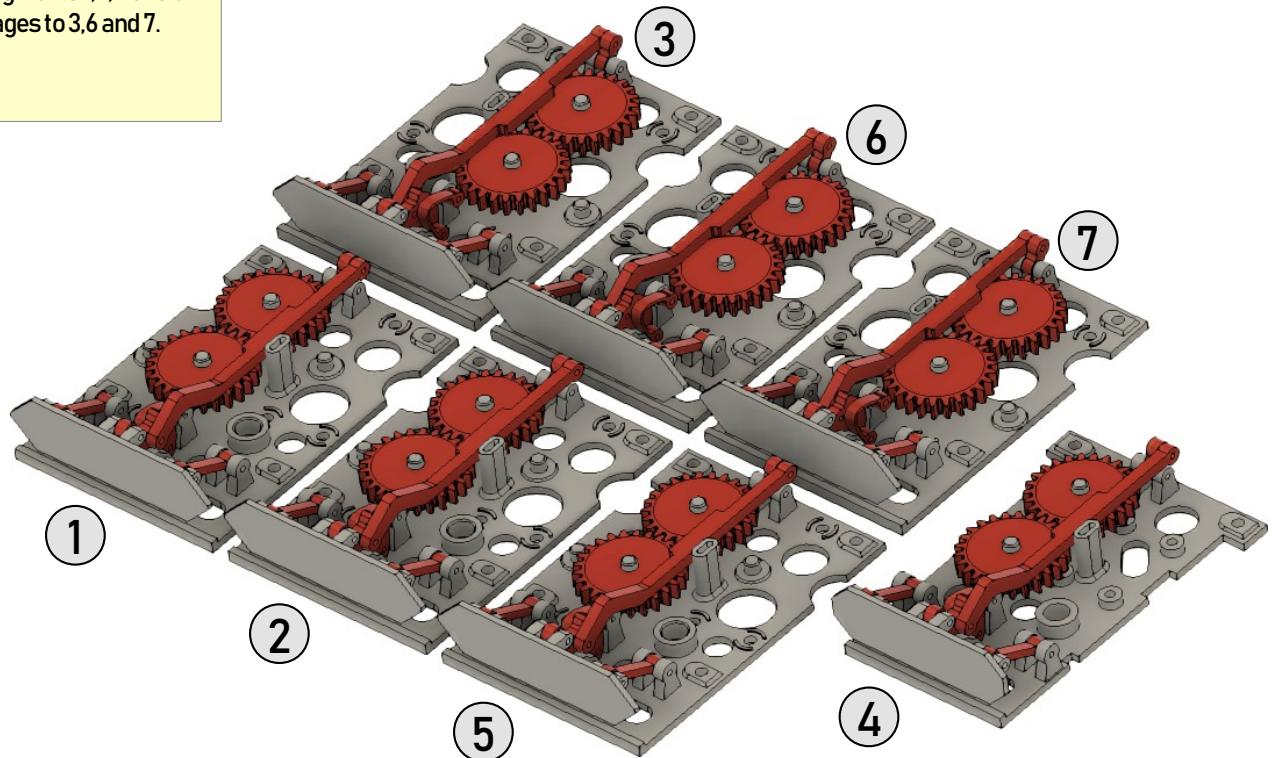


## Step 6



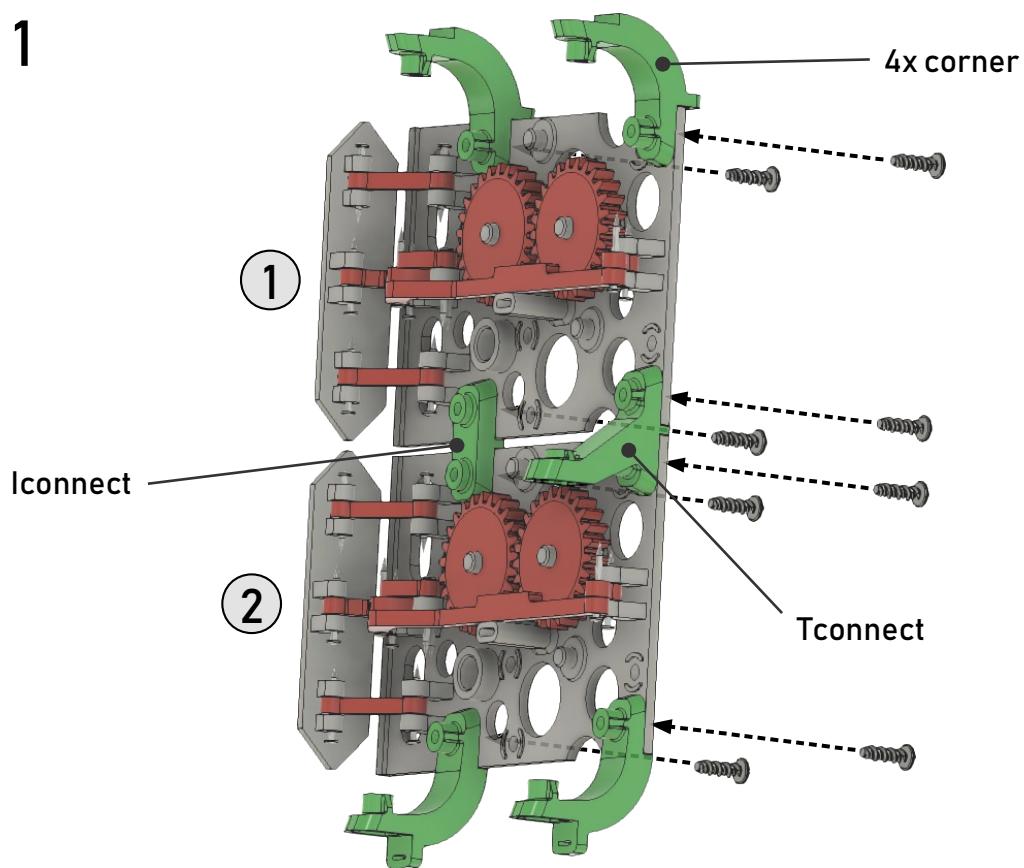
\*Repeat the previous steps for the remaining segments.

Remember, segments 1,2,4 and 5 are mirror images to 3,6 and 7.

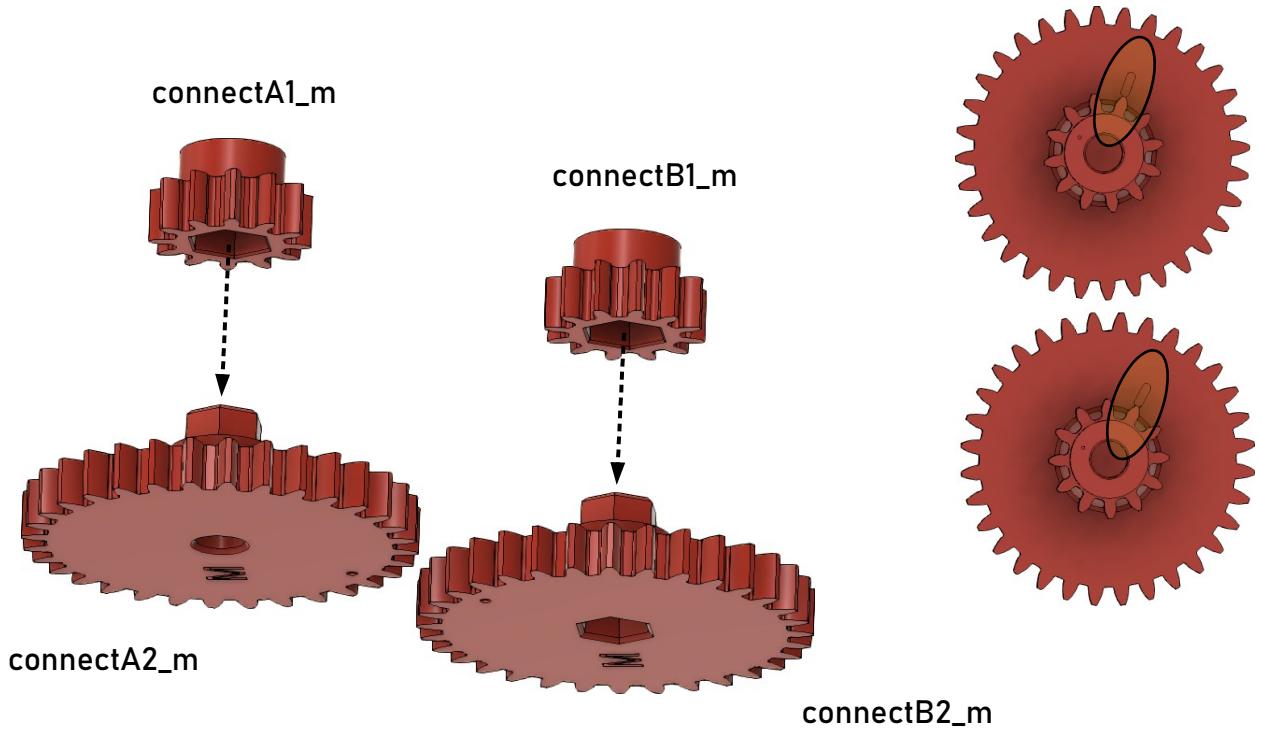


## 2. Connecting the segments

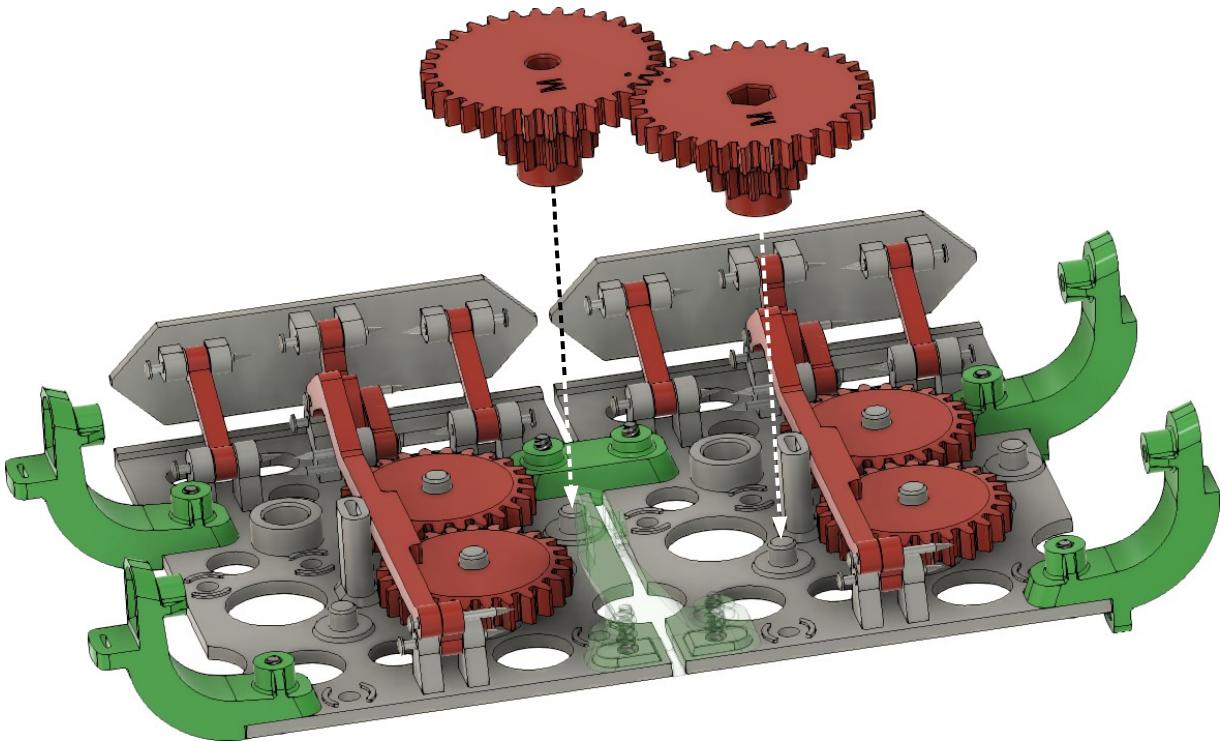
### Step 1



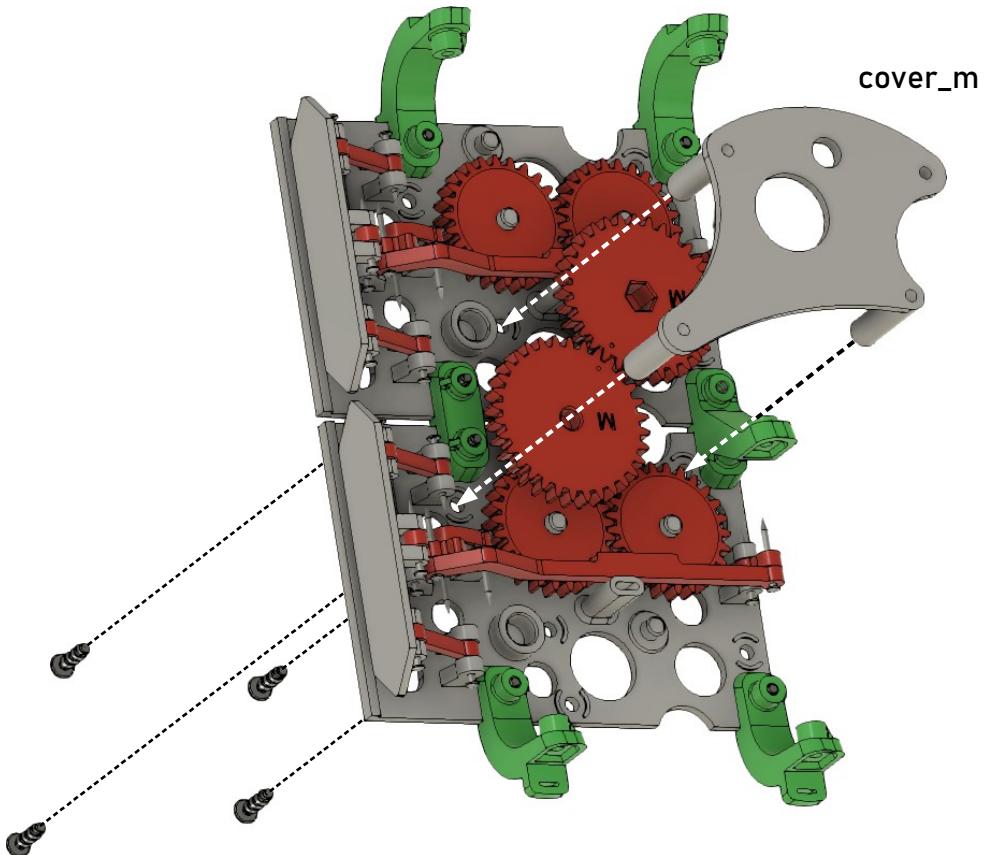
### Step 2



## Step 3



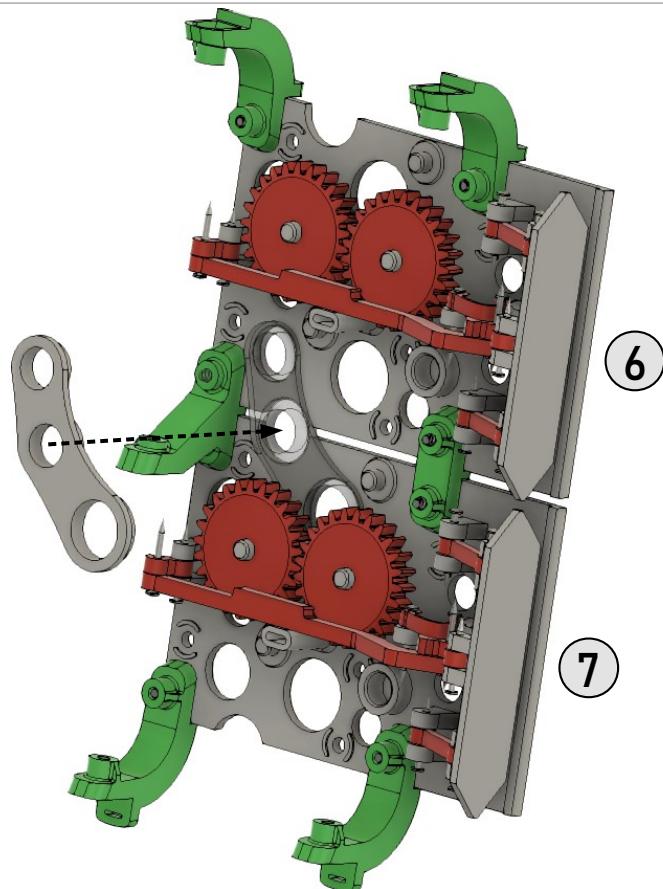
## Step 4



## Step 5\*

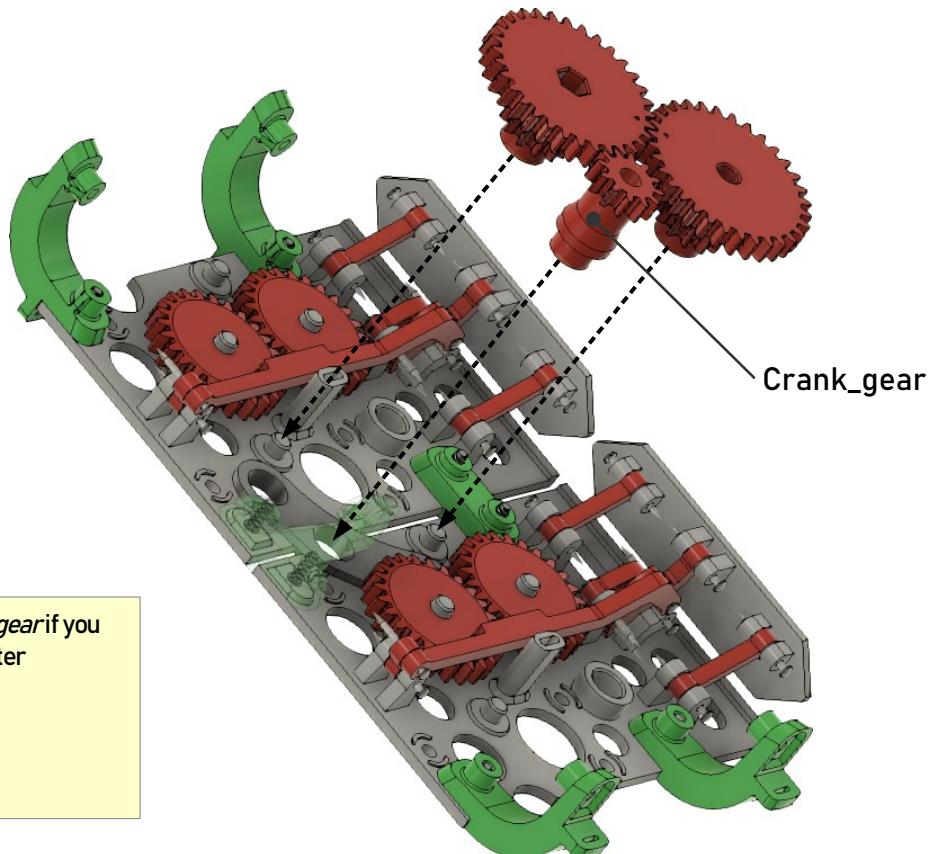
Repeat steps 1-4 for the mirrored segments 6 and 7.

Crank\_collar



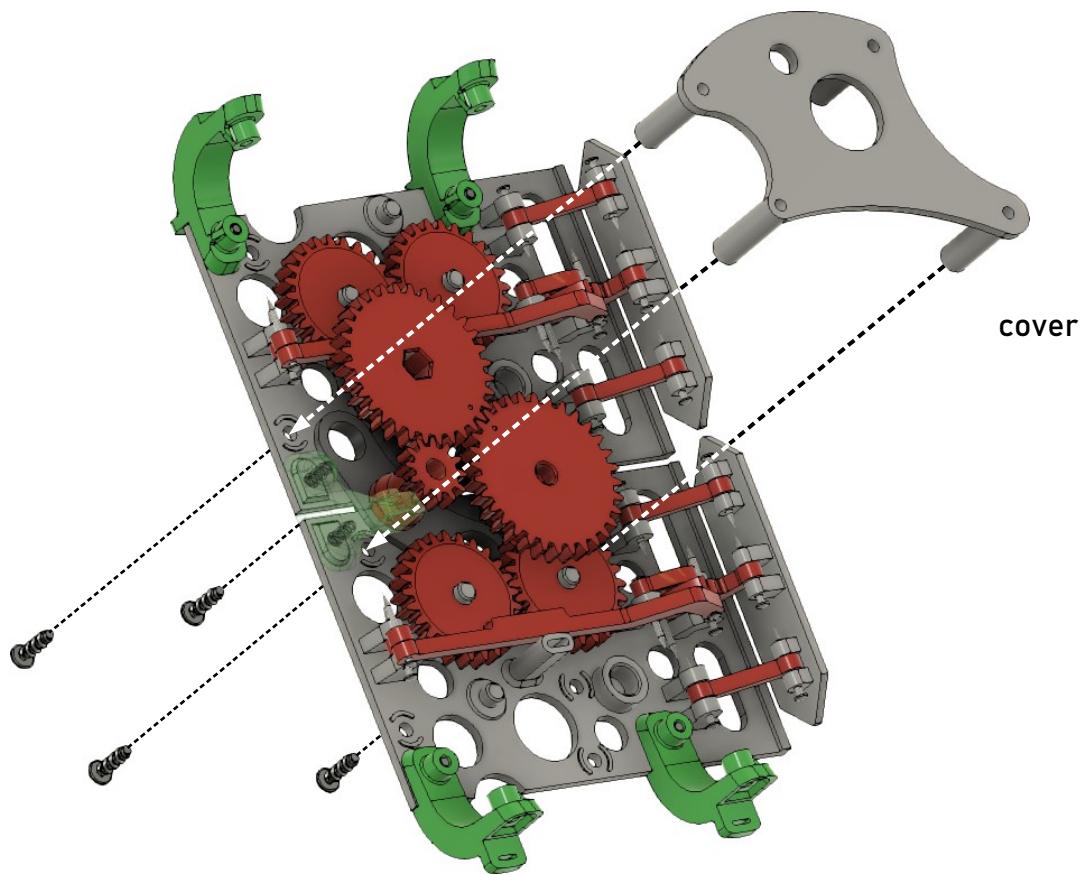
\*Only install this part if you want to drive the counter with the crank. Otherwise skip this step.

## Step 6\*

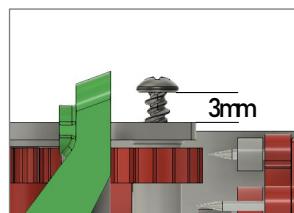


\*Leave out the *Crank\_gear* if you want to drive the counter with a motor.

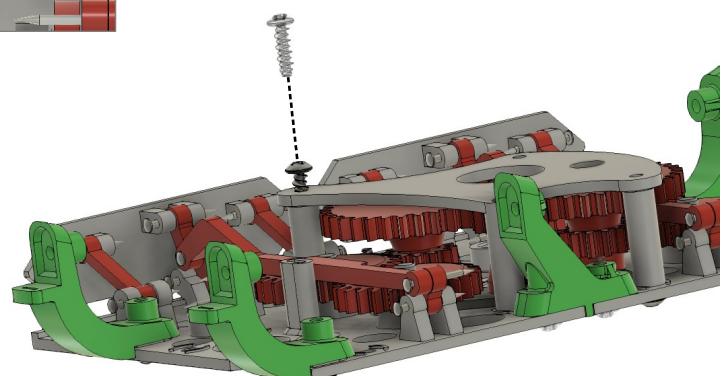
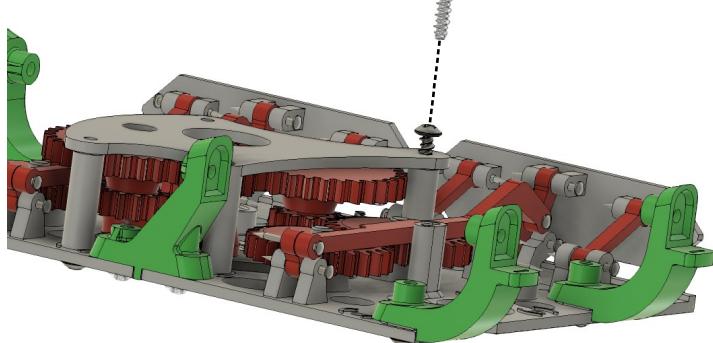
## Step 7



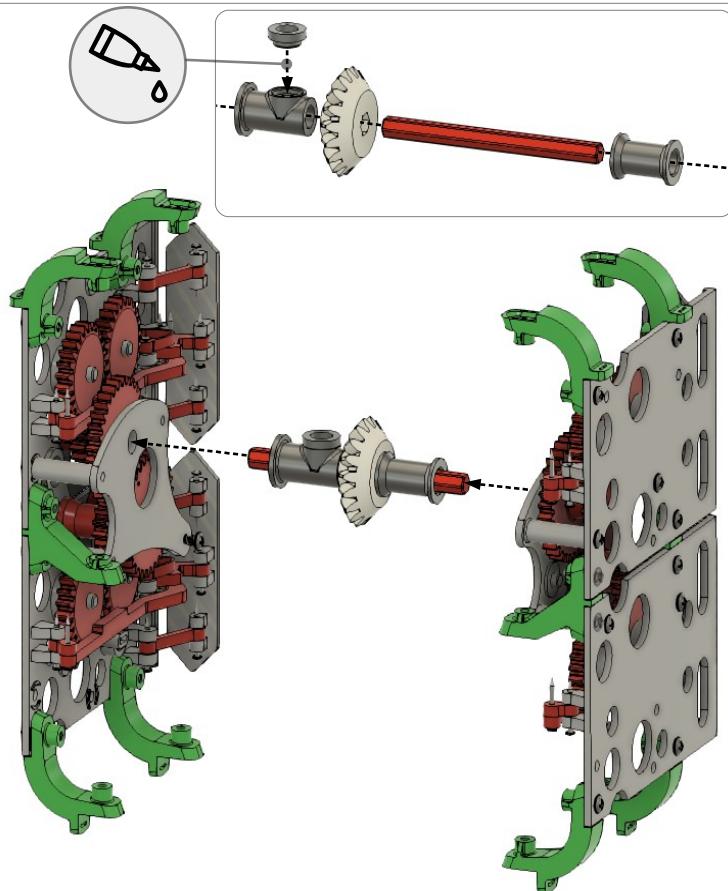
## Step 8



Insert two screws into the two covers but leave them sticking out about 3mm.

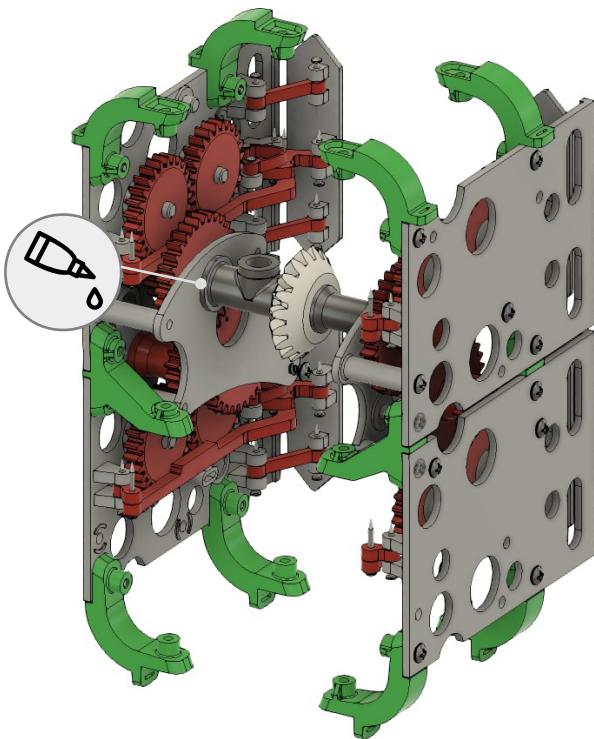


## Step 9



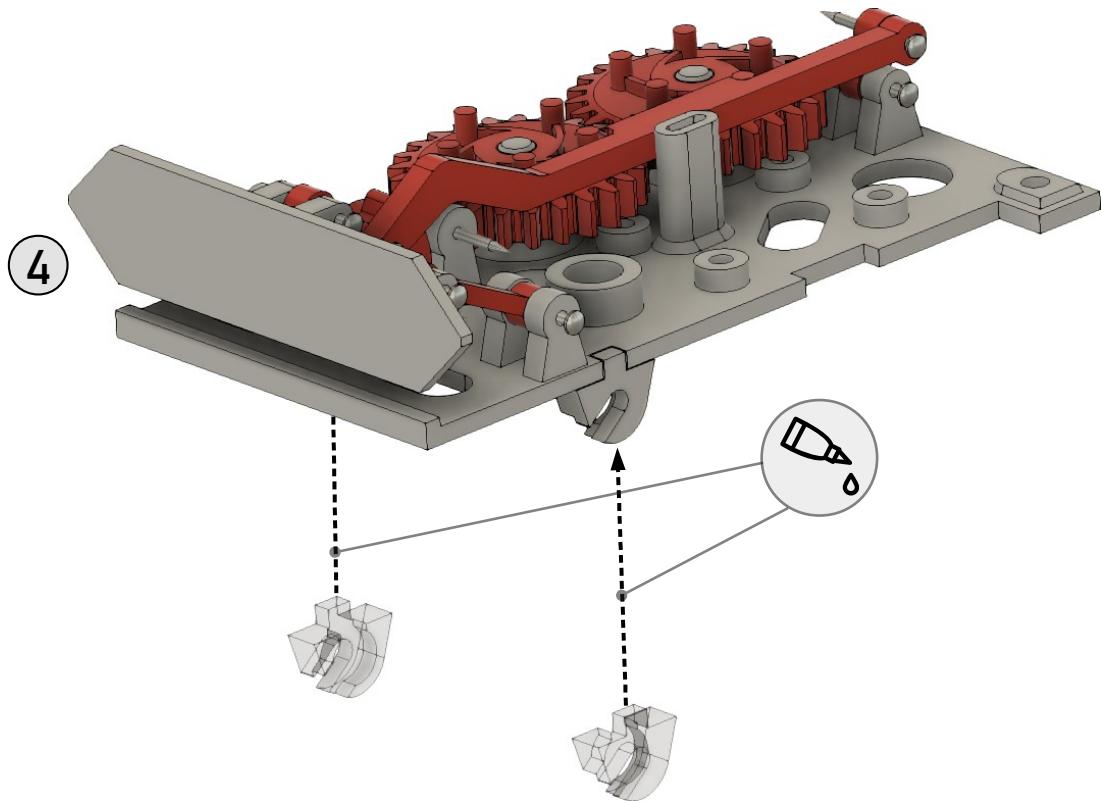
Left to right:  
TjuncA,  
TjuncB,  
Bevel\_gearB,  
ShaftH,  
Spacer

## Step 10

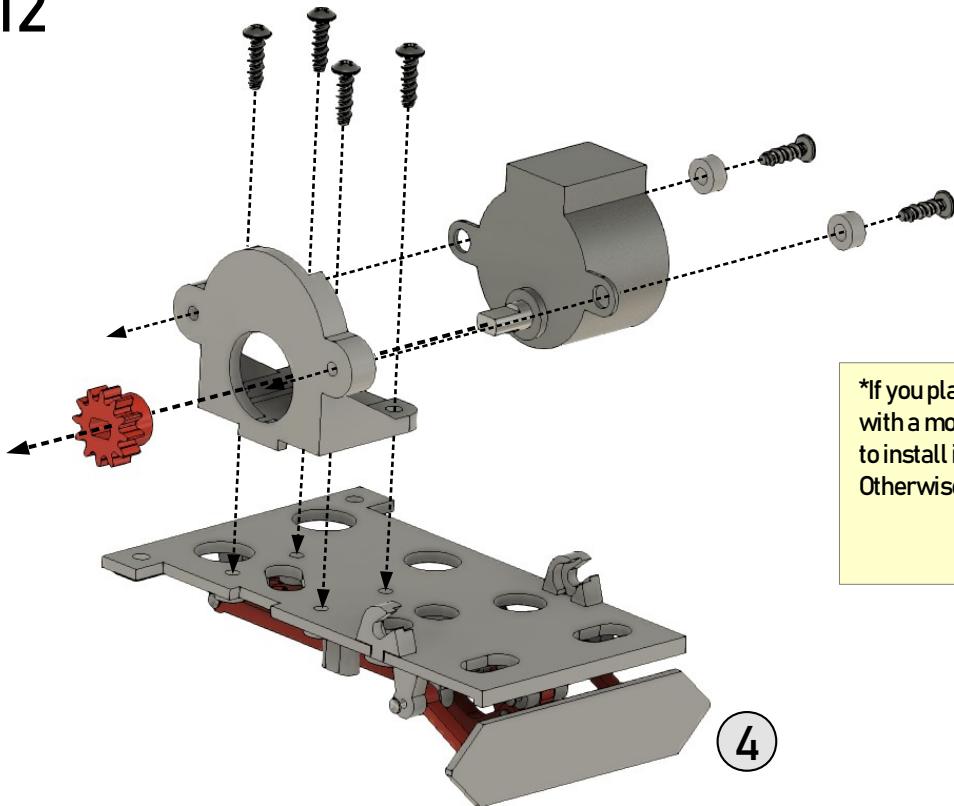


Rotate the TjuncA/B part on the shaft so that the opening points straight up. Then glue it's wide end to where it connects to the cover. Make sure it is completely vertical. A few drops of glue on the outside surfaces is sufficient. Avoid getting glue on the shaft.  
*(This step can also be completed after everything is assembled and aligned, but it will be harder to reach)*

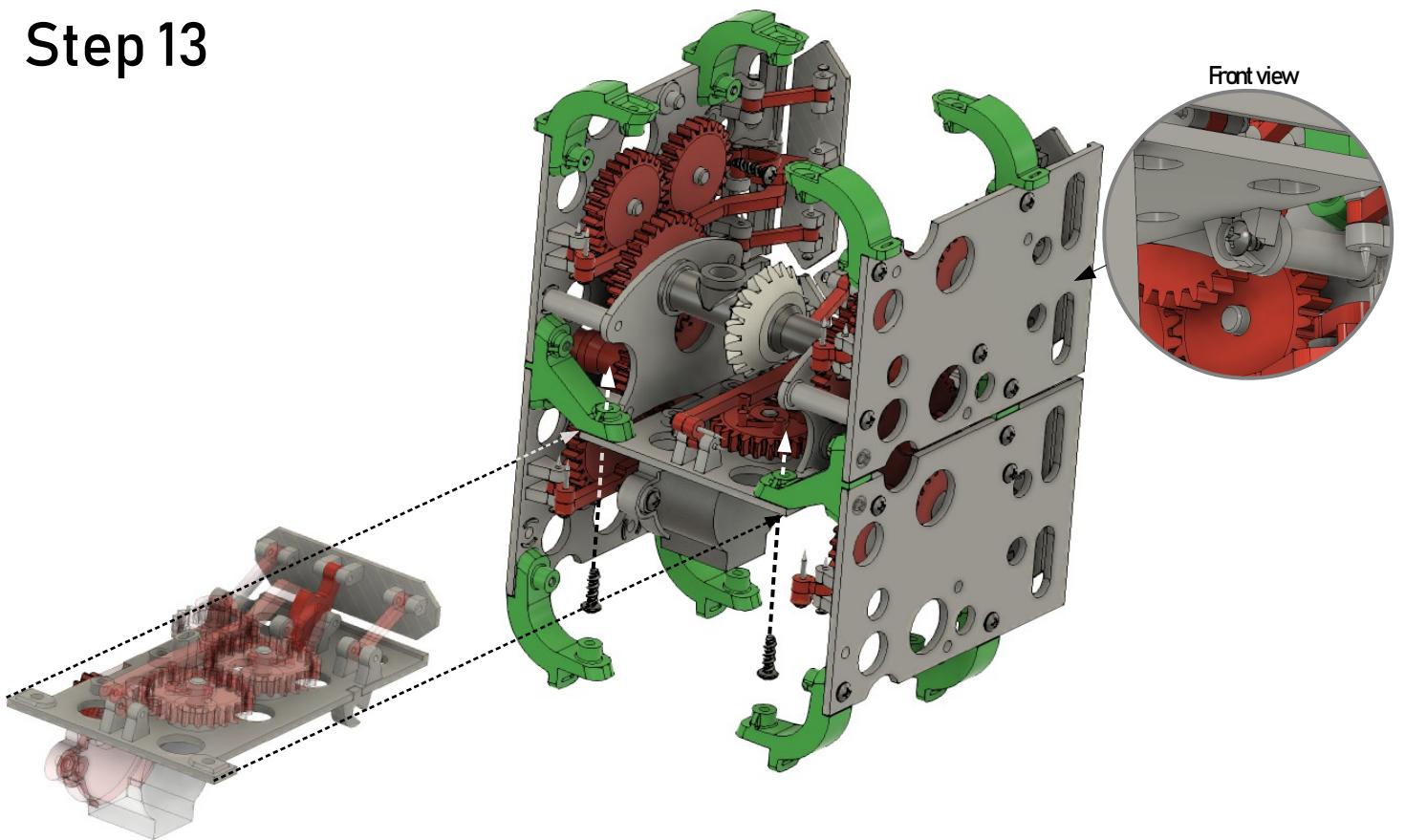
## Step 11



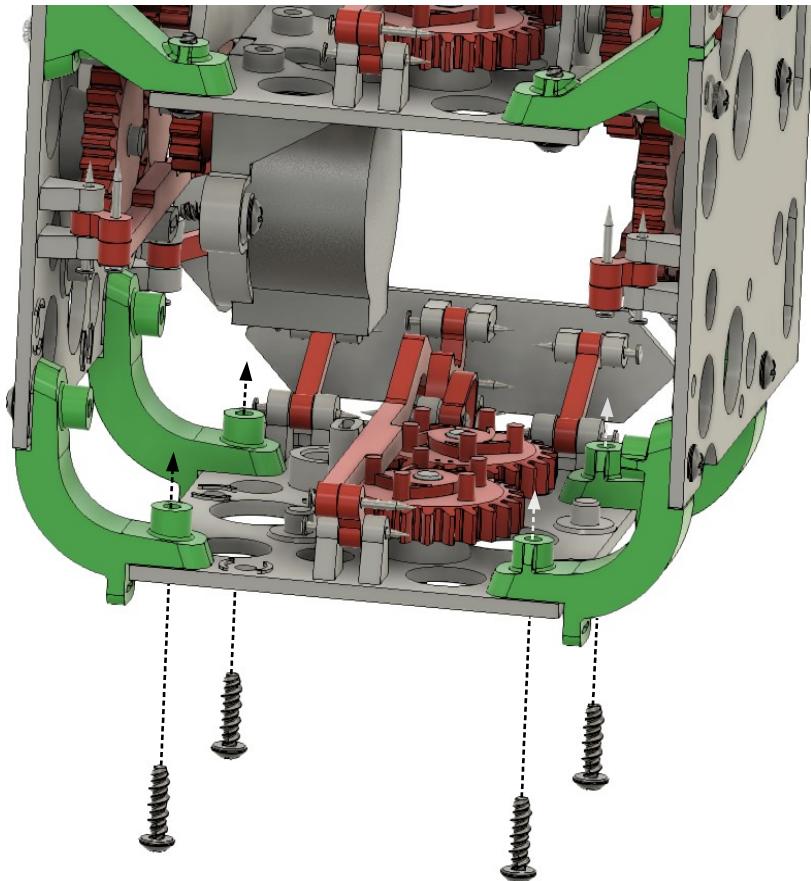
## Step 12\*



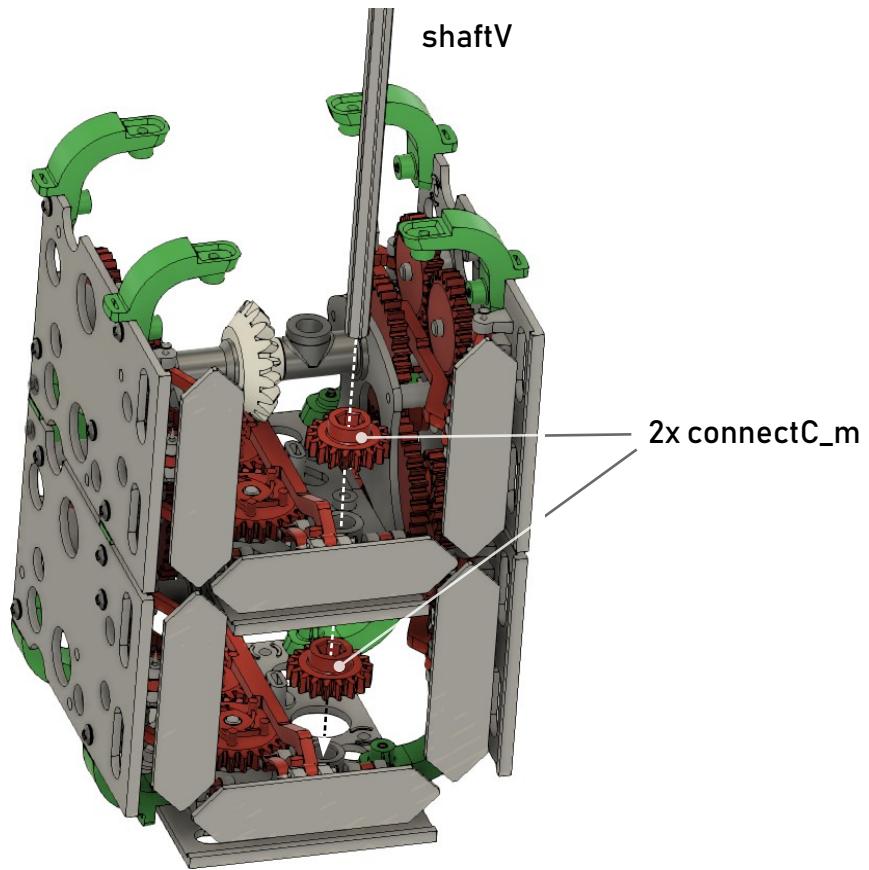
## Step 13



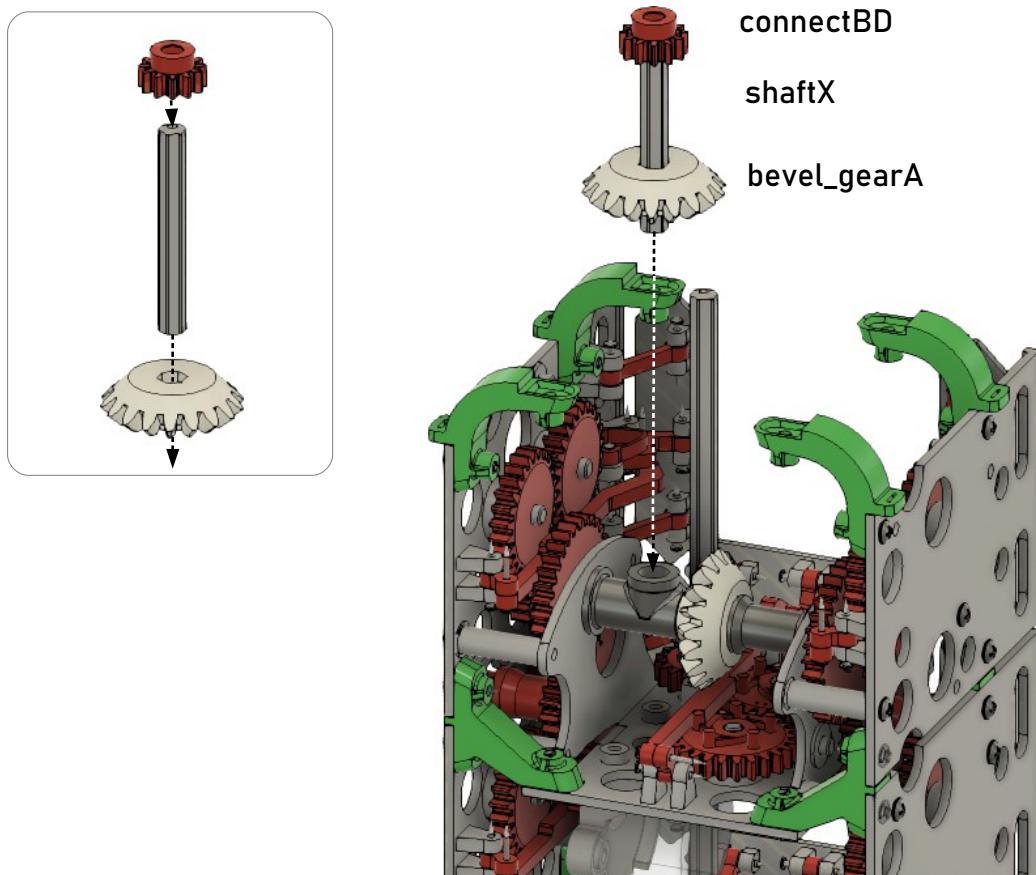
## Step 14



## Step 15

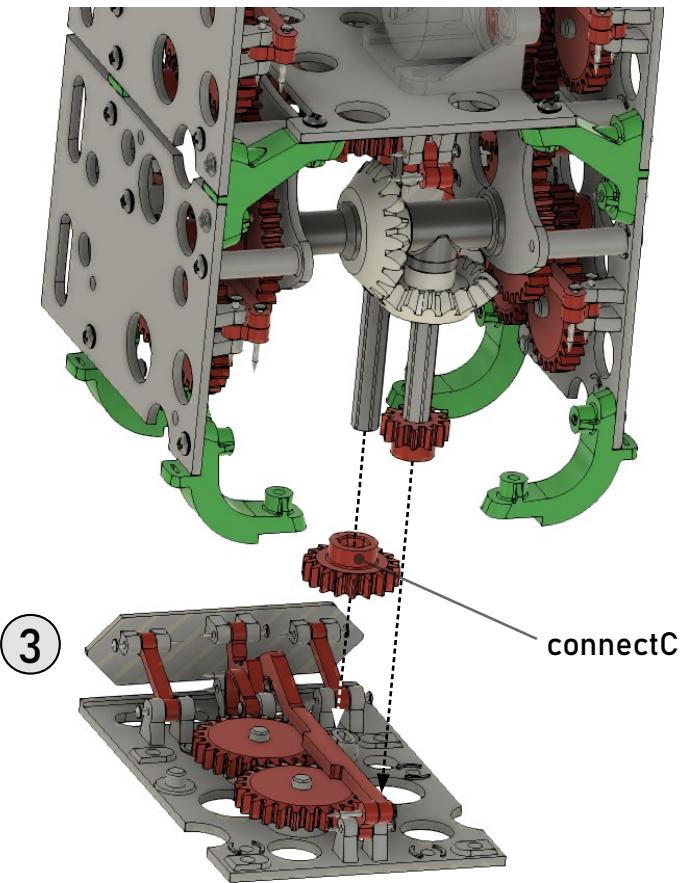


## Step 16

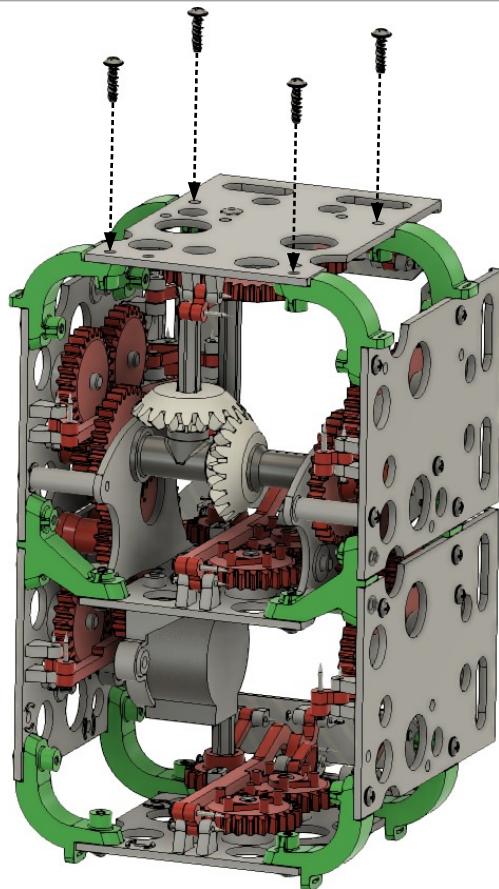


## Step 17

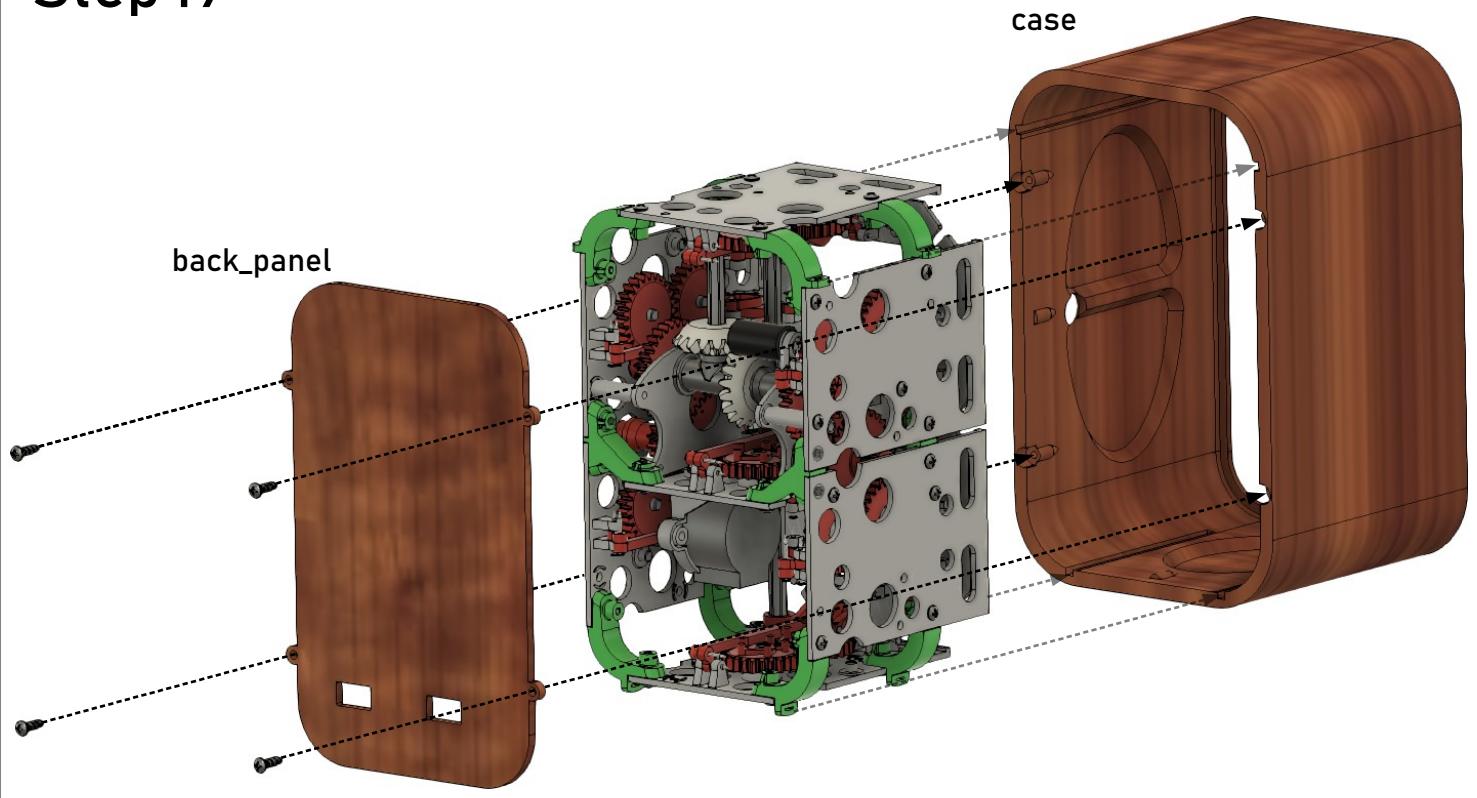
The final segment is best assembled upside down.



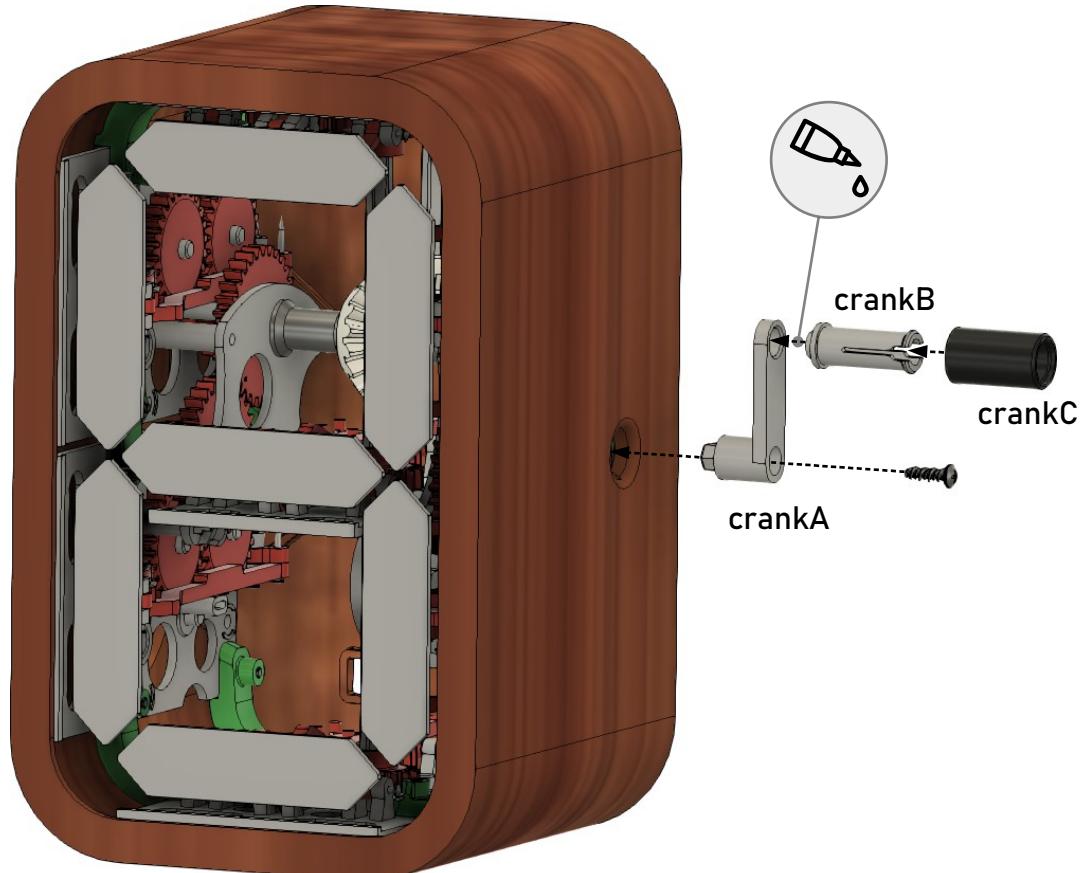
## Step 18



## Step 19



## Step 20



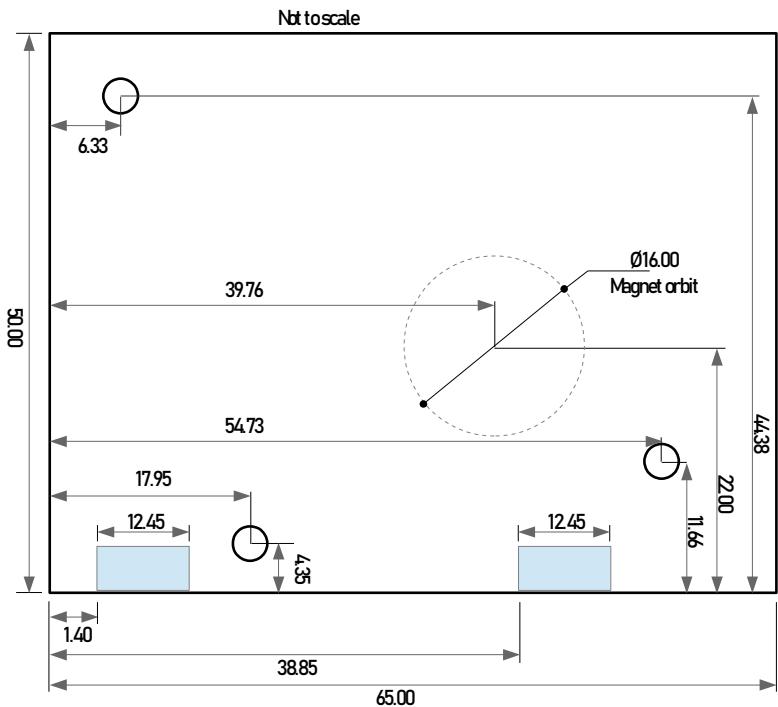
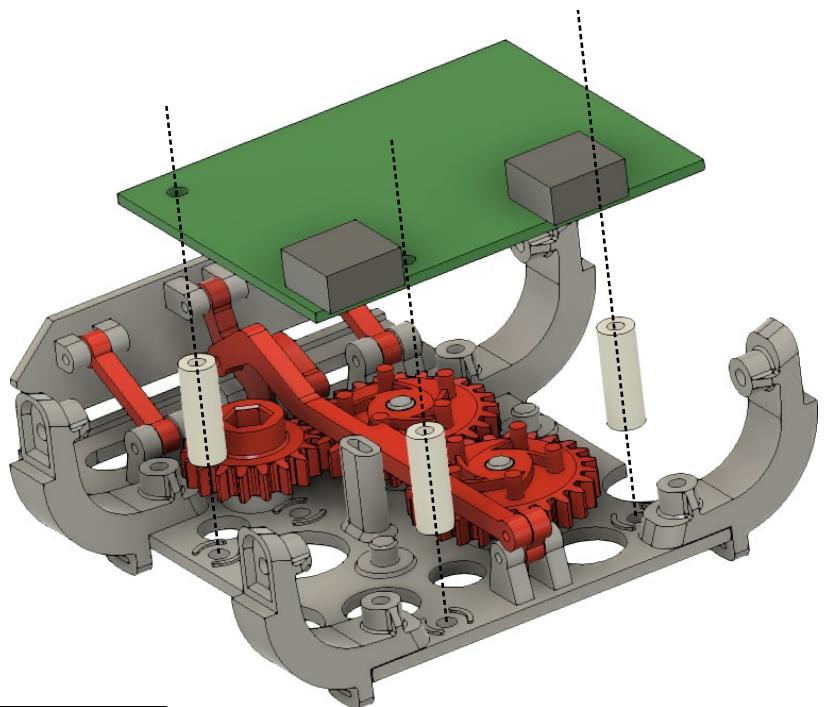
# Addendum

If you decide to build the motorized version of the counter and want to add a circuit board to it you can use the existing mounting holes in conjunction with the *pcb\_spacers*.

There is also a hole in the *gear5B* part that fits a 3x4mm cylindrical magnet for position indexing.

The reference design can also be found here:

<https://sites.google.com/site/fpgaandco/7-segments>



# Last Tips

The counter is designed for 3D printing, which means with large tolerances in mind. All moving parts should be able to freely actuate with little to resistance. Cleaning up print artifacts from the bores of the gears with a reamer can greatly improve their play. The same is true for the hinge holes of the nails which can be opened up with a suitably sized drill if necessary.

If you find that once assembled your segments don't perfectly flip in unison, the easiest way to fine tune the timing is to remove the 4-6 screws of a single segment, pull it out, then rotate the gear train by one tooth and put it back in. Repeat this until you are happy with the timing. Try to assemble the unit with all the gears aligned the same way, using the dot marks pointing in the same direction.

I hope you enjoyed this build !

