



Mechanical wall clock



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Summary

A fully printed mechanical wall clock in the shape of a flying bird.

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This is a fully printed functional mechanical clock. All parts are dimensioned to fit on build plates at least 18x18cm.

When assembled the clock measures 60x42cm (weight not included).

The weight is designed as a container with screw lid which can be filled with rice or sand.

Total running time will depend on how high up on the wall you hang it. With the smallest reel the weight will drop ~111cm per hour (54 min per

meter) for the standard version. With the tail feather remix the weight will drop ~9.6cm per hour (10h 25m per meter).

Below are tables with the relation between reel center size and how fast the weight drops.

Table 1. Dropping speeds for original version

Reel size	cm per hour	time per meter
16	111	54 min
24	166	36 min
32	221	27 min

Table 2. Dropping speeds with tail feathers remix

Reel size	cm per hour	time per meter
16	9.6	10h 25m
24	14.4	6h 57m
32	19.2	5h 12m

Update 2021-06-20: Added remix of tail feathers which increases running time of the clock. See section Tail feathers remix.

Print settings

Layer height: 0.2mm

Infill: 10-20% (pendulum weight 100% infill)

Seam: All shafts and gears have a small notch for the seam. Make sure when slicing that the seam is placed in that notch (in PrusaSlicer seam position should be Nearest or Aligned, in Cura it should be set to Sharpest corner).

Top infill: I used concentric infill for the top layer which in my experience gives a smoother top surface.

Post processing

No post processing of parts should be needed but to be sure, check that the top surface of all gears and nuts is smooth. If it is not, gently sand down any imperfections.

Additional parts

Almost everything for this clock is printed but you will need a few things:

- A string or fishing line for the weight. I recommend a fishing line or other thin (diameter <1mm) but strong string.
- Silicone spray or other suitable (non greasy) lubricant for the moving parts
- Something to fill the weight with, e.g. rice or sand.
- Glue if the press fits are not tight enough

Testing tolerances

Start by printing the models `press_tolerance_test` and `rotation_tolerance_test` from the folder `Common parts`.

Press fit tolerance

Use the press fit test to decide which press fit parts to print. The pieces should be held together tightly but you should be able to assemble them without a hammer.

If press fit #1 is too loose, use glue when assembling the press fit parts. If press fit #2 is too tight, use more force when assembling or check your printer/settings.

Rotational tolerance

Use the rotational test to decide which rotational parts to print.

Cylinders

Place the cylinders on the shaft and try to spin them. Select the one with lowest number which can spin freely.

Nuts

Select the nut with the lowest number which is easy to screw on and off.

Color scheme

These are the filaments I used and the parts I used them for

Prusament Galaxy Black

Used for backplate, nuts and connectors.

Prusament Oh My Gold

Used for hands and weight.

PrimaSelect Bronze

Used for most gears and pendulum arm.

PrimaSelect Antique Copper

Used for time gears, reel, escapement gear, pendulum weight and markings on the time rings.

PrimaSelect Silver

Used for the time rings.

Printing

You need to print three (3) instances of the part gear_48-12_rx, all other parts which require multiple instances already have them in the .3mf files. (Three instances of gear_48-12 will not fit on most build plates which is why I decided to only add one instance).

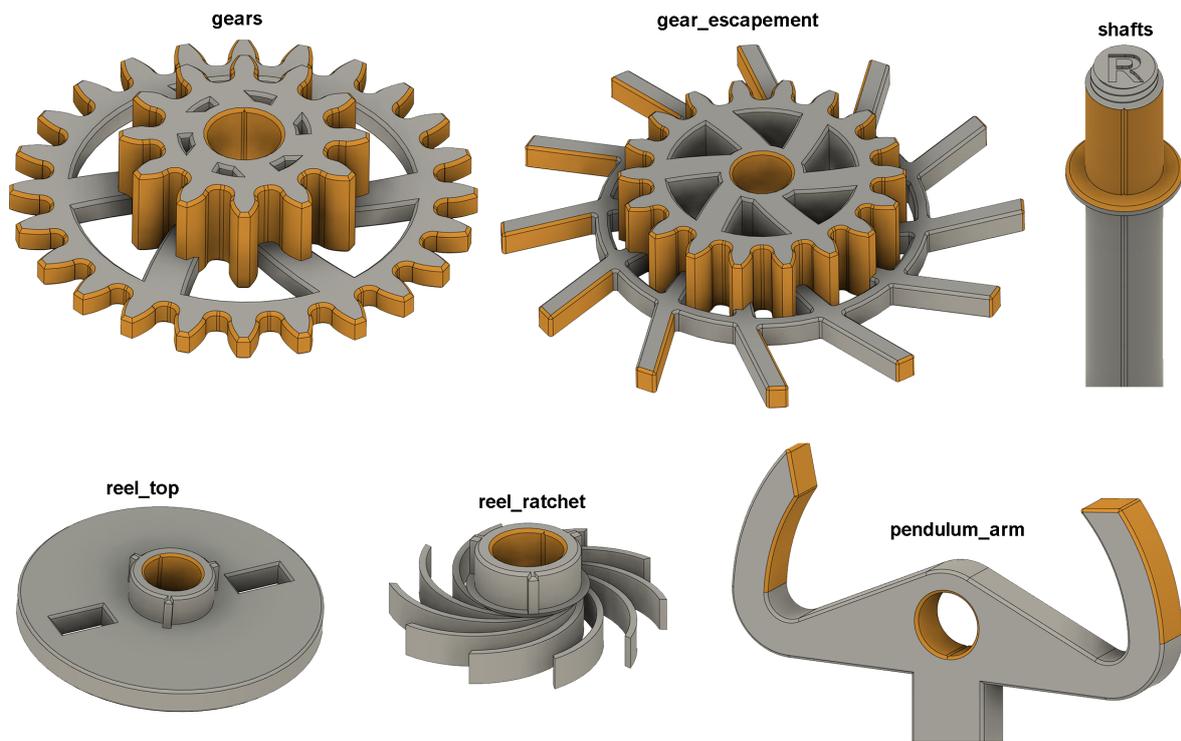
The parts are divided in folders (and have suffix, _pX for press fit, _rX for rotational) depending on their tolerances, print only those who match what you selected from the tolerance tests.

You do not need to print all reel_center_X pieces directly, start with reel_center_s if you are using a fishing line or other thin (<1mm diameter) string for the weight, otherwise reel_center_m. You only need to print other dimensions if needed later.

Lubrication

For proper functionality it is crucial to lubricate the moving parts correctly. I used silicone spray applied with a small brush.

Lubricate the parts as indicated with orange in the picture below.



Assembly

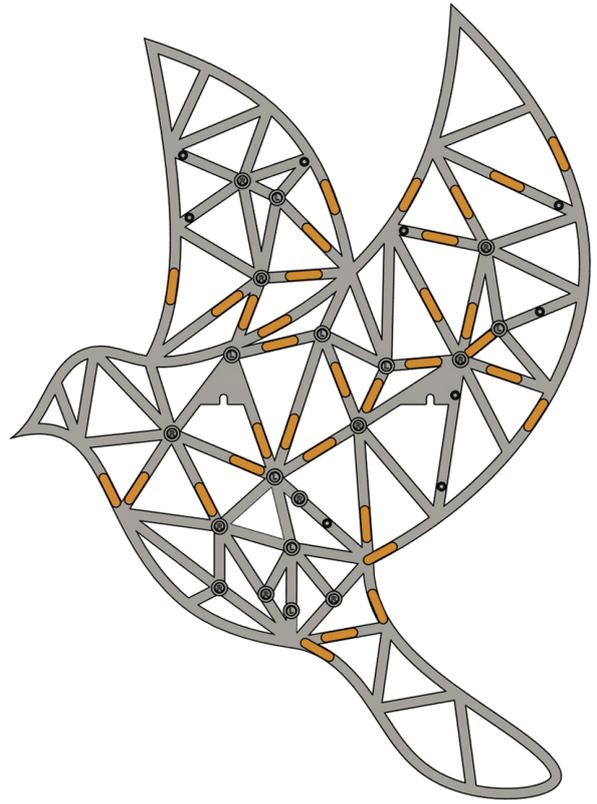
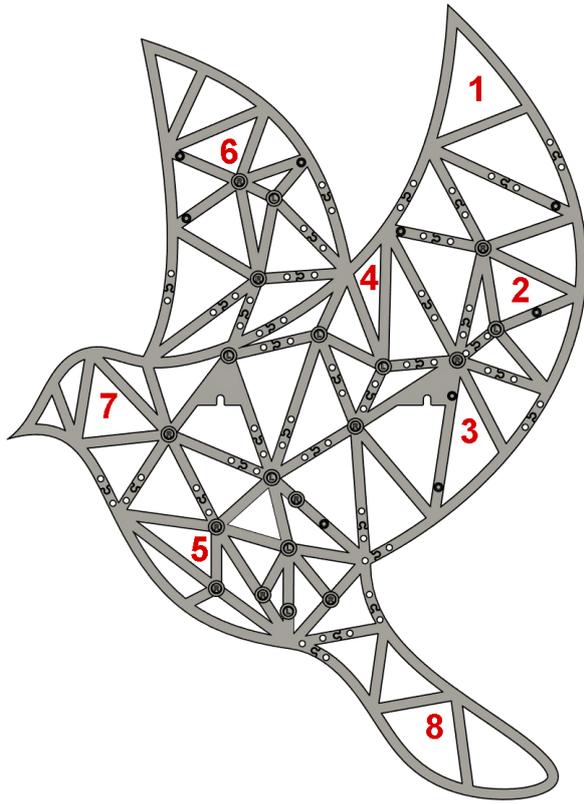
Backplate

The order in which the backplate parts are assembled are not important unless you use glue.

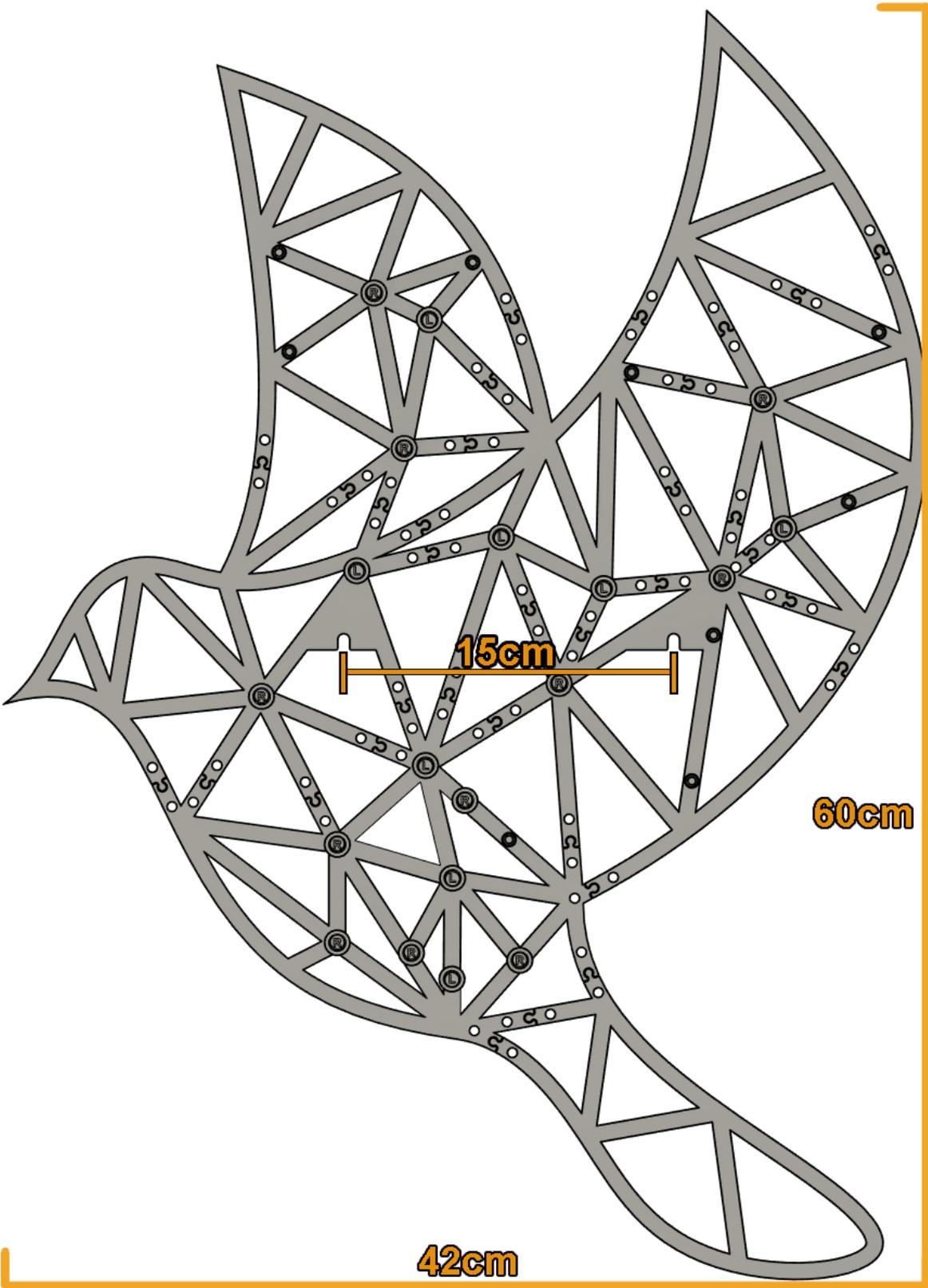
If you decide to use glue in the puzzle joints I would recommend to assemble them in their numbered order as this will let you apply glue to the pins which will always be pressed down into the slots when assembled in order.

Lay the parts on a flat surface and press them together.

When all backplate parts are put together, secure them with the connector pieces, one over each joint.



Wall mounting



When you have the backplate assembled you should decide where to hang the clock. The distance between the center of the mounting points is 15cm.

Mount the clock to the wall before continuing with the assembly.

Gears

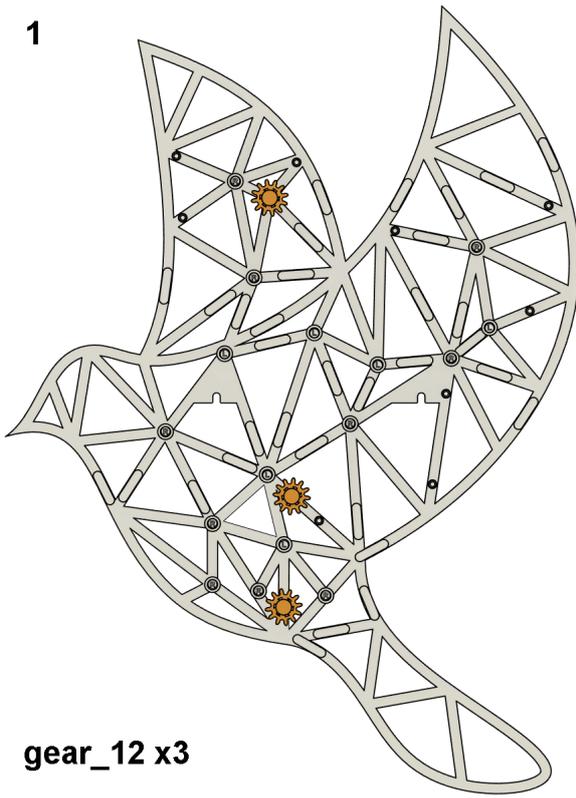
Attach the gears in the order pictured below. Secure each gear with a nut with the same letter as the shaft. Shafts and nuts marked with "R" are normal right handed threads, shafts and nuts marked with "L" are left handed threads.

All gears have their number of teeth in the name, so if you do not know which gear is which you can count the teeth.

Gears 27-10, 36-12, second_36-12 and minute_60-12 should have the smaller gear pointing towards the back, all other double gears should have the smaller gear pointing forwards.

For each gear you attach, make sure it can rotate freely (should be able to keep rotating by it self after you turn it). For all gears until the last (minute gear) it should be relatively easy to spin the entire chain of gears by turning the last added gear. If there is significant resistance, make sure the tolerances are correct, that there are no imperfections in the print causing resistance and that both the shaft and gear are properly lubricated.

1



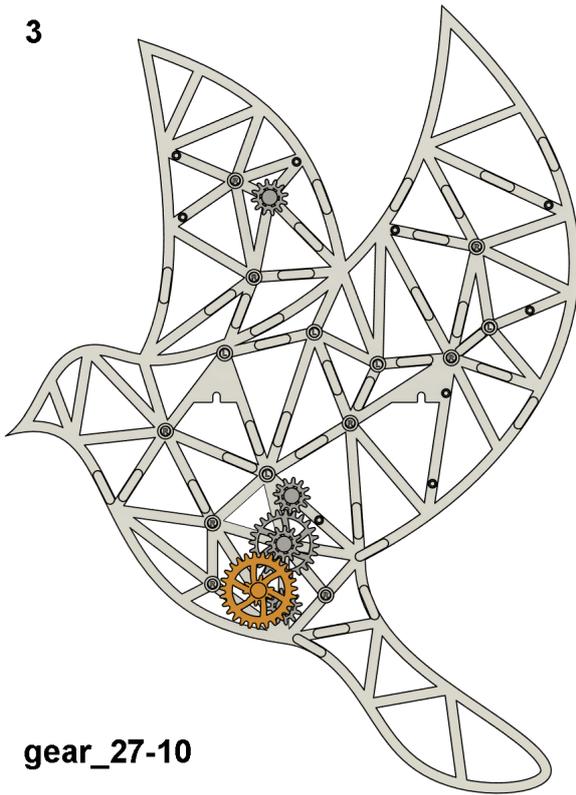
gear_12 x3

2



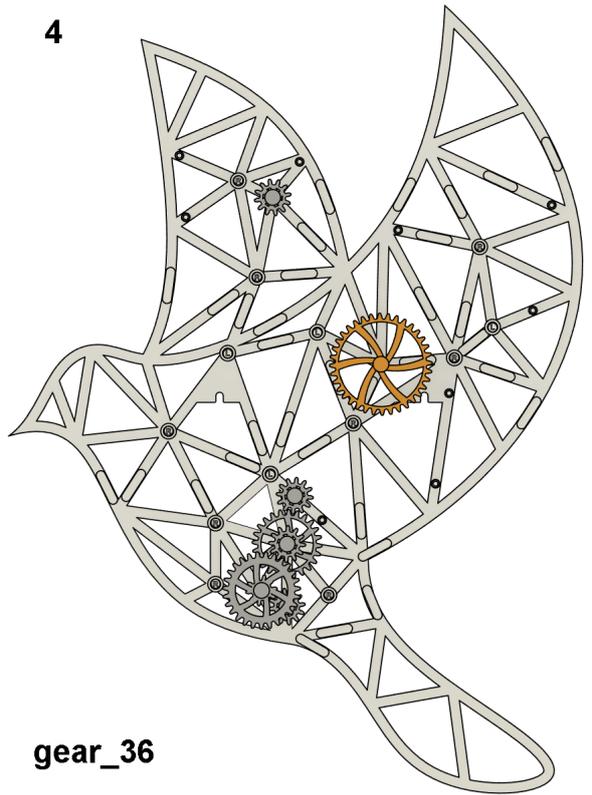
gear_24-12

3



gear_27-10

4



gear_36

5



gear_18-12

6



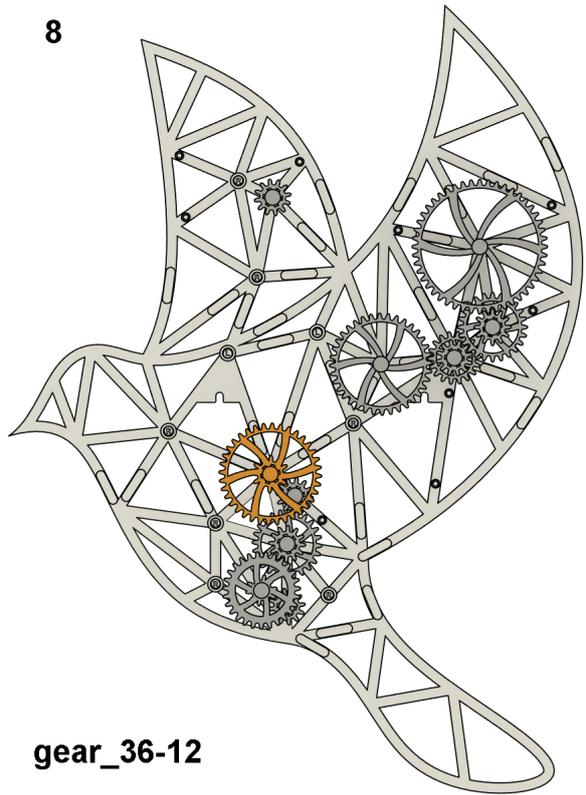
gear_24-12

7



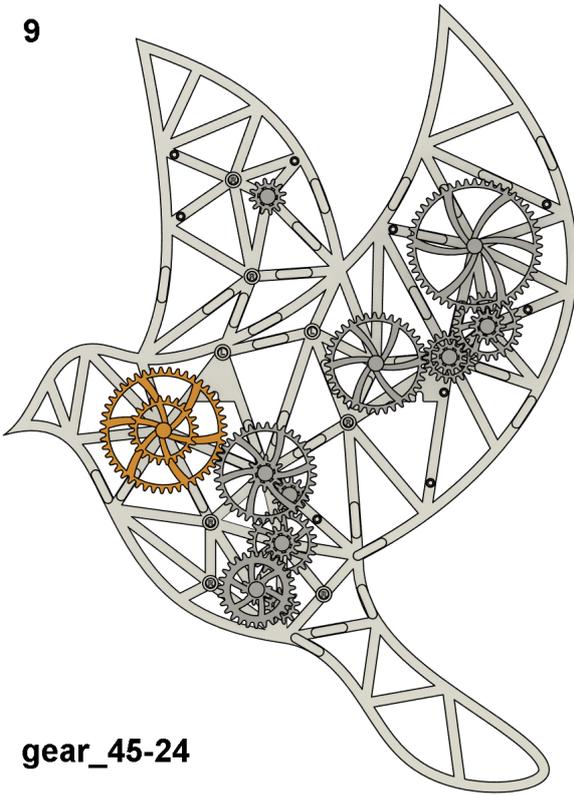
gear_hour_48

8



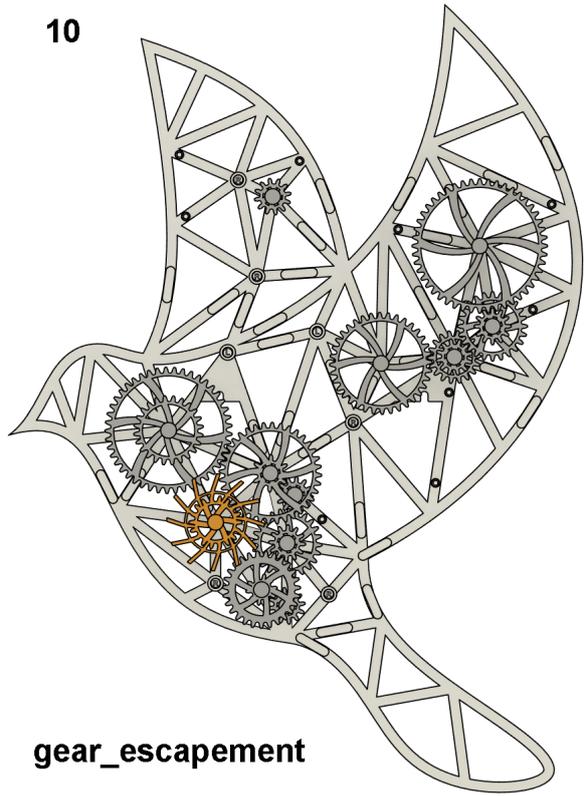
gear_36-12

9



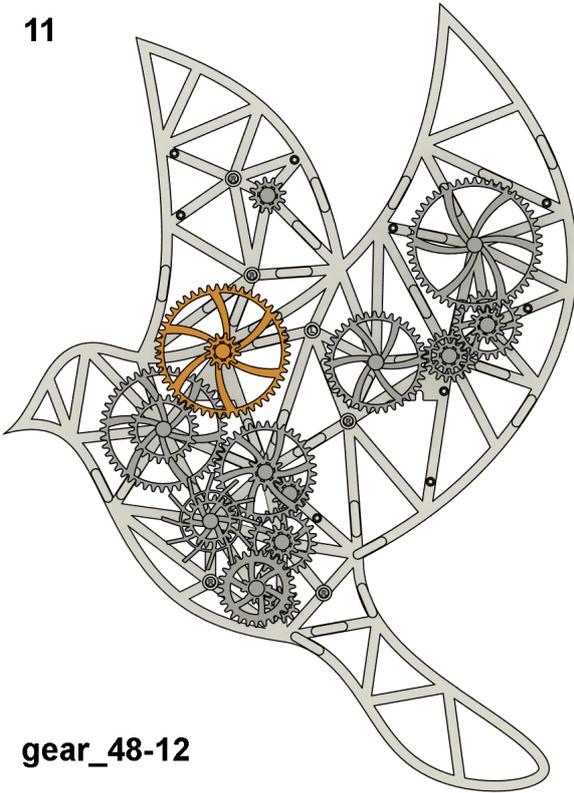
gear_45-24

10



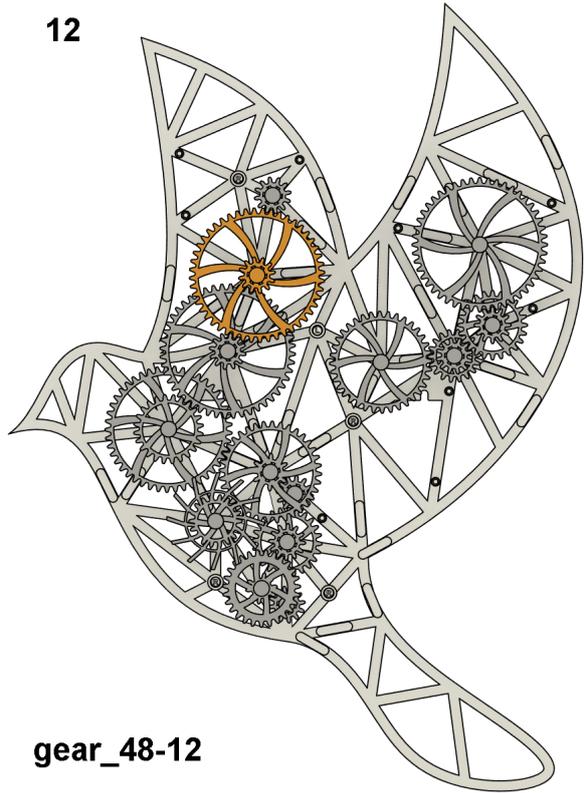
gear_escapement

11



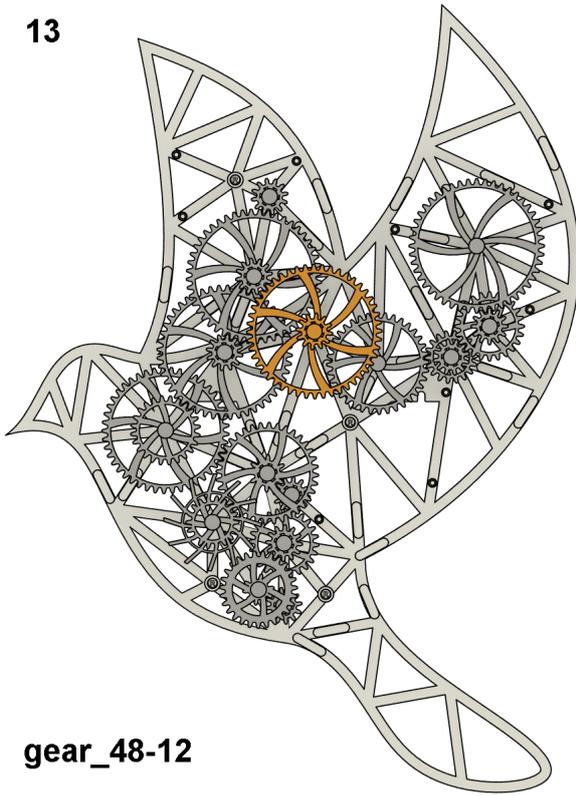
gear_48-12

12



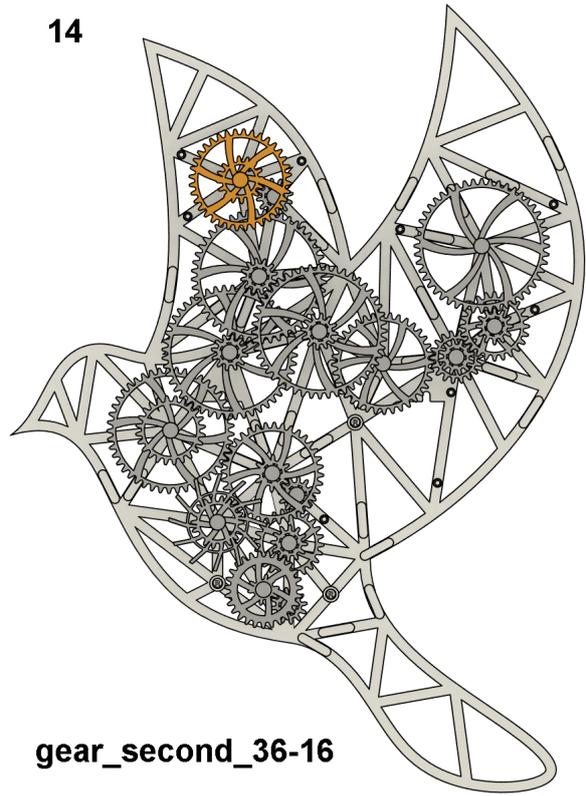
gear_48-12

13



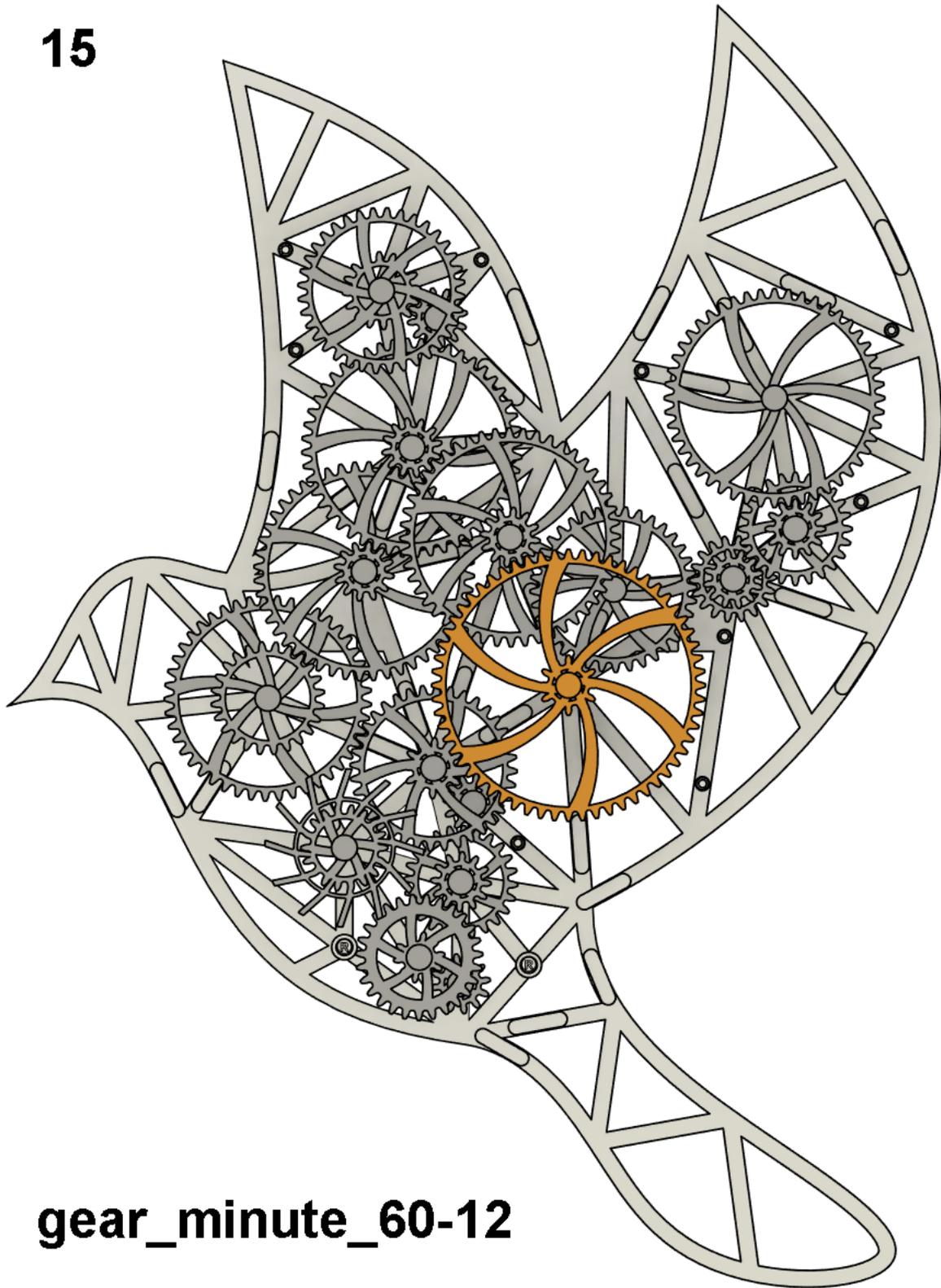
gear_48-12

14



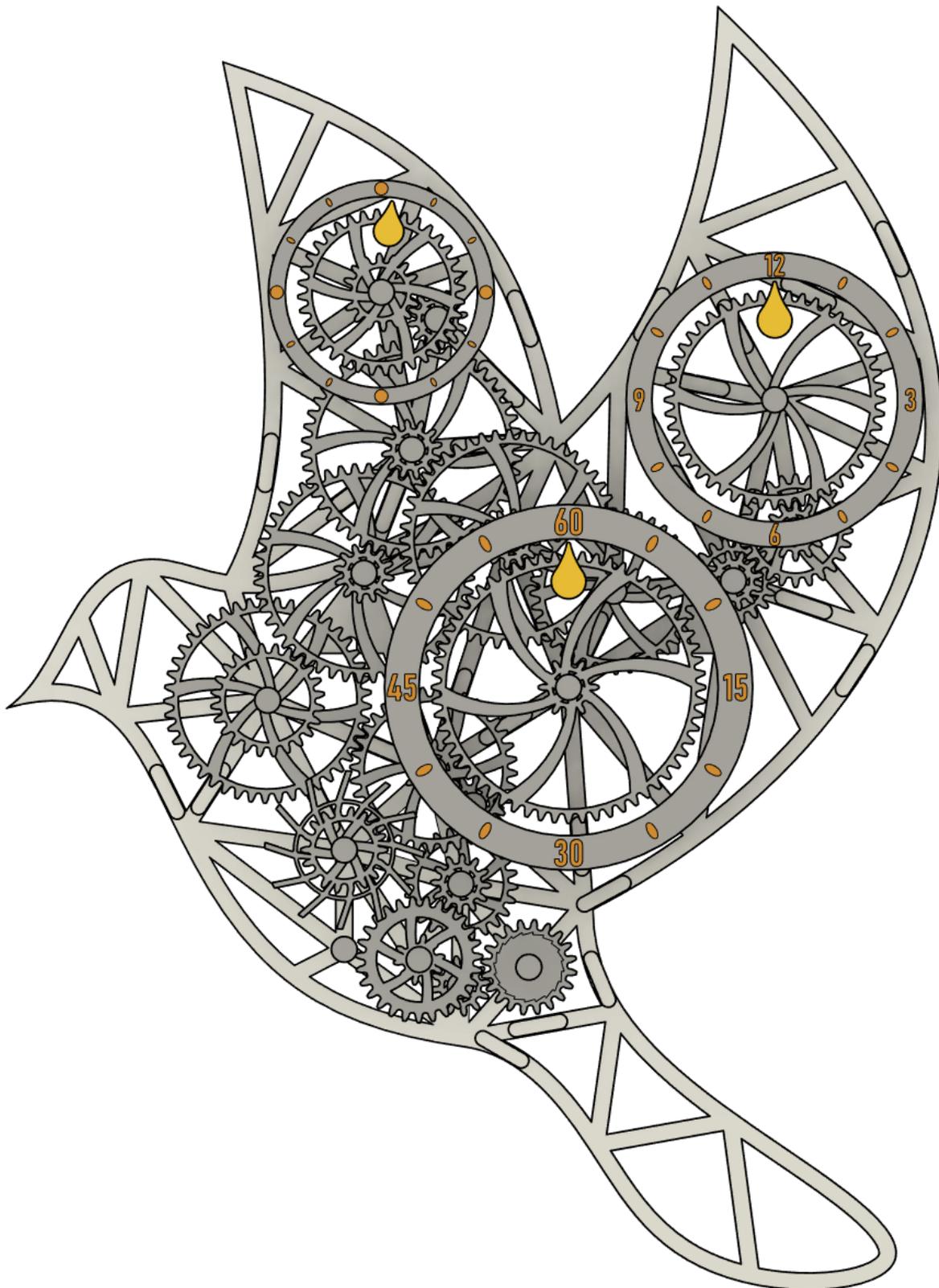
gear_second_36-16

15



gear_minute_60-12

Rings and hands



Attach the rings to the pins on the backplate. If the press fit is too loose, add a drop of glue in each hole on the back side of the rings.

Attach the hands to the time gears and rotate the minute and hour gears so they each point straight upwards. Each hand has a letter stamped on the back to indicate which gear it fits on (S for seconds, M for minutes, H for hours).

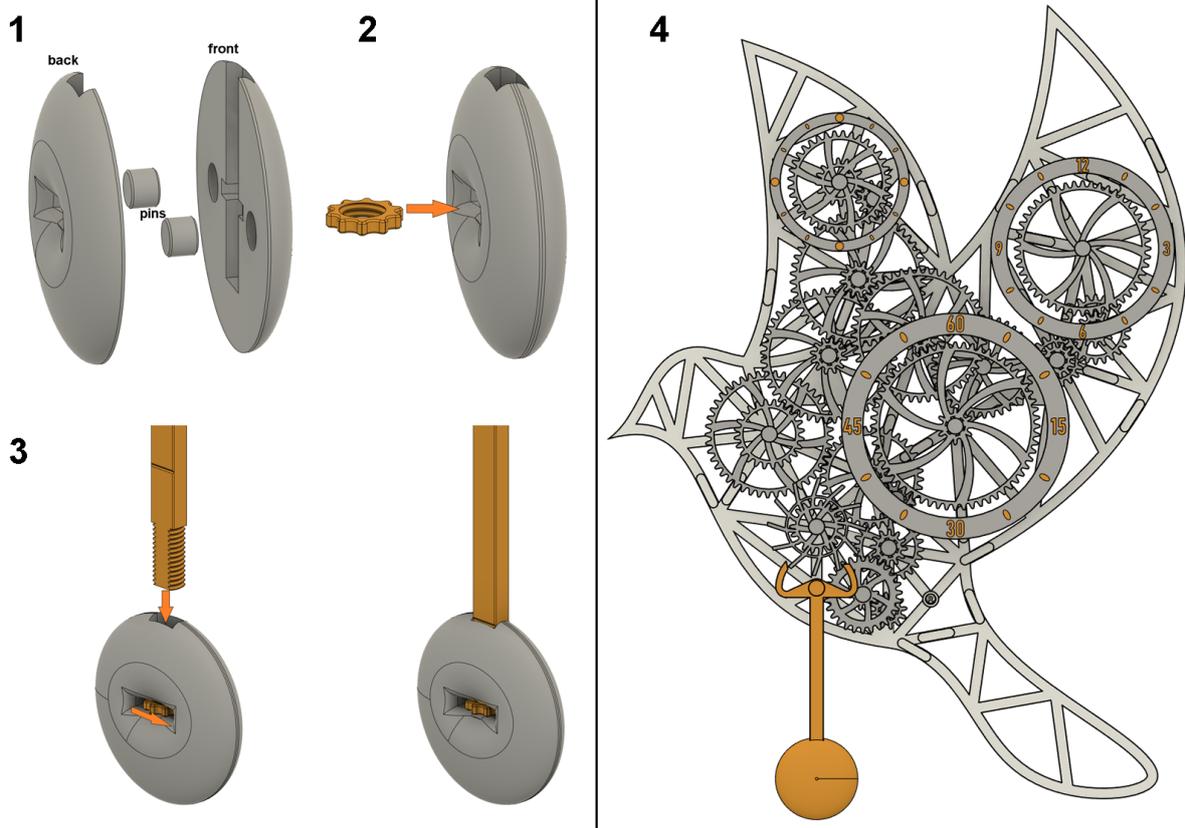
Pendulum

Connect the two parts of the pendulum weight using the pendulum pins and glue if needed.

Insert the pendulum nut and the pendulum arm and turn the nut until the notch on the back of the pendulum arm is in line with the top of the weight.

Attach the pendulum to the backplate and secure it with a nut.

Check that the pendulum can swing freely, you should be able to get it to swing at a constant rate by gently turning the escapement wheel clockwise. If not, remove it and resolve any issues causing resistance (print imperfections, lubrication etc.)



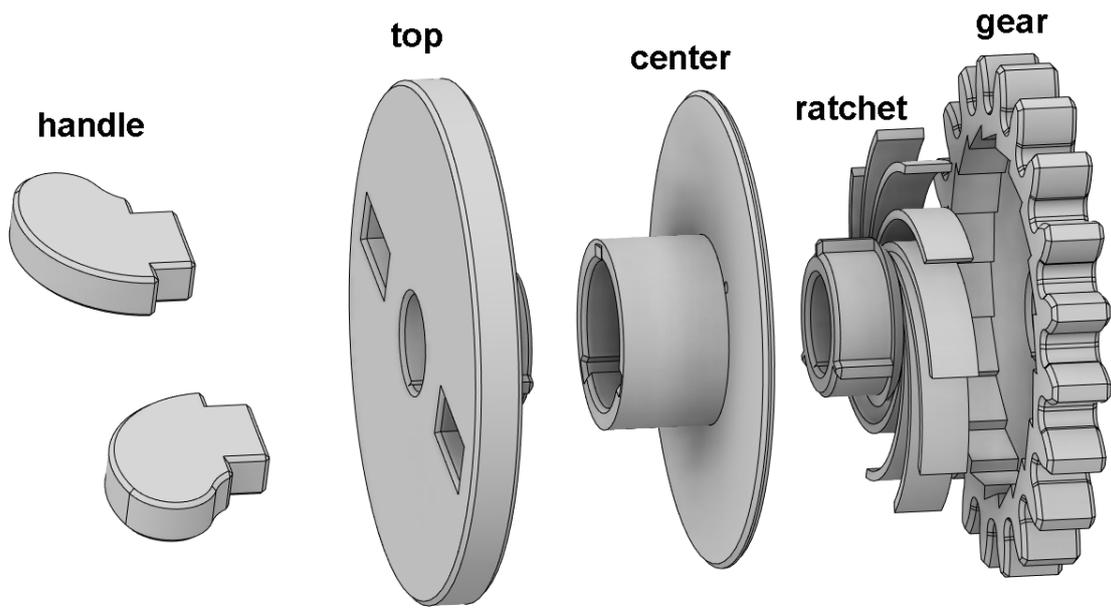
Reel and weight

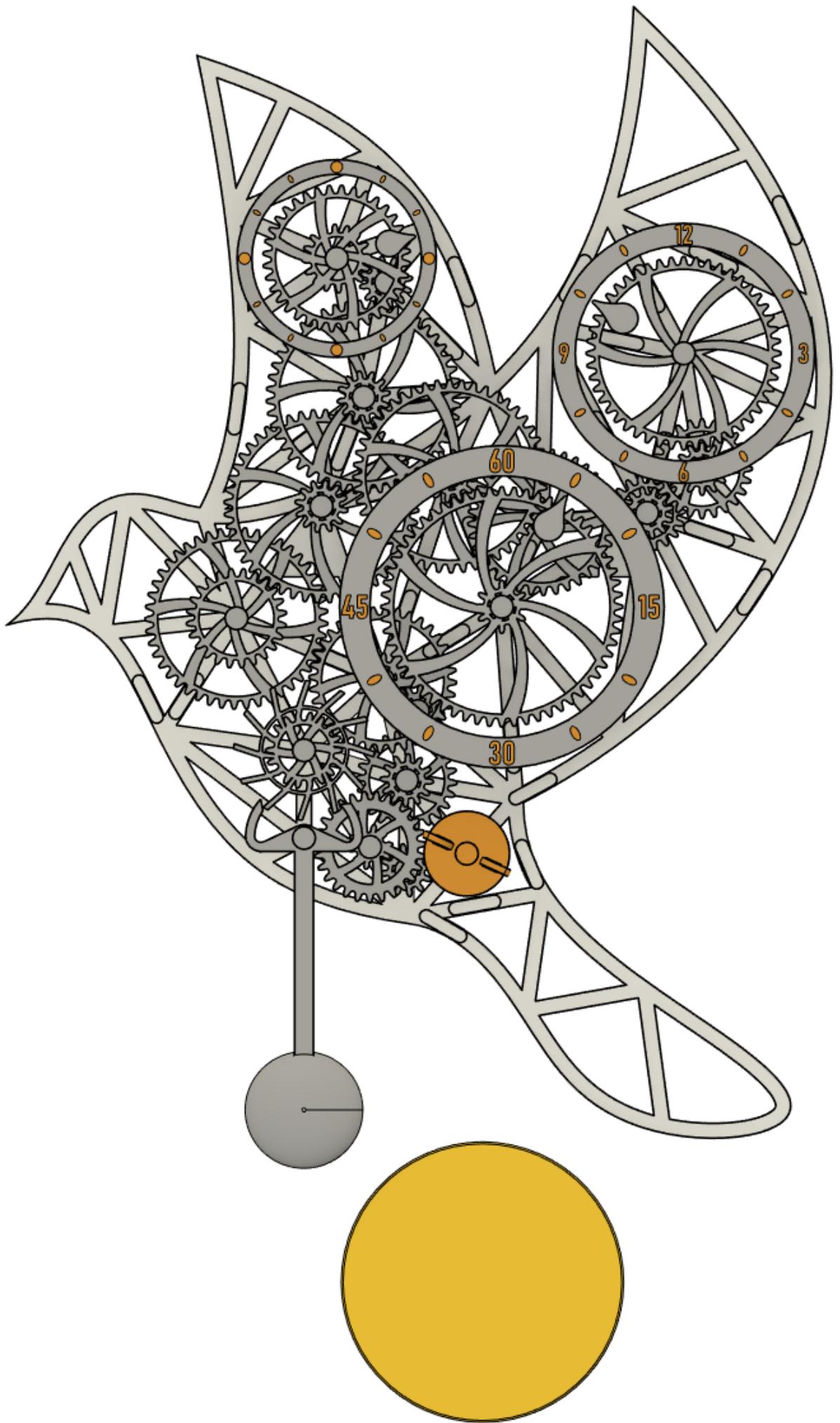
Start by cutting the string for the weight to a proper length, it should reach from the remaining shaft on the backplate to the floor.

Tie the string to the weight and add a piece of tape on the inside to cover the hole to prevent leaking when filling the weight.

Fill the weight with rice or sand and screw on the lid. For me 3 dl of rice was enough, but the weight holds up to 3.9 dl.

Attach the other end of the string to the reel center piece. If you are using a fishing line with the reel_center_s piece, pull it through the hole in the plate and tie a small stopping knot on the other side, for example a **double overhand stopper knot**. If you are using another center piece, tie the string around the pin as you did with the weight. Cut off any excess string.





Assemble the reel as shown in the picture above left to right, use glue for the handles if needed. If you are using the center piece reel_center_s make sure the stopper knot lies between the spokes of the ratchet. Turn the ratchet counter clockwise when inserting it into the gear.

Attach the reel to the backplate and secure it with a nut.

Congratulations! You are now done with the assembly. Now it is time to test and tune the clock. Wind it up by turning the reel counter clockwise and give the pendulum a gentle push to start it.

Adjustments

Reel and weight

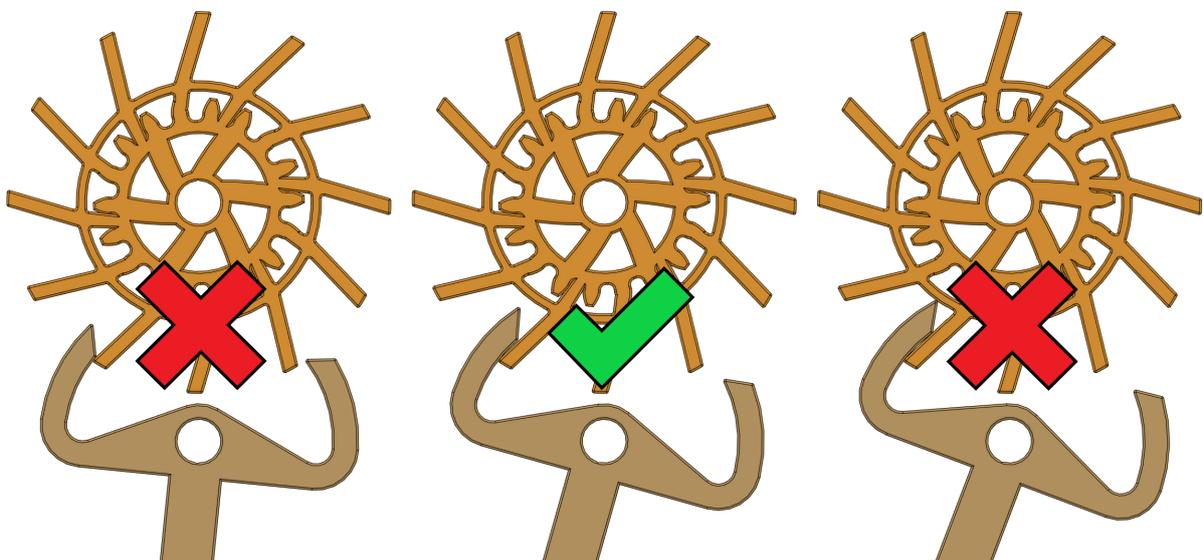
To function properly the right amount of force must be applied to the pendulum, this is tuned with the reel center piece and the weight. The pendulum should continue to swing a bit past the point where it stops the escapement wheel but not so far that it is stopped by the escapement wheel, see picture below.

If the pendulum is not swinging far enough you can:

- make sure the parts are properly lubed
- increase the mass of the weight by filling it with more or heavier material
- use a bigger reel center piece

If the pendulum swings too far (hits the inner part of the escapement wheel) you can:

- use a smaller reel center piece
- decrease the mass of the weight



Pendulum period

To adjust the speed of the clock you can alter the period of the pendulum by turning the screw inside the pendulum weight (accessible from the back). Moving the weight upwards will decrease the period and make the clock run faster, downwards will make the clock run slower.

In theory the clock speed will be adjusted by ~12 seconds per hour by moving the weight 1mm up or down.

The period of the pendulum should be 0.75 seconds, which means it should take 9 seconds for the escapement wheel to make one full revolution.

Adjusting time

To adjust the time, remove the screw holding the minute gear and pull it out 5-10mm and turn it. This will turn the minute and hour gears without interacting with the rest of the gears. Push the minute gear back and replace the nut.

Tail feathers remix

This is a remix which allows you to replace the tail feathers (backplate_08) with a new version with additional gears to increase the running time of the clock.

Assemble and test the original version of the clock before printing this remix (if you plan to print this you can ignore backplate_08 when printing the original version, all other parts will still be used).

Printing

Print the parts in the folder Tail remix (models with "remix" in the file name). Use same print settings and tolerances as with the rest.

Lubrication

Lubricate all remix parts as described above.

Weight

Due to the additional gearing in the remix you will need a much heavier weight. I have not provided any printable version for this since it would be ridiculously large. I recommend testing how much weight you need for reliable operation by using various objects as weight and then finding a

nice rock with the correct weight to use (I use a 4.7kg rock with reel_center_24).

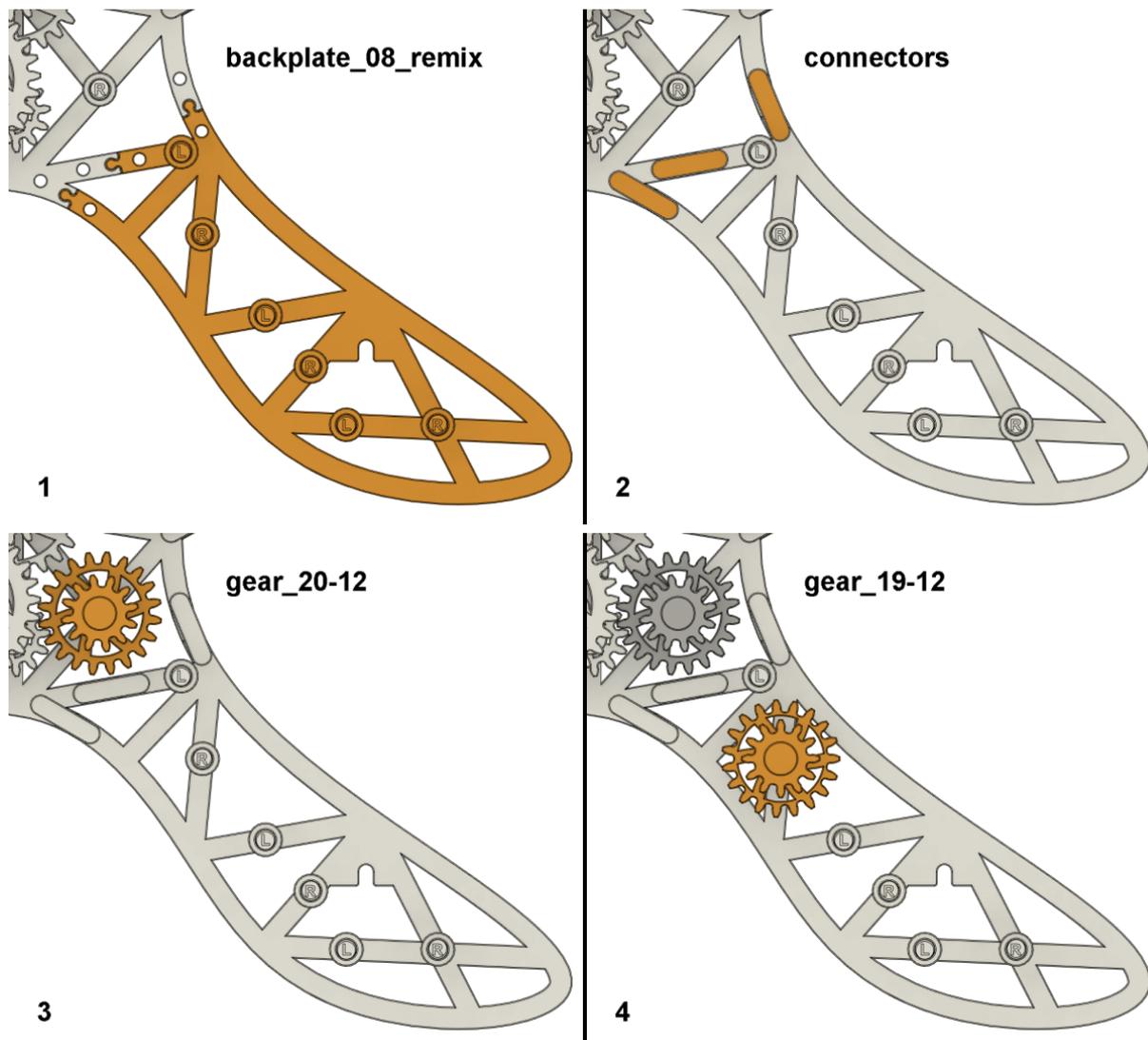
Remember to protect your wall by adding felt pads to the back of the rock to prevent scratches.

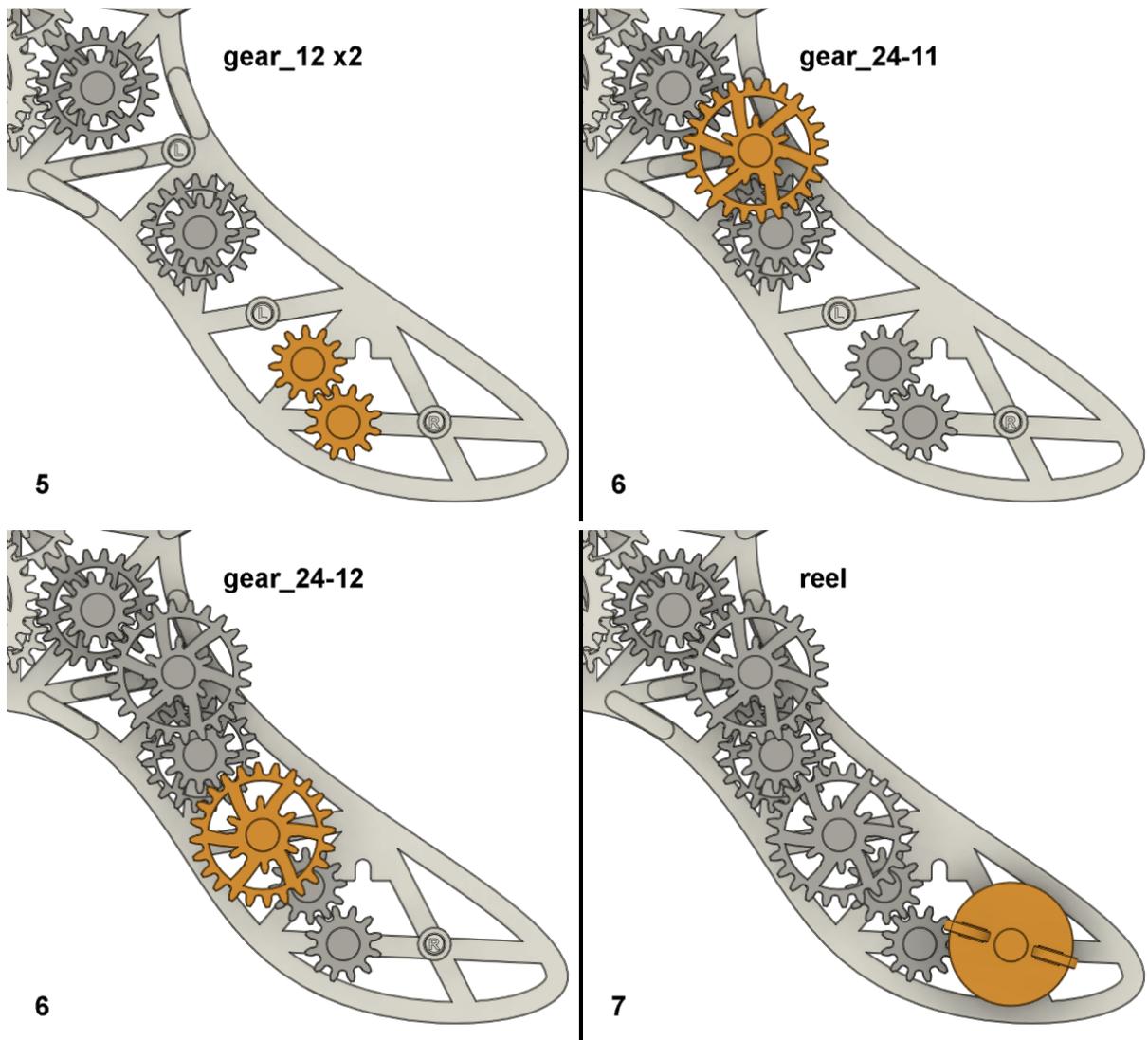
Assembly

Start by removing the reel and tail feathers from the clock. Attach the new tail feathers and secure it with the connectors.

When the new tail feathers are attached you should add a screw at the new mounting point. This is really important to handle the mass of the new weight.

Attach the gears and reel in order as pictured below. Gears 24-11 and 24-12 should have the smaller gear pointing towards the back.





Done! Now the remix is assembled and you can start testing how much weight you need.

Tags

decoration bird wall office functional clock time decor decorative art gear gears mechanical big cool watch wireframe flying pendulum advanced awesome build assemble unique livingroom weight design tick tock useful home household engineering timekeeper

Model files



Common parts

6 files



press_tolerance_test.3mf

Print this before any press fit parts



rotation_tolerance_test.3mf

Print this before any rotational tolerance parts



connectors.3mf



pendulum_weight_pins.3mf



reel_handles.3mf



weight_body.3mf



Press fit tolerance 1

13 files



backplate_01_p1.3mf



backplate_02_p1.3mf

backplate_03_p1.3mf



backplate_04_p1.3mf



backplate_05_p1.3mf



backplate_06_p1.3mf



backplate_07_p1.3mf



backplate_08_p1.3mf



ring_seconds_p1.3mf



Use color change for the markings

ring_minutes_p1.3mf



Use color change for the markings

ring_hours_p1.3mf



Use color change for the markings

hands_p1.3mf





pendulum_weight_p1.3mf

Print with 100% infill



Press fit tolerance 2

13 files

backplate_01_p2.3mf



backplate_02_p2.3mf



backplate_03_p2.3mf



backplate_04_p2.3mf



backplate_05_p2.3mf



backplate_06_p2.3mf



backplate_07_p2.3mf



backplate_08_p2.3mf



ring_seconds_p2.3mf



Use color change for the markings

ring_minutes_p2.3mf



Use color change for the markings

ring_hours_p2.3mf



Use color change for the markings

hands_p2.3mf



pendulum_weight_p2.3mf



Print with 100% infill



Rotational tolerance 1

23 files

gears_12_r1.3mf



gear_18-12_r1.3mf



gears_24-12_r1.3mf



gear_27-10_r1.3mf



gear_36_r1.3mf



gear_36-12_r1.3mf



gear_45-24_r1.3mf



gear_48-12_r1.3mf



Print 3 instances

gear_second_36-16_r1.3mf



gear_hour_48_r1.3mf



gear_minute_60-12_r1.3mf



gear_escapement_r1.3mf





pendulum_arm_r1.3mf



pendulum_nut_r1.3mf



weight_lid_r1.3mf



reel_top_r1.3mf



reel_ratchet_r1.3mf



gear_reel_r1.3mf



reel_center_s_r1.3mf



reel_center_m_r1.3mf



reel_center_l_r1.3mf



nuts_left_r1.3mf



nuts_right_r1.3mf



Rotational tolerance 2

23 files



gears_12_r2.3mf



gear_18-12_r2.3mf



gears_24-12_r2.3mf



gear_27-10_r2.3mf



gear_36_r2.3mf



gear_36-12_r2.3mf



gear_45-24_r2.3mf



gear_48-12_r2.3mf

Print 3 instances



gear_second_36-16_r2.3mf



gear_hour_48_r2.3mf



gear_minute_60-12_r2.3mf



gear_escapement_r2.3mf



pendulum_arm_r2.3mf



pendulum_nut_r2.3mf



weight_lid_r2.3mf



reel_top_r2.3mf



reel_ratchet_r2.3mf



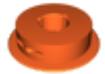
gear_reel_r2.3mf



reel_center_s_r2.3mf



reel_center_m_r2.3mf



reel_center_l_r2.3mf



nuts_left_r2.3mf



nuts_right_r2.3mf



Rotational tolerance 3

23 files



gears_12_r3.3mf



gear_18-12_r3.3mf

gears_24-12_r3.3mf



gear_27-10_r3.3mf



gear_36_r3.3mf



gear_36-12_r3.3mf



gear_45-24_r3.3mf



gear_48-12_r3.3mf



Print 3 instances

gear_second_36-16_r3.3mf



gear_hour_48_r3.3mf



gear_minute_60-12_r3.3mf



gear_escapement_r3.3mf





pendulum_arm_r3.3mf



pendulum_nut_r3.3mf



weight_lid_r3.3mf



reel_top_r3.3mf



reel_ratchet_r3.3mf



gear_reel_r3.3mf



reel_center_s_r3.3mf



reel_center_m_r3.3mf



reel_center_l_r3.3mf



nuts_left_r3.3mf



nuts_right_r3.3mf



Tail remix

9 files

backplate_08_remix_p1.3mf



backplate_08_remix_p2.3mf



remix_gears_r1.3mf



remix_gears_r2.3mf



remix_gears_r3.3mf



remix_nuts_r1.3mf



remix_nuts_r2.3mf





remix_nuts_r3.3mf



tail_feather_remix.f3d

Use this if you want to make your own remix of the tail feathers

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