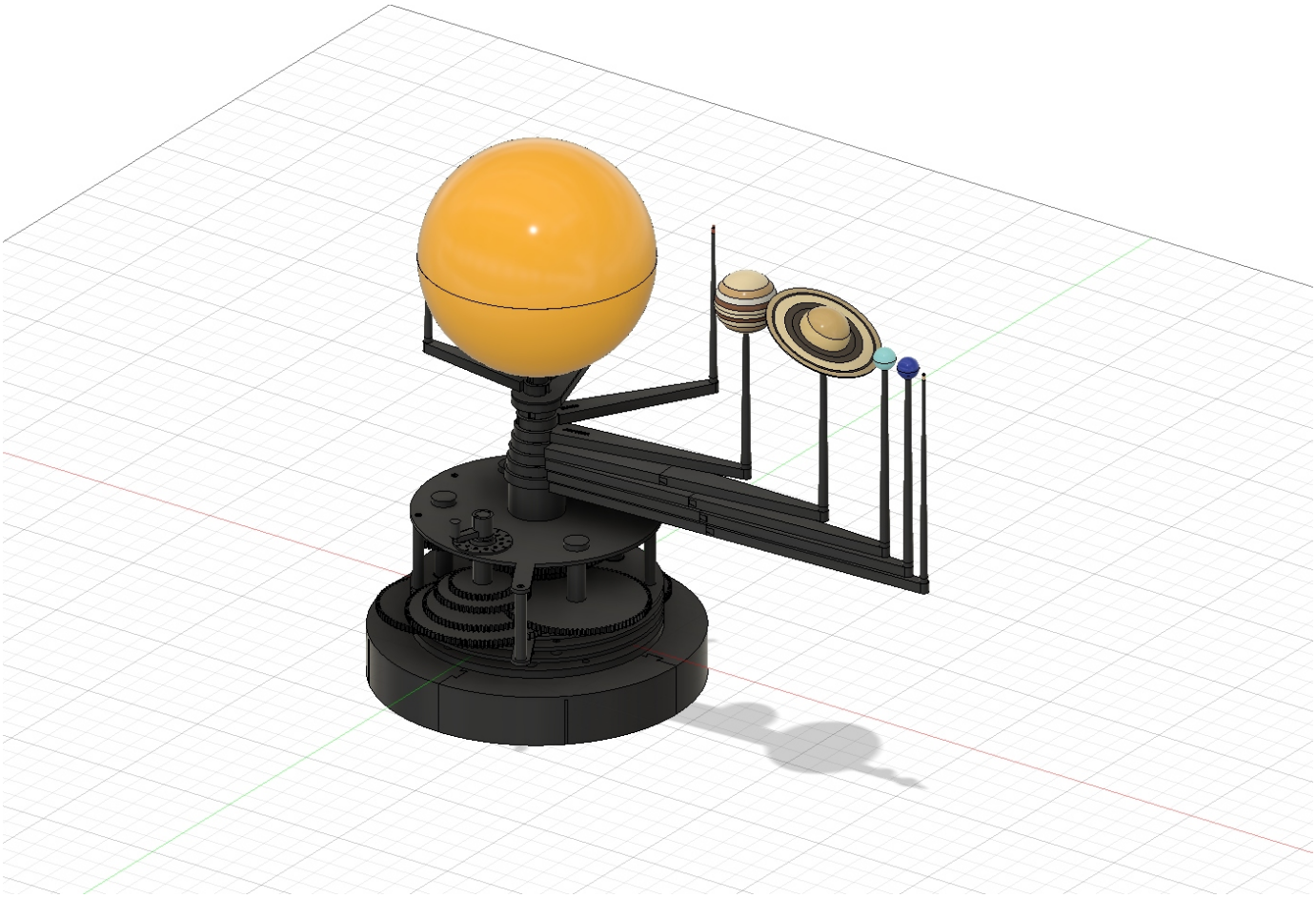
ORRERY

9-planet geared orrery with Moon - 3D-printed - snap-fit, no screws or glue



105	49	0.88 m	1 turn	0
printed parts	build steps	arm sweep	= 1 Earth year	screws or glue

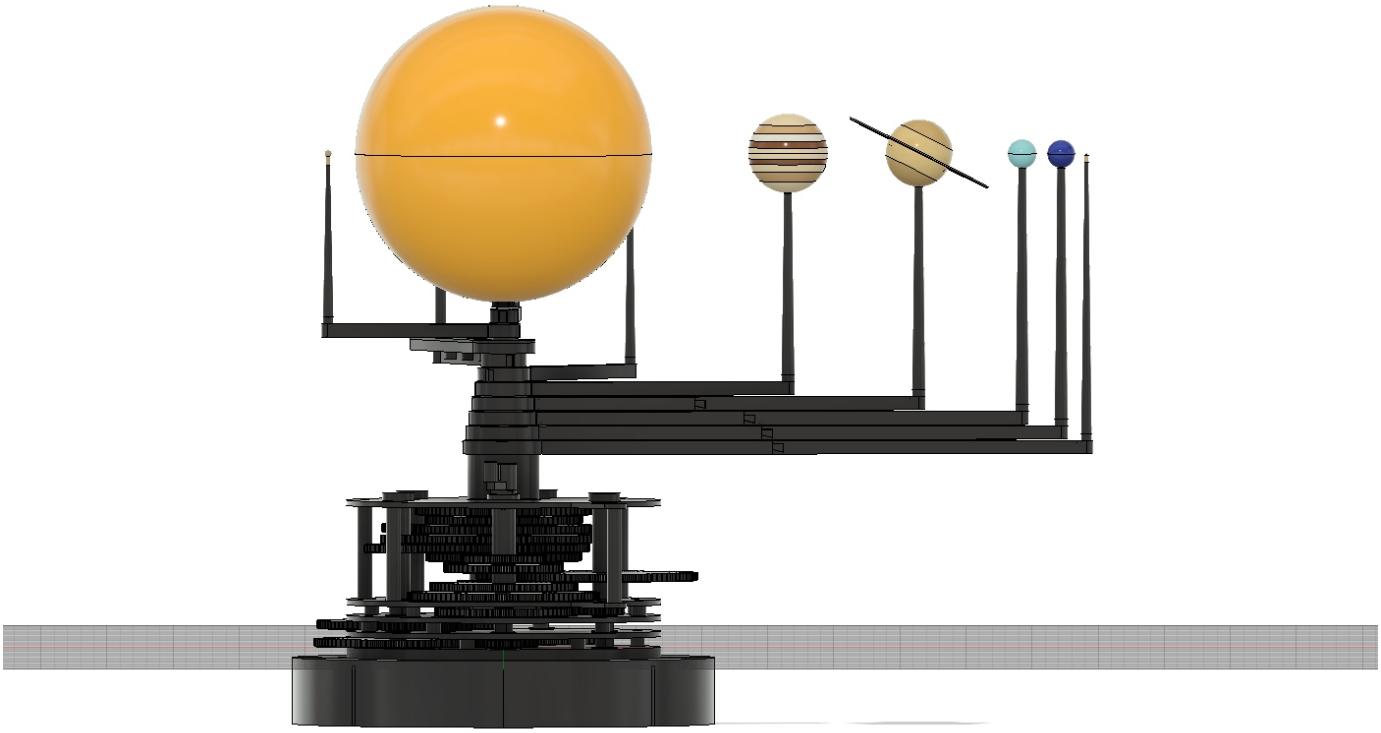
Before you start

Every printed part is in this folder as NN_partname.3mf (multi-colour parts keep one object per colour for the AMS). Print settings, orientation and supports per part: parts_table.csv / parts_and_BOM.md. Small bodies (Mercury, Venus, Earth, Moon, Mars, Pluto tips) print on a 0.2 mm nozzle; everything else on 0.4 mm. Gears and structure in PETG, planets in PLA, the Sun in translucent PETG.

Non-printed parts

1x smooth steel rod, 8 mm x 306 mm (central post)
4x steel pins, 8 mm x 15 mm (main-train idlers)
3x steel pins, 8 mm x 14.5 mm (Earth-arm idlers)
1x steel rod, 4 mm x 155.5 mm (Earth post)
Optional motor drive: 28BYJ-48 stepper, ULN2003 board, ESP32 DevKit, USB-C vertical breakout

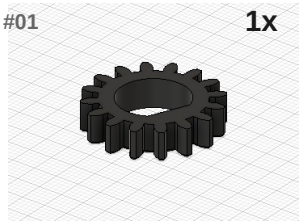
Tools: none required. A flush cutter for brims and a little dry lubricant on the tube nest and shafts help. Every joint is a snap, dovetail or press fit - if something needs force, check orientation first.



Parts list

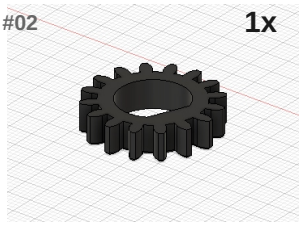
1 - 24 of 105

#01 1x



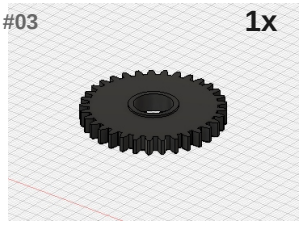
C1 16T Saturn
PETG

#02 1x



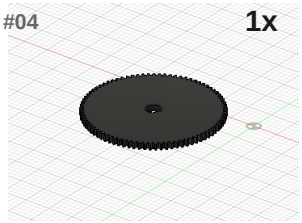
C1 16T stage
PETG

#03 1x



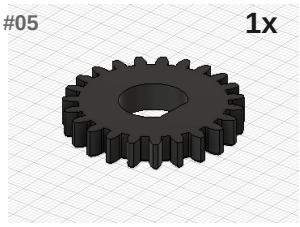
C1 gear 33T
PETG

#04 1x



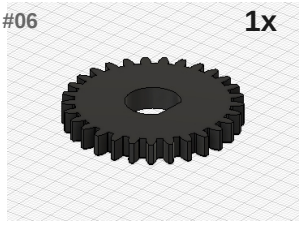
C1 gear 83T
PETG

#05 1x



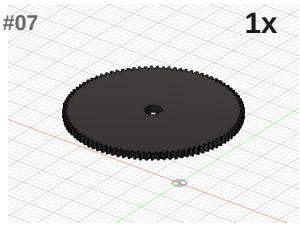
C2 gear 23T
PETG

#06 1x



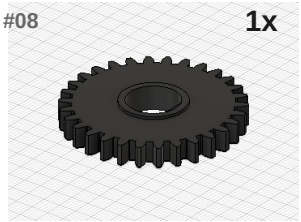
C2 gear 29T
PETG

#07 1x



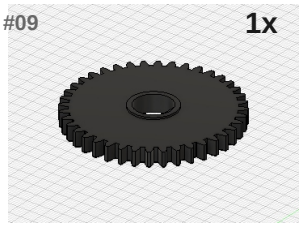
C2 gear 95T
PETG

#08 1x



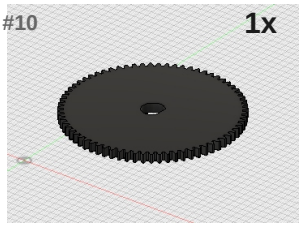
C3 gear 30T
PETG

#09 1x



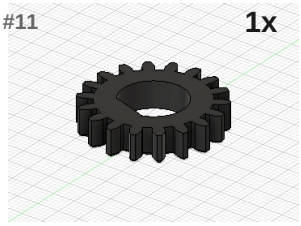
C3 gear 40T
PETG

#10 1x



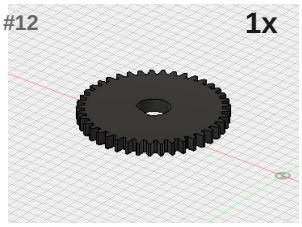
C3 gear 71T
PETG

#11 1x



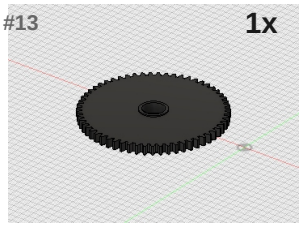
Layshaft gear 18T
PETG

#12 1x



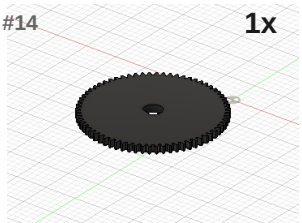
Layshaft gear 41T
PETG

#13 1x



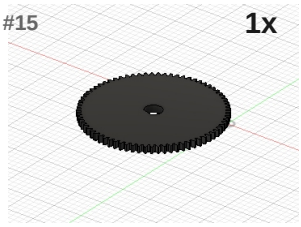
Layshaft gear 59T
PETG

#14 1x



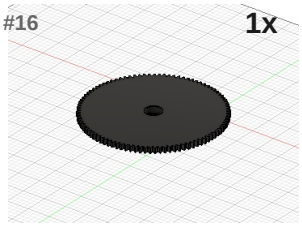
Layshaft gear 68T
PETG

#15 1x



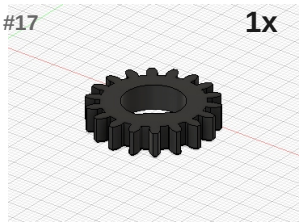
Layshaft gear 73T
PETG

#16 1x



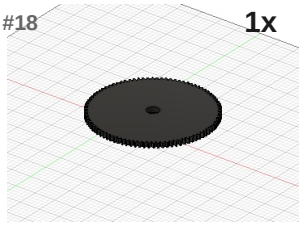
Layshaft gear 95T
PETG

#17 1x



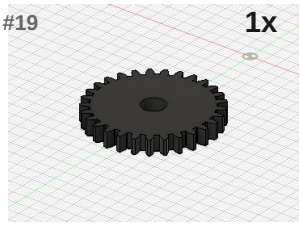
Moon-shaft gear 18T
PETG

#18 1x



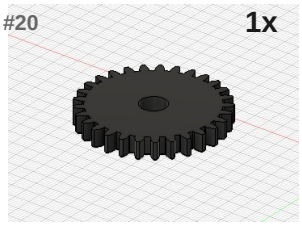
Moon-shaft gear 92T
PETG

#19 1x



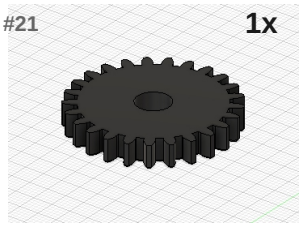
Idler I1 29T
PETG

#20 1x



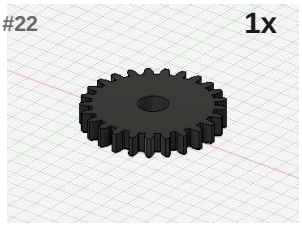
Idler I2 29T
PETG

#21 1x



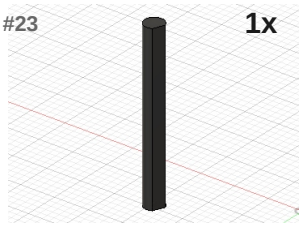
Idler I3 25T
PETG

#22 1x



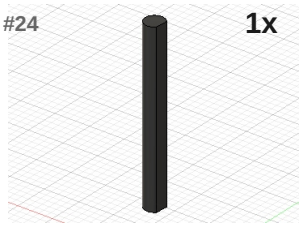
Idler IM 25T
PETG

#23 1x



Shaft C1
PETG

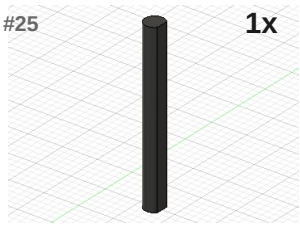
#24 1x



Shaft C2
PETG

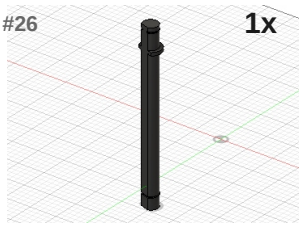
Parts list

#25 1x



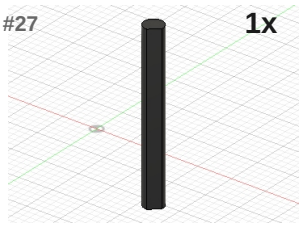
Shaft C3
PETG

#26 1x



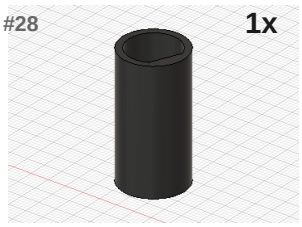
Shaft L
PETG

#27 1x



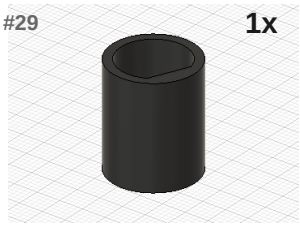
Shaft MS
PETG

#28 1x



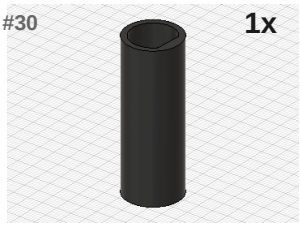
Spacer C1 1
PETG

#29 1x



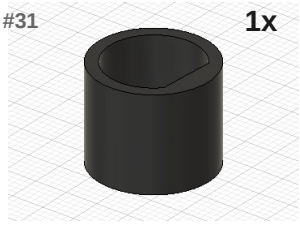
Spacer C1 2
PETG

#30 1x



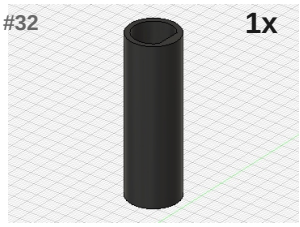
Spacer C2 1
PETG

#31 1x



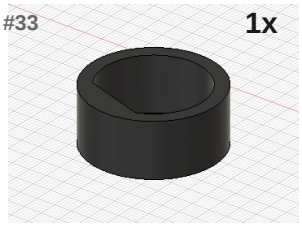
Spacer C2 2
PETG

#32 1x



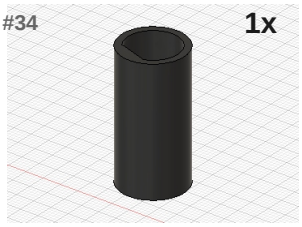
Spacer C3 1
PETG

#33 1x



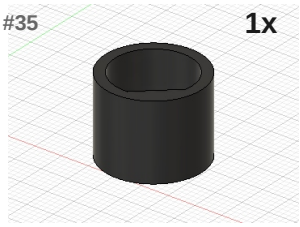
Spacer L 1
PETG

#34 1x



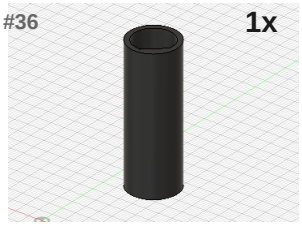
Spacer L 2
PETG

#35 1x



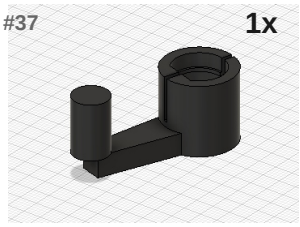
Spacer MS 1
PETG

#36 1x



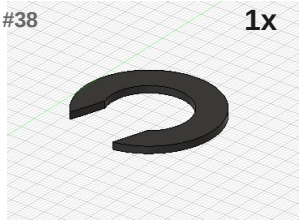
Spacer MS 2
PETG

#37 1x



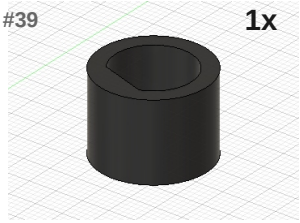
CrankKnob
PETG

#38 1x



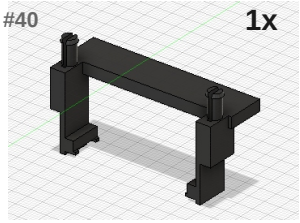
LayshaftClip
PETG

#39 1x



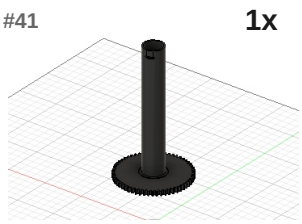
MotorCoupler
PETG

#40 1x



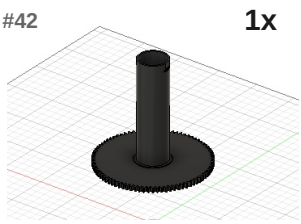
MotorCradle
PETG

#41 1x



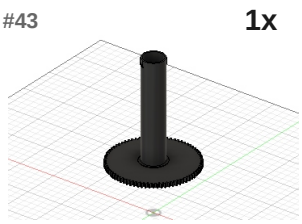
Tube Earth
PETG

#42 1x



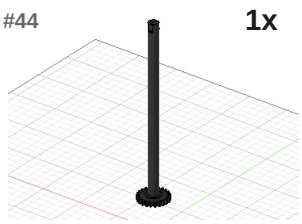
Tube Jupiter
PETG

#43 1x



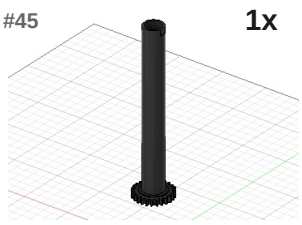
Tube Mars
PETG

#44 1x



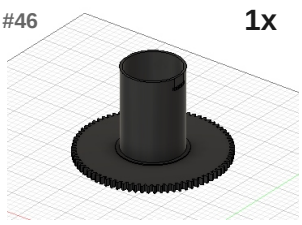
Tube Mercury
PETG

#45 1x



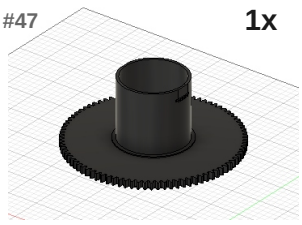
Tube Moon
PETG

#46 1x



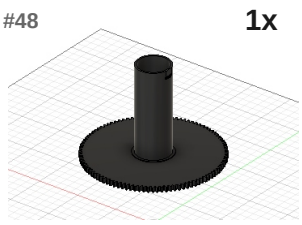
Tube Neptune
PETG

#47 1x



Tube Pluto
PETG

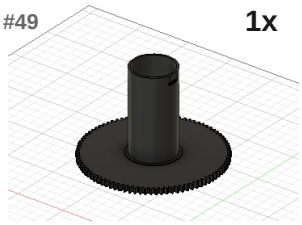
#48 1x



Tube Saturn
PETG

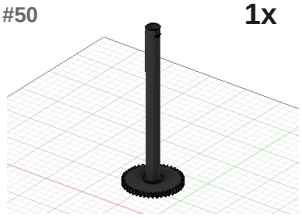
Parts list

#49 1x



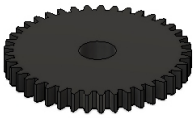
Tube Uranus
PETG

#50 1x



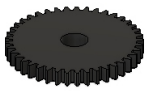
Tube Venus
PETG

#51 1x



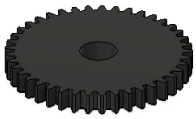
Earth-arm idler EI1 41T
PETG

#52 1x



Earth-arm idler EI2 41T
PETG

#53 1x



Earth-arm idler EI3 41T
PETG

#54 1x



EarthArm
PETG

#55 1x



EarthArmLid
PETG + white label inlay

#56 1x



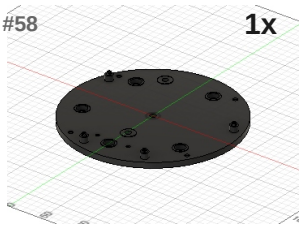
MoonCentre 31T
PETG

#57 1x



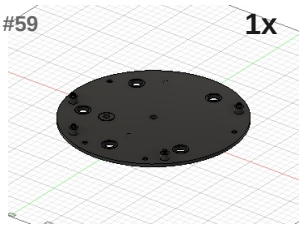
MoonGearSleeve
PETG

#58 1x



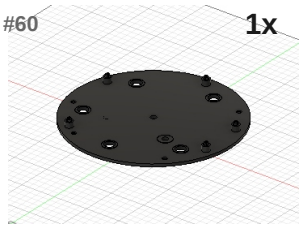
Deck0
PETG

#59 1x



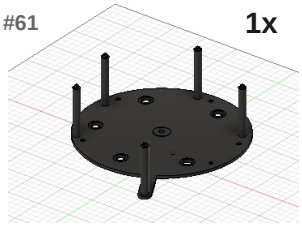
Deck1
PETG

#60 1x



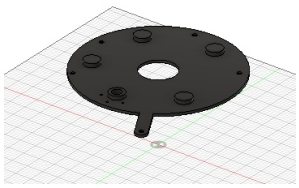
Deck2
PETG

#61 1x



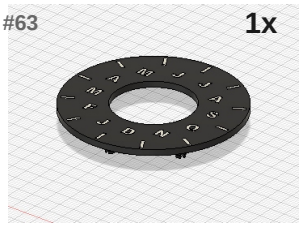
Deck3
PETG

#62 1x



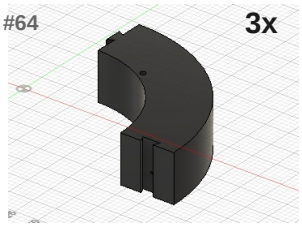
Lid
PETG

#63 1x



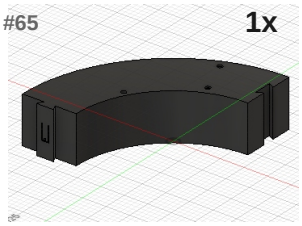
YearDial
PETG + white inlays

#64 3x



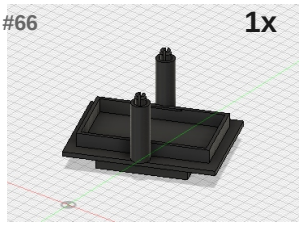
BaseWedge
PETG

#65 1x



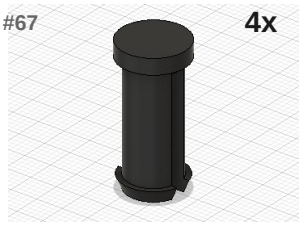
BaseWedge USB
PETG

#66 1x



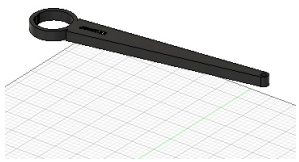
ElectronicsTray
PETG

#67 4x



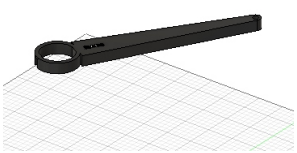
SnapRivet
PETG

#68 1x



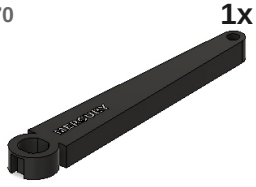
Arm Jupiter
PETG + white label inlay

#69 1x



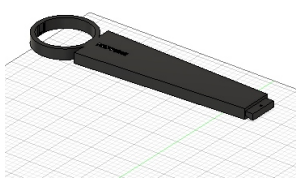
Arm Mars
PETG + white label inlay

#70 1x



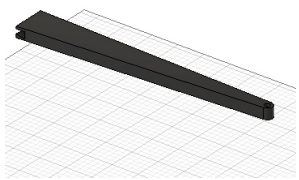
Arm Mercury
PETG + white label inlay

#71 1x



Arm Neptune 1
PETG + white label inlay

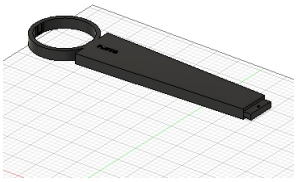
#72 1x



Arm Neptune 2
PETG

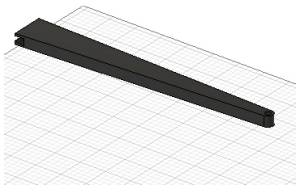
Parts list

#73 **1x**



Arm Pluto 1
PETG + white label inlay

#74 **1x**



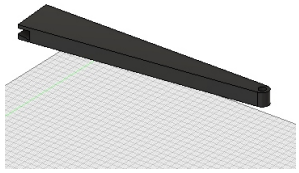
Arm Pluto 2
PETG

#75 **1x**



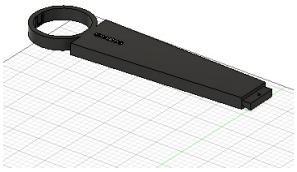
Arm Saturn 1
PETG + white label inlay

#76 **1x**



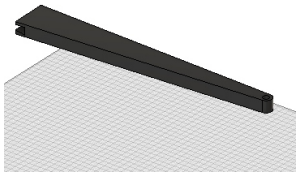
Arm Saturn 2
PETG

#77 **1x**



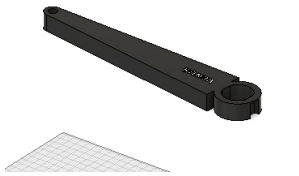
Arm Uranus 1
PETG + white label inlay

#78 **1x**



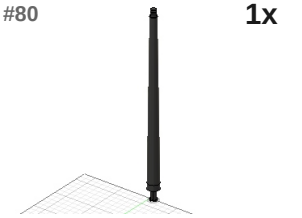
Arm Uranus 2
PETG

#79 **1x**



Arm Venus
PETG + white label inlay

#80 **1x**



Post Jupiter
PETG

#81 **1x**



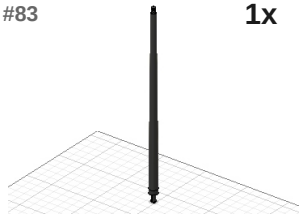
Post Mars
PETG

#82 **1x**



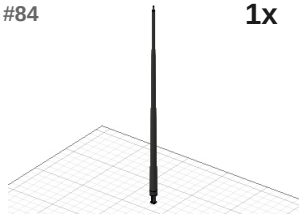
Post Mercury
PETG

#83 **1x**



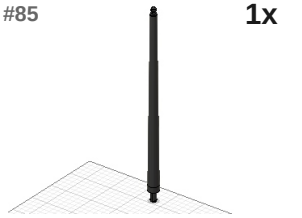
Post Neptune
PETG

#84 **1x**



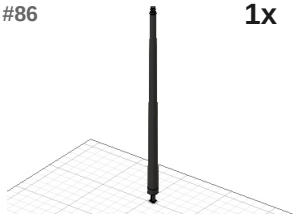
Post Pluto
PETG

#85 **1x**



Post Saturn
PETG

#86 **1x**



Post Uranus
PETG

#87 **1x**



Post Venus
PETG

#88 **1x**



EarthTip
PLA (multicolour)

#89 **1x**



Jupiter lower
PLA (AMS bands)

#90 **1x**



Jupiter upper
PLA (AMS bands)

#91 **1x**



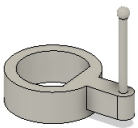
MarsTip
PLA

#92 **1x**



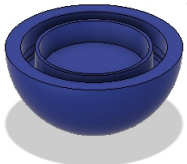
MercuryTip
PLA

#93 **1x**



MoonArm
PLA

#94 **1x**



Neptune lower
PLA

#95 **1x**



Neptune upper
PLA

#96 **1x**

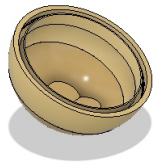


PlutoTip
PLA

Parts list

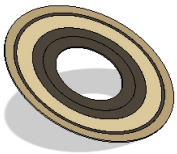
97 - 105 of 105

#97 **1x**



Saturn lower
PLA (AMS bands)

#98 **1x**



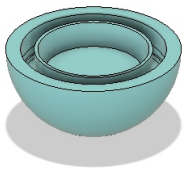
Saturn rings
PLA (AMS, 3 colours)

#99 **1x**



Saturn upper
PLA (AMS bands)

#100 **1x**



Uranus lower
PLA

#101 **1x**



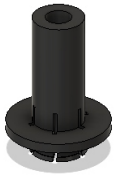
Uranus upper
PLA

#102 **1x**



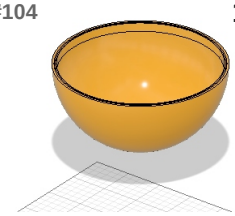
VenusTip
PLA

#103 **1x**



Sun hub
PETG

#104 **1x**



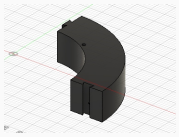
Sun lower
PETG translucent

#105 **1x**

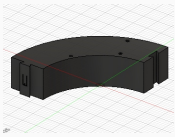


Sun upper
PETG translucent

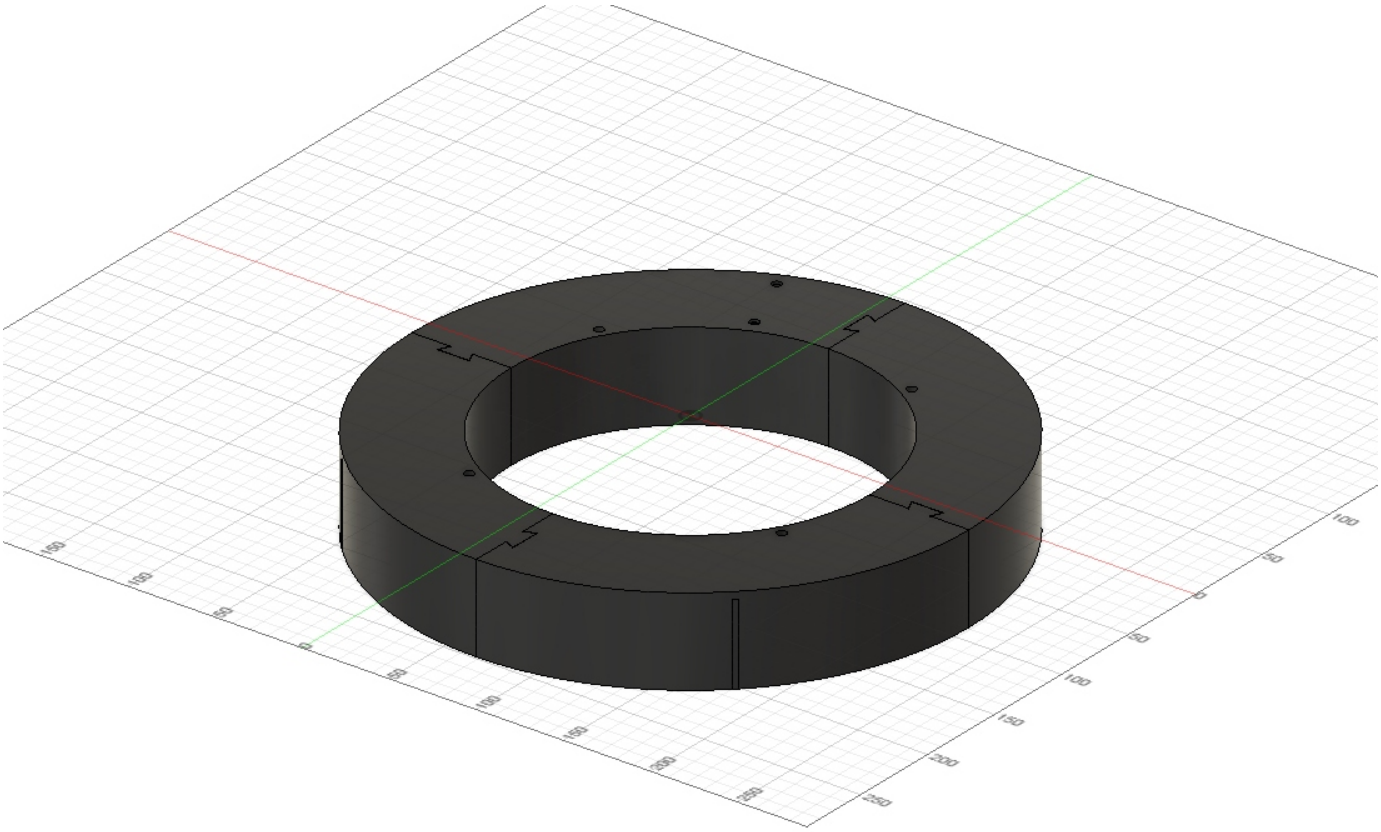
1 Base ring



3x #64
BaseWedge

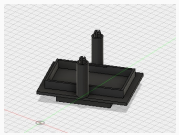


1x #65
BaseWedge USB

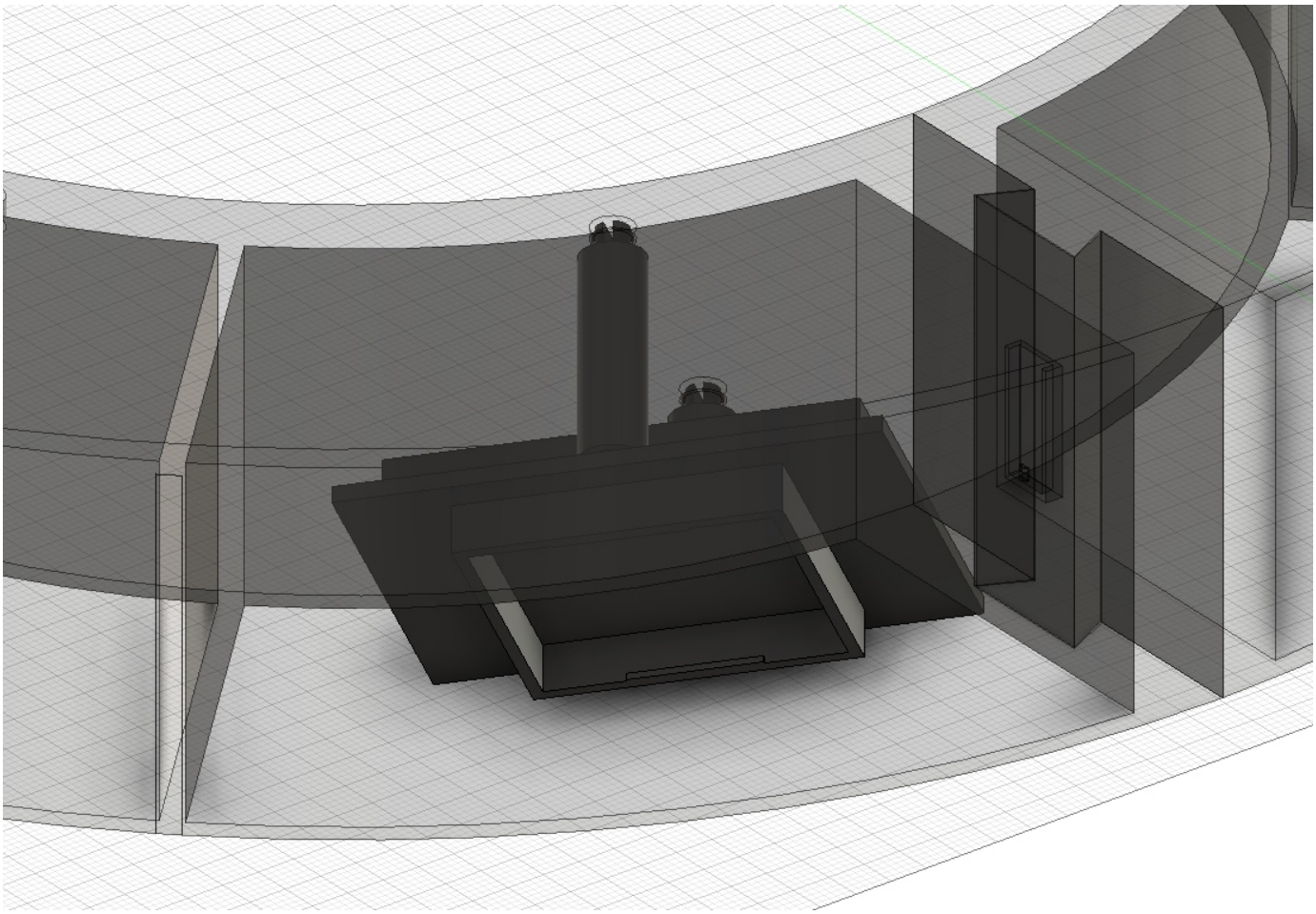


Slide the four base wedges together on their vertical dovetails until each detent clicks.
The wedge with the USB-C opening goes at the back.

2 Electronics (optional)

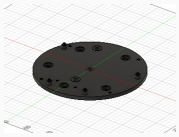


1x #66
ElectronicsTray



Clip the ESP32 into the top pocket and the ULN2003 board into the underside pocket of the tray. Slide the USB-C breakout up into its holder until it clicks. Push the tray hangers up through the base plate until both snap pins click.

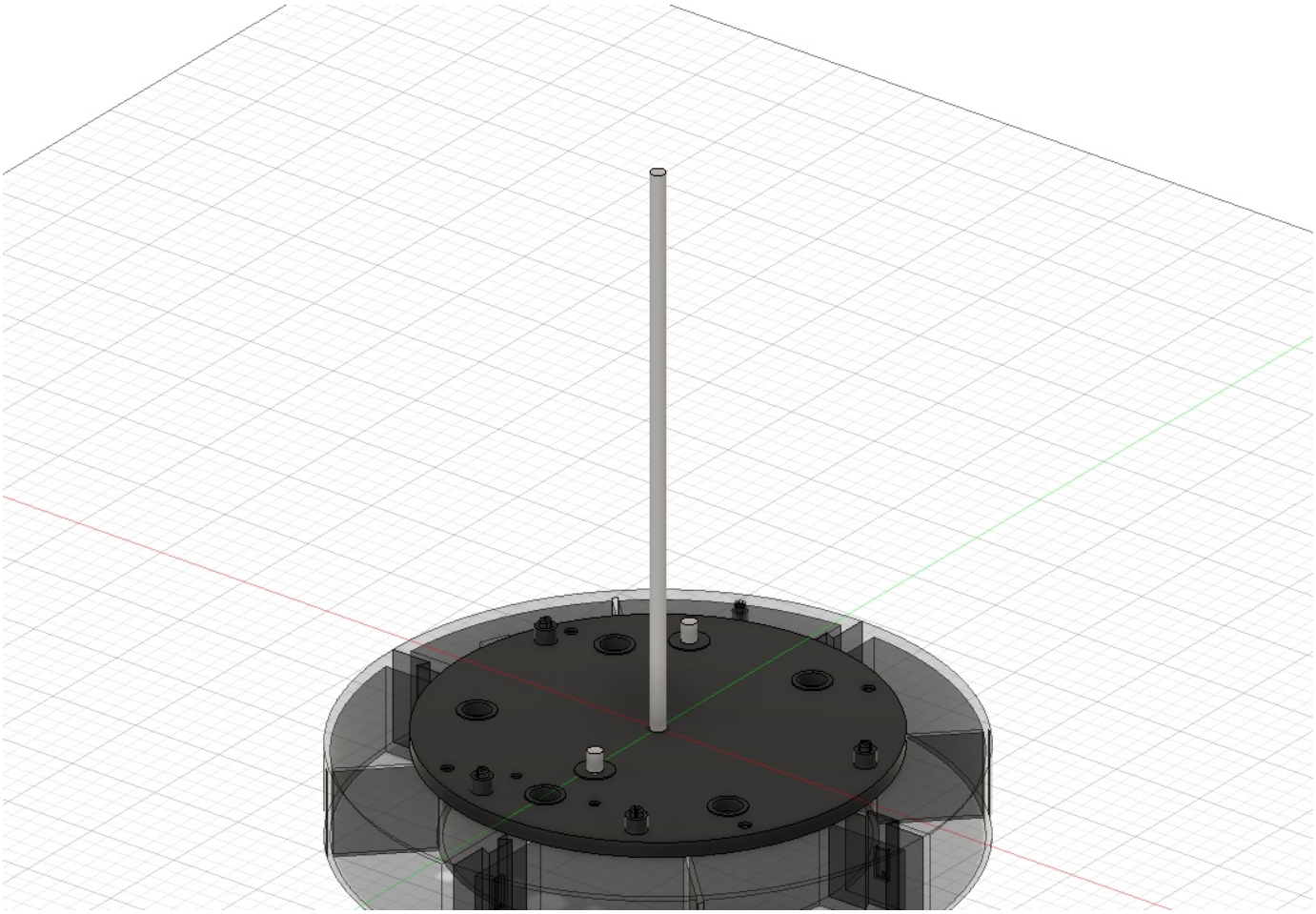
3 Bottom deck



1x #58
Deck0

2x
8 mm steel
pin x 15 mm

1x
8 mm steel
rod x 306 mm

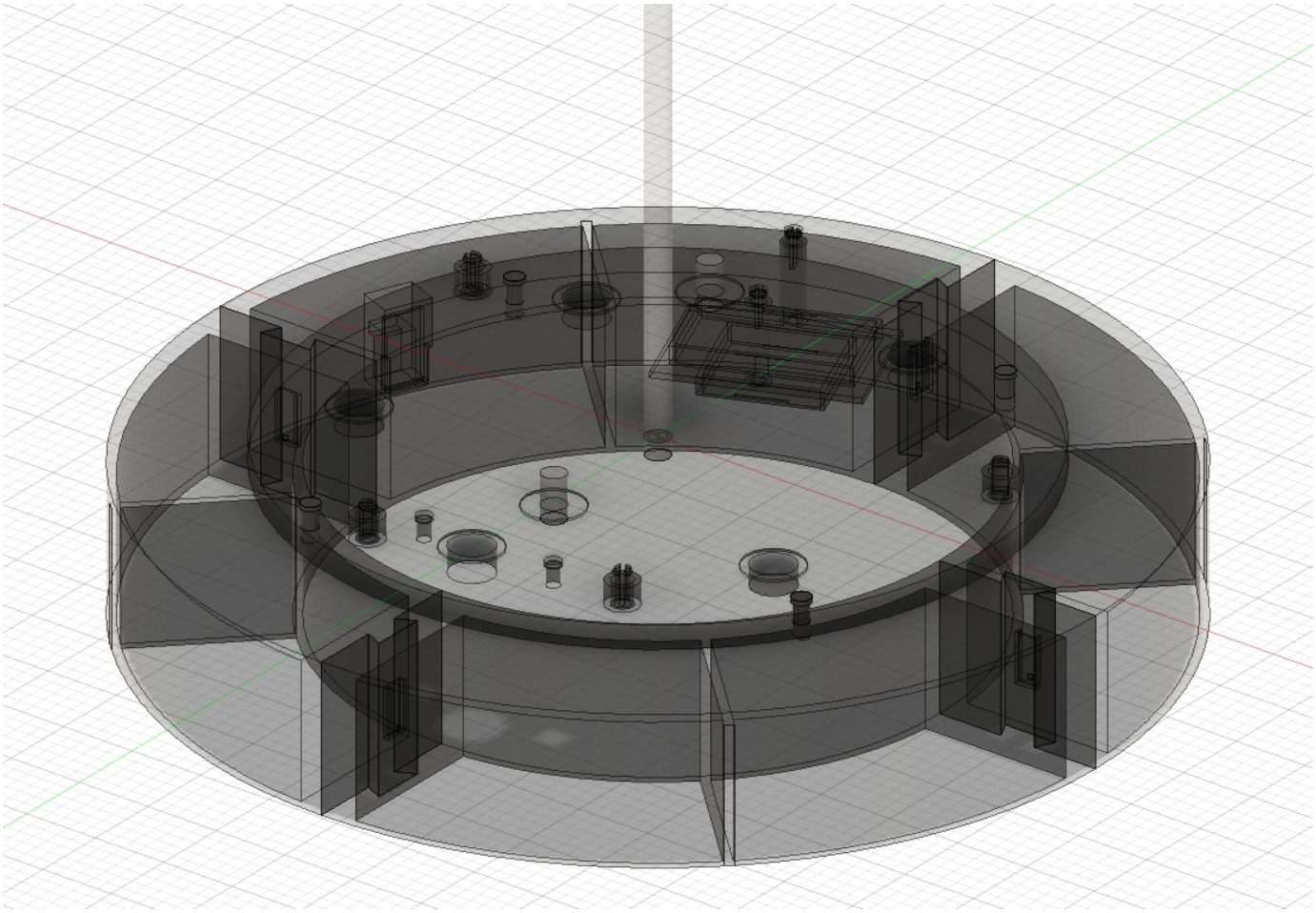


Press the 8 mm central rod into the centre socket of deck D0 and the two 15 mm idler pins into their sockets. Set D0 on the base ring.

4 Snap rivets

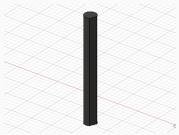


4x #67
SnapRivet

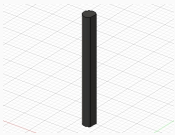


Push the four snap rivets down through D0 into the base plate until they click flush.

5 Shafts



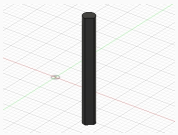
1x #23
Shaft C1



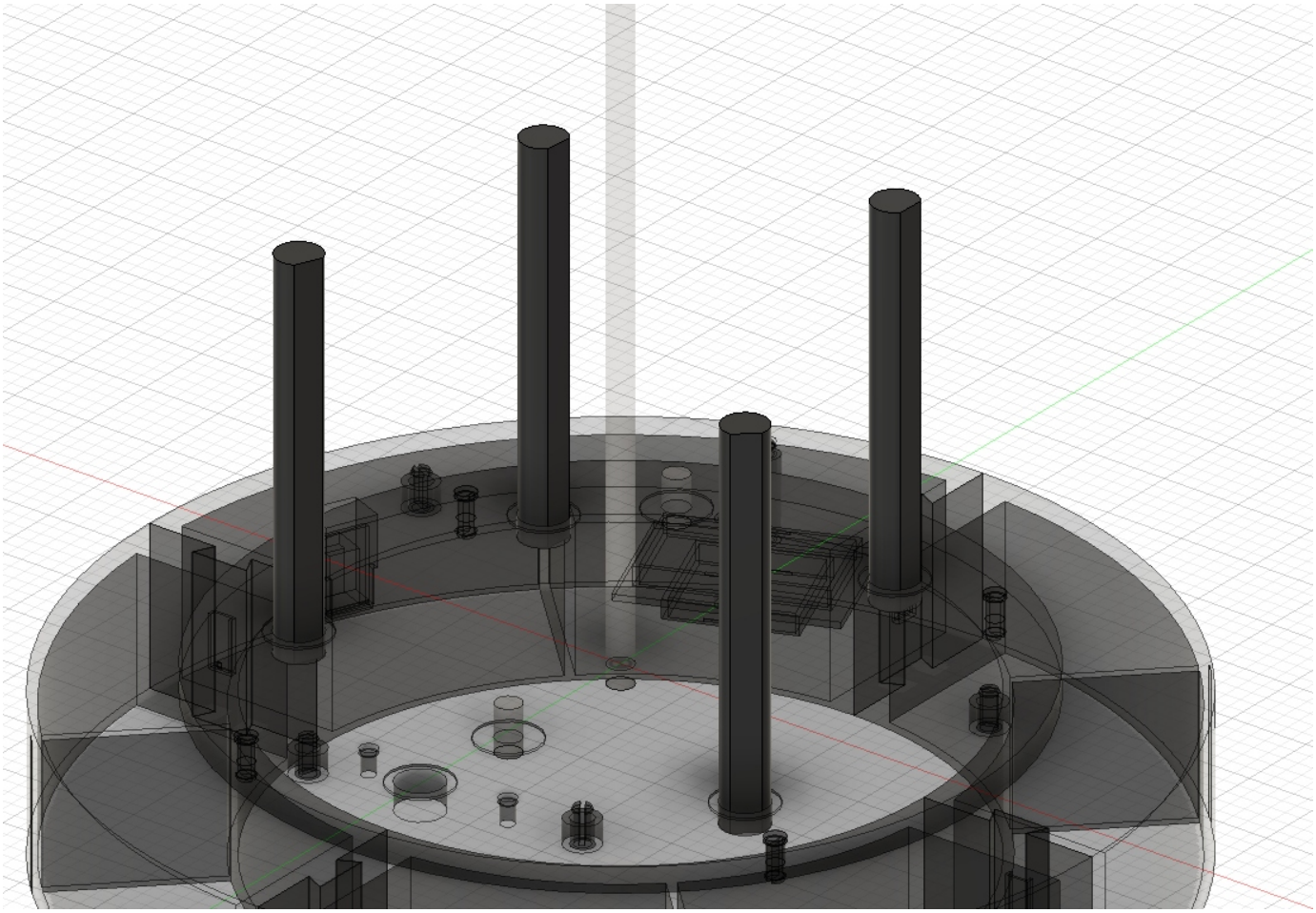
1x #24
Shaft C2



1x #25
Shaft C3

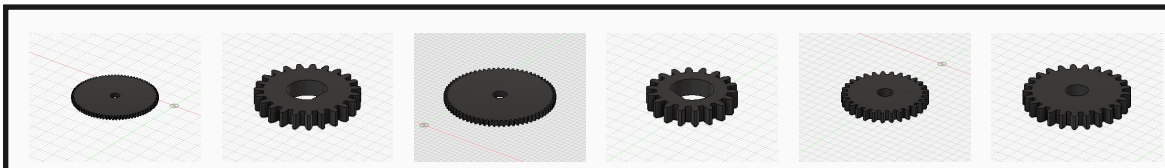


1x #27
Shaft MS



Stand the four printed D-shafts (C1, C2, C3, MS) in their blind sockets in D0.

6 Stage gears - level 1



1x #04
C1 gear 83T

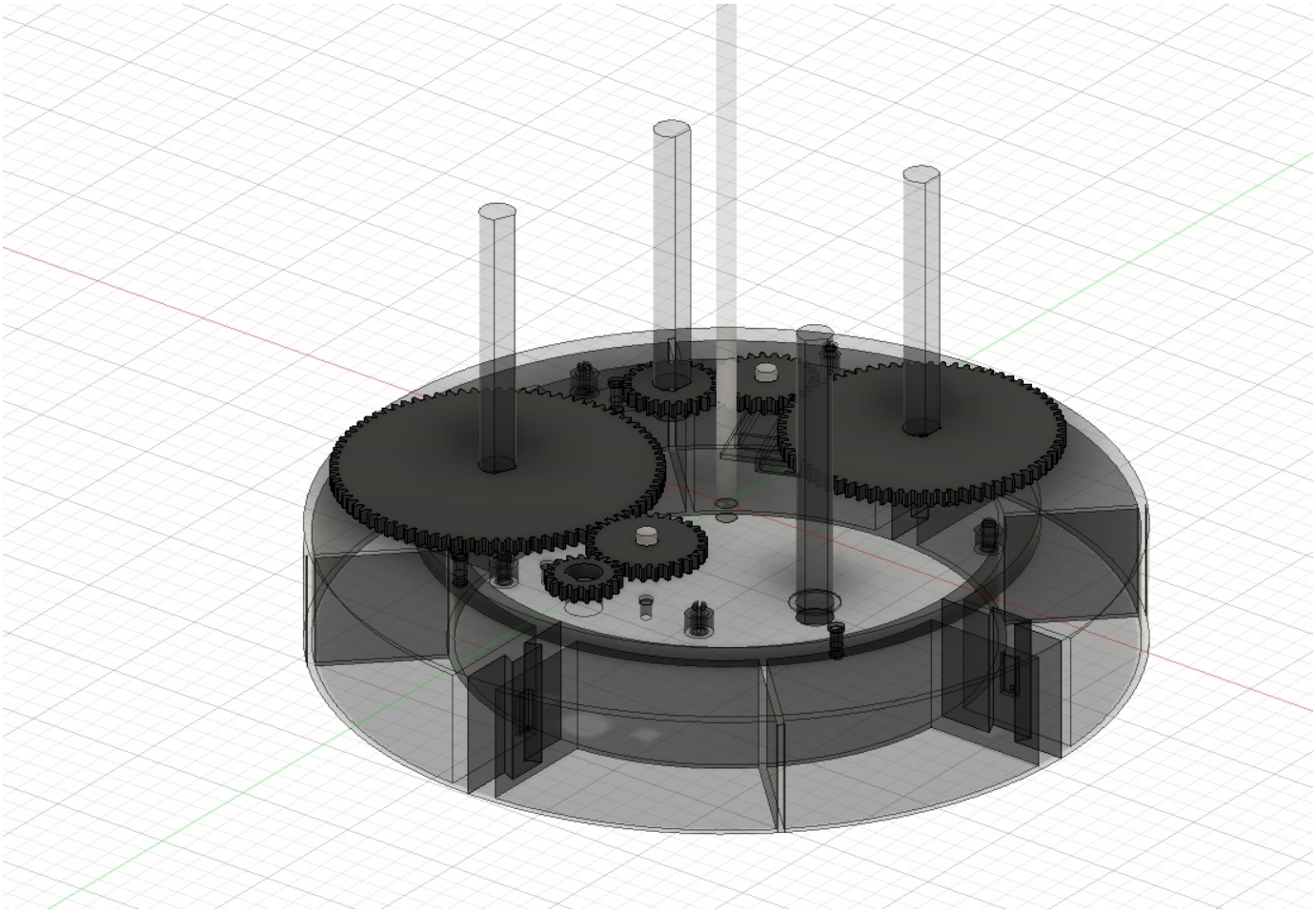
1x #05
C2 gear 23T

1x #10
C3 gear 71T

1x #11
Layshaft gear 18T

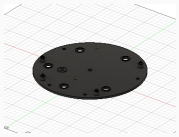
1x #19
Idler I1 29T

1x #21
Idler I3 25T



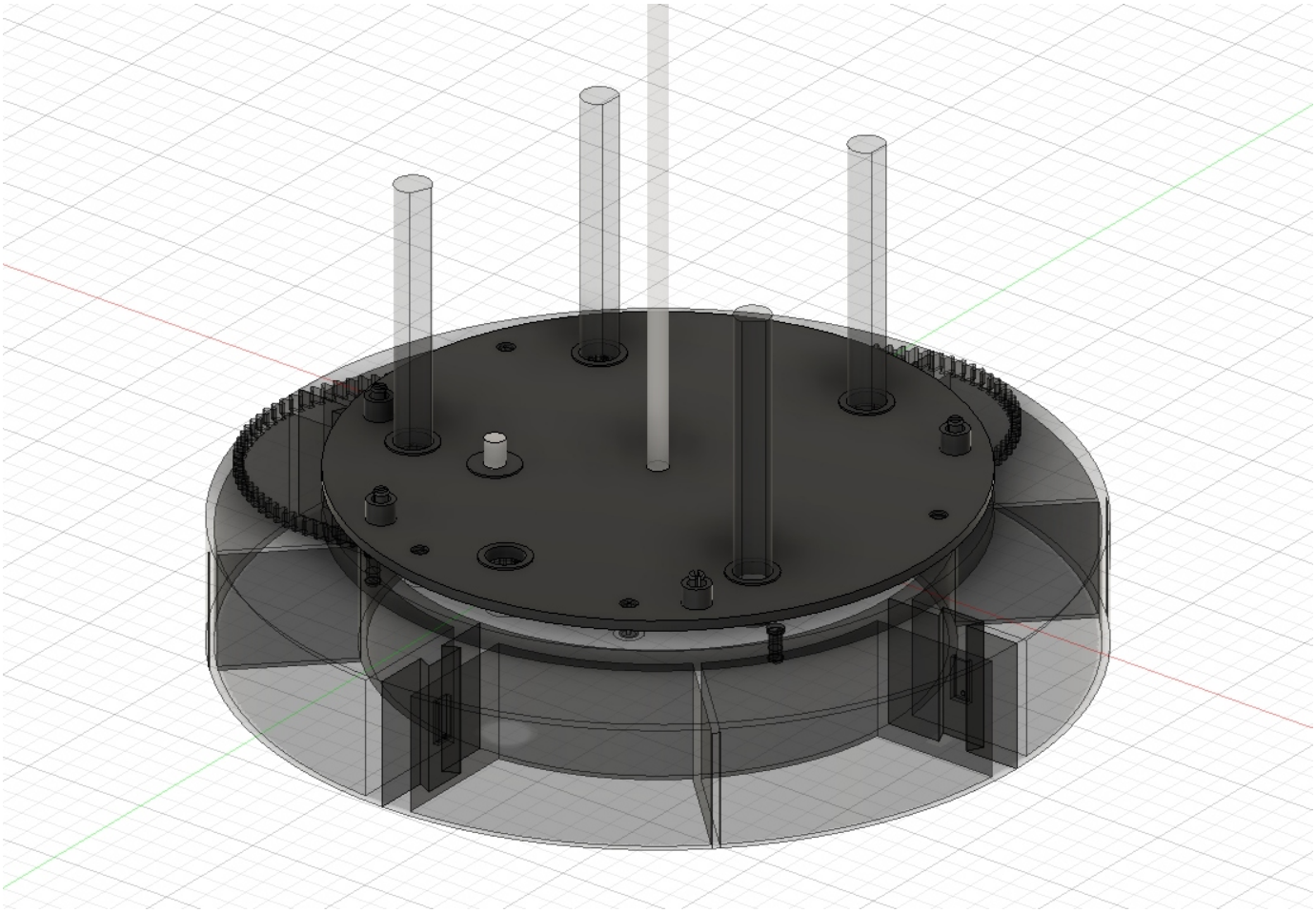
Slide the gears onto their shafts, D-flat aligned: C1 83T, C2 23T, C3 71T. Drop idlers I1 (29T) and I3 (25T) onto their pins. Set the layshaft 18T gear loosely on its boss (the layshaft goes in later).

7 Deck D1



1x #59
Deck1

1x
8 mm steel
pin x 15 mm

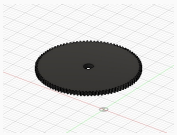


Lower deck D1 over the shafts and snap it onto the four pillars of D0. Press the I2 idler pin into D1.

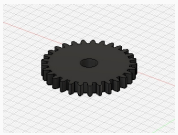
8 Stage gears - level 2



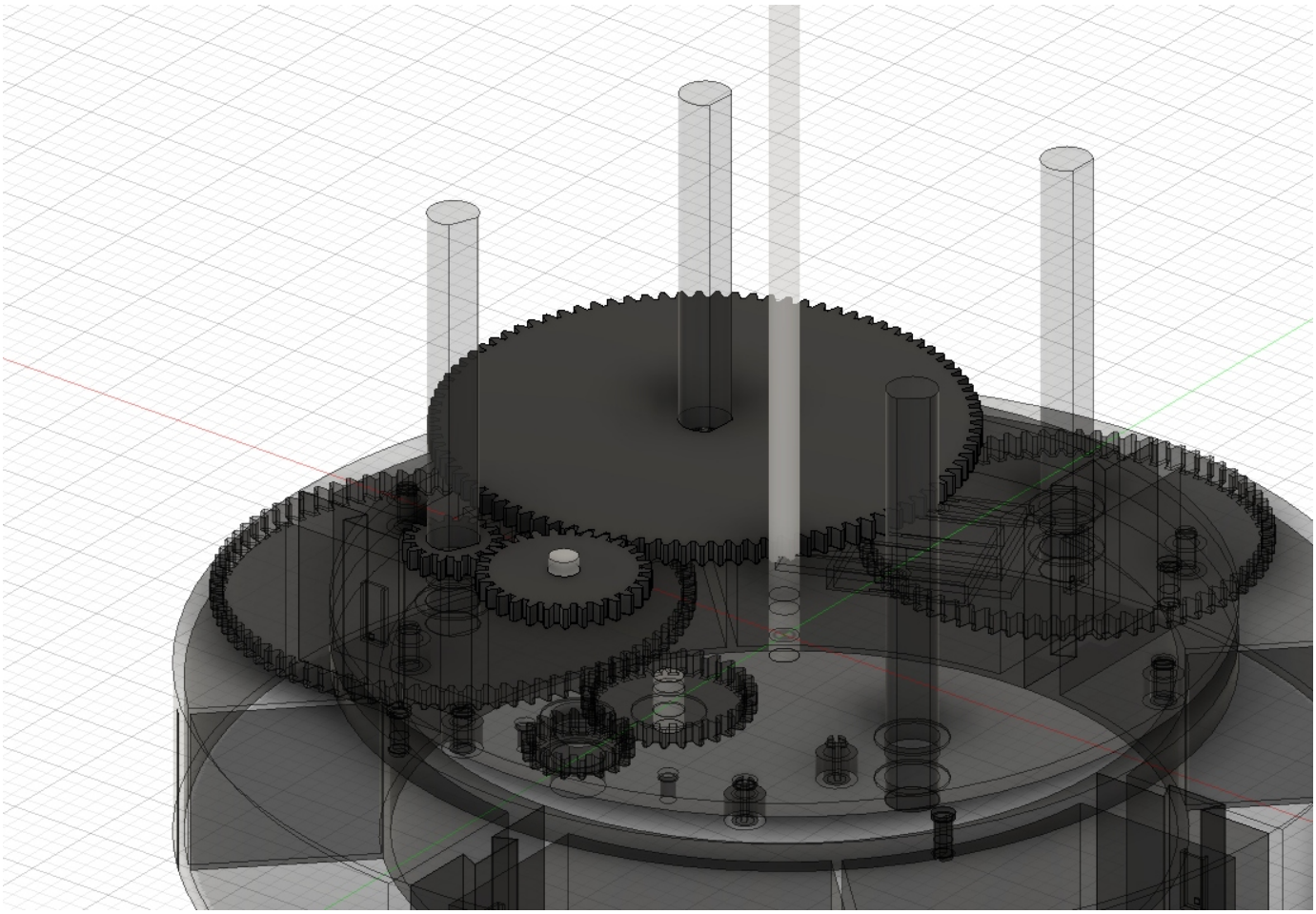
1x #02
C1 16T stage



1x #07
C2 gear 95T

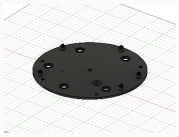


1x #20
Idler I2 29T



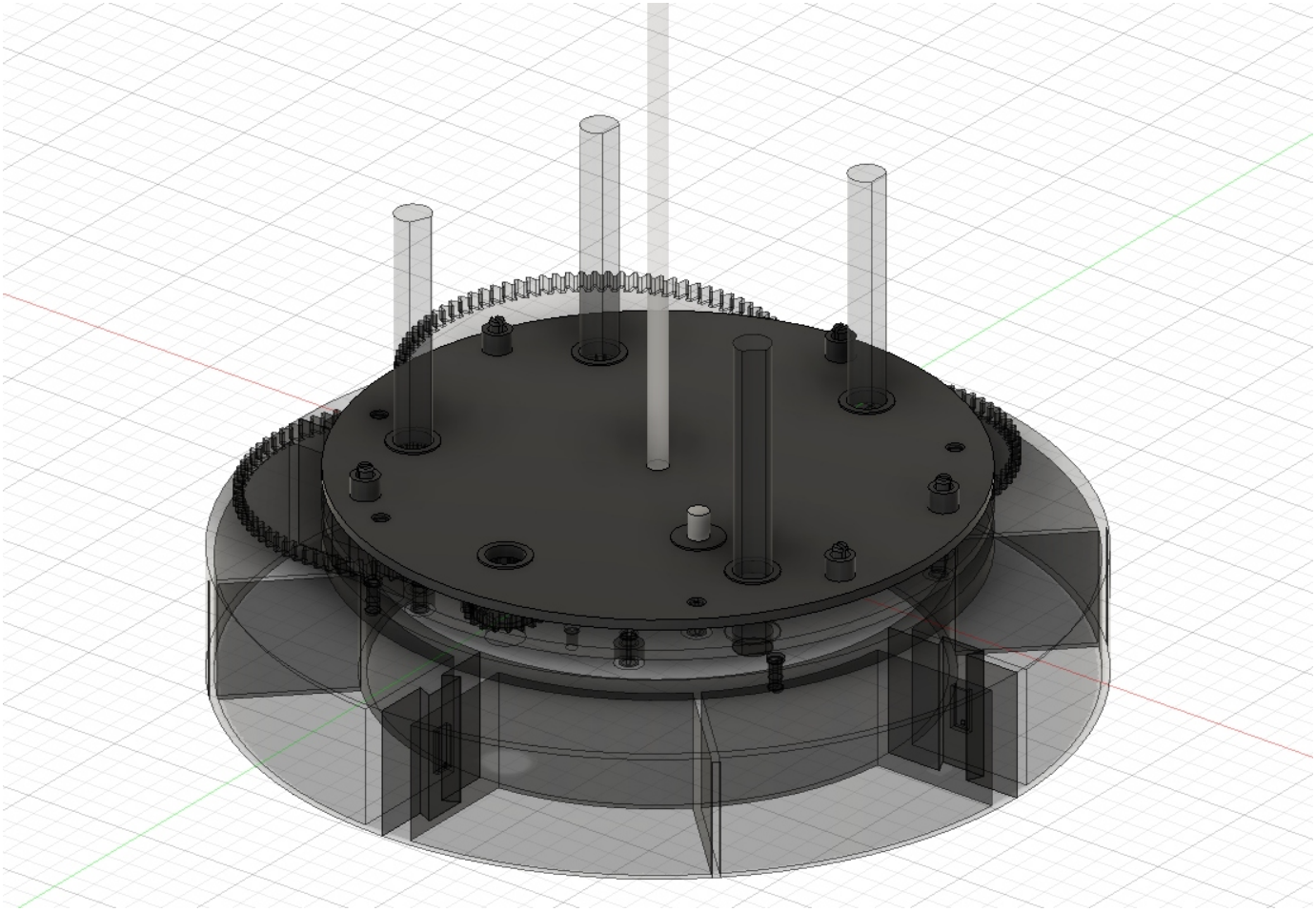
Fit C1 16T and C2 95T on their shafts and the I2 idler (29T) on its pin.

9 Deck D2



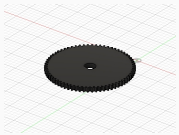
1x #60
Deck2

1x
8 mm steel
pin x 15 mm



Snap deck D2 onto the D1 pillars. Press the IM idler pin into D2.

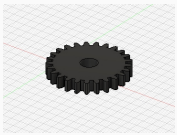
10 Stage gears - level 3



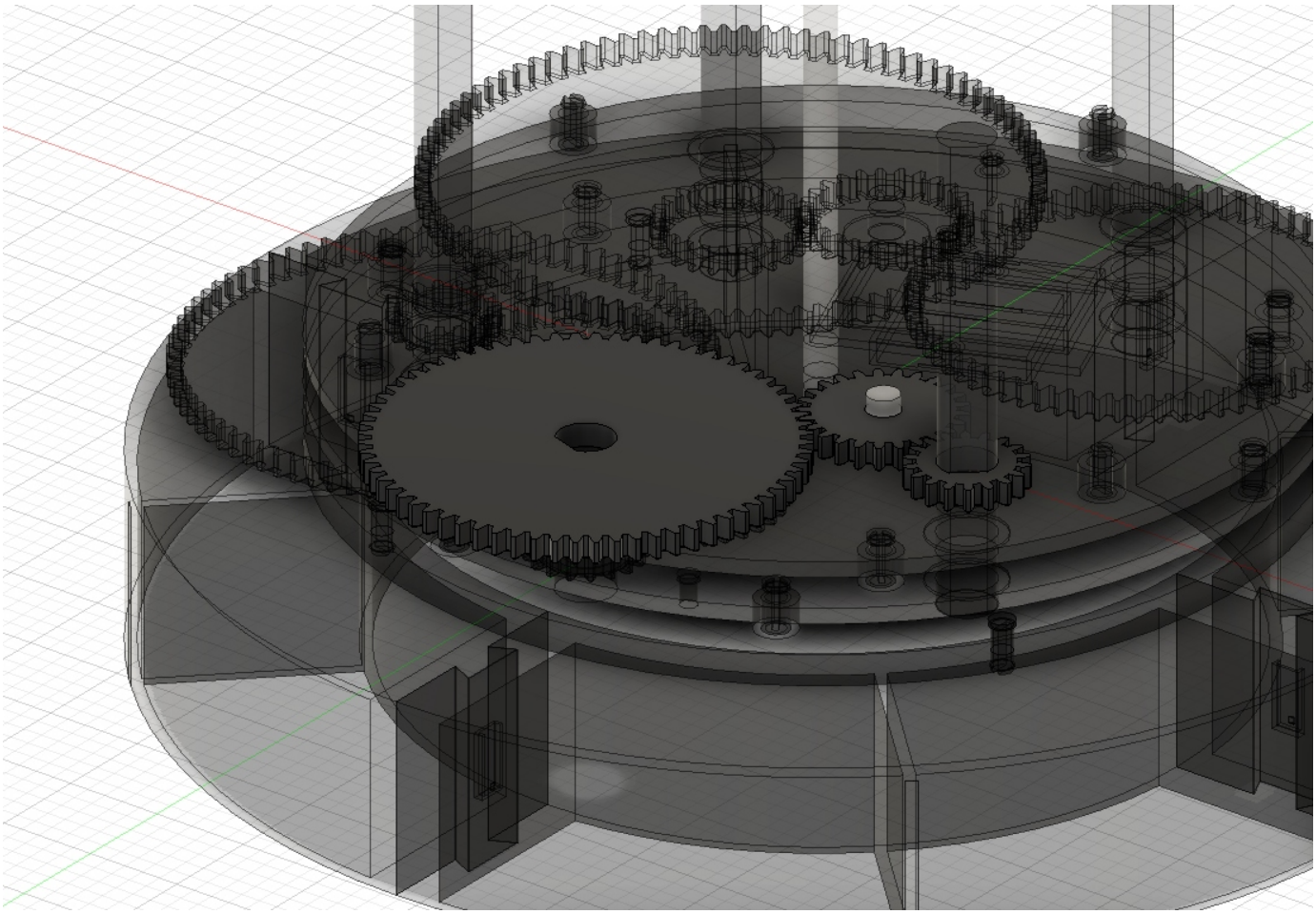
1x #14
Layshaft gear 68T



1x #17
Moon-shaft gear 18

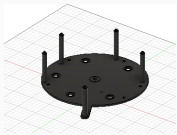


1x #22
Idler IM 25T

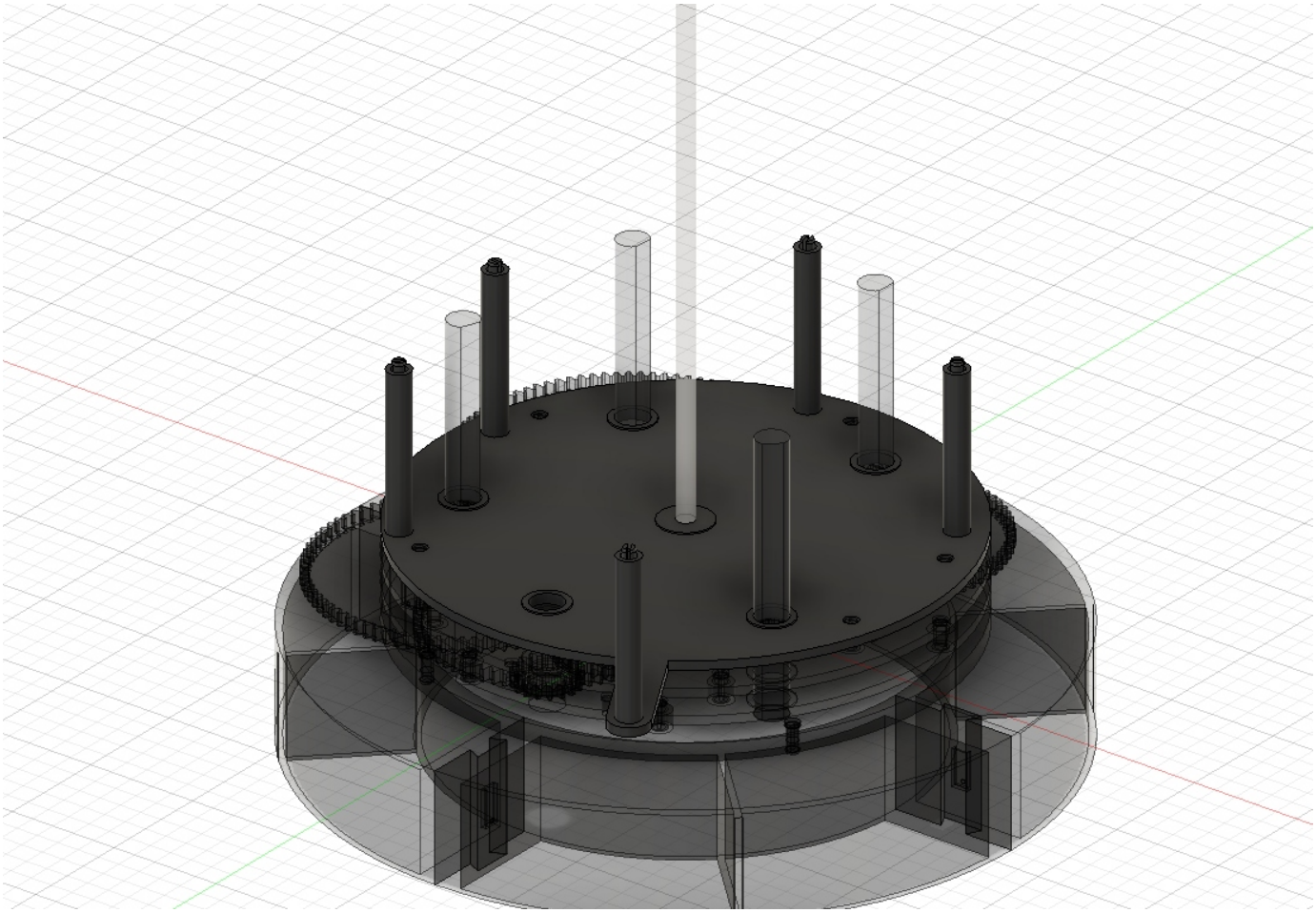


Set the layshaft 68T gear on its boss, the IM idler (25T) on its pin and the MS 18T gear on the Moon shaft.

11 Deck D3

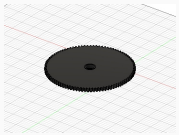


1x #61
Deck3

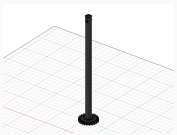


Snap deck D3 (the one with the ear) onto the D2 pillars.

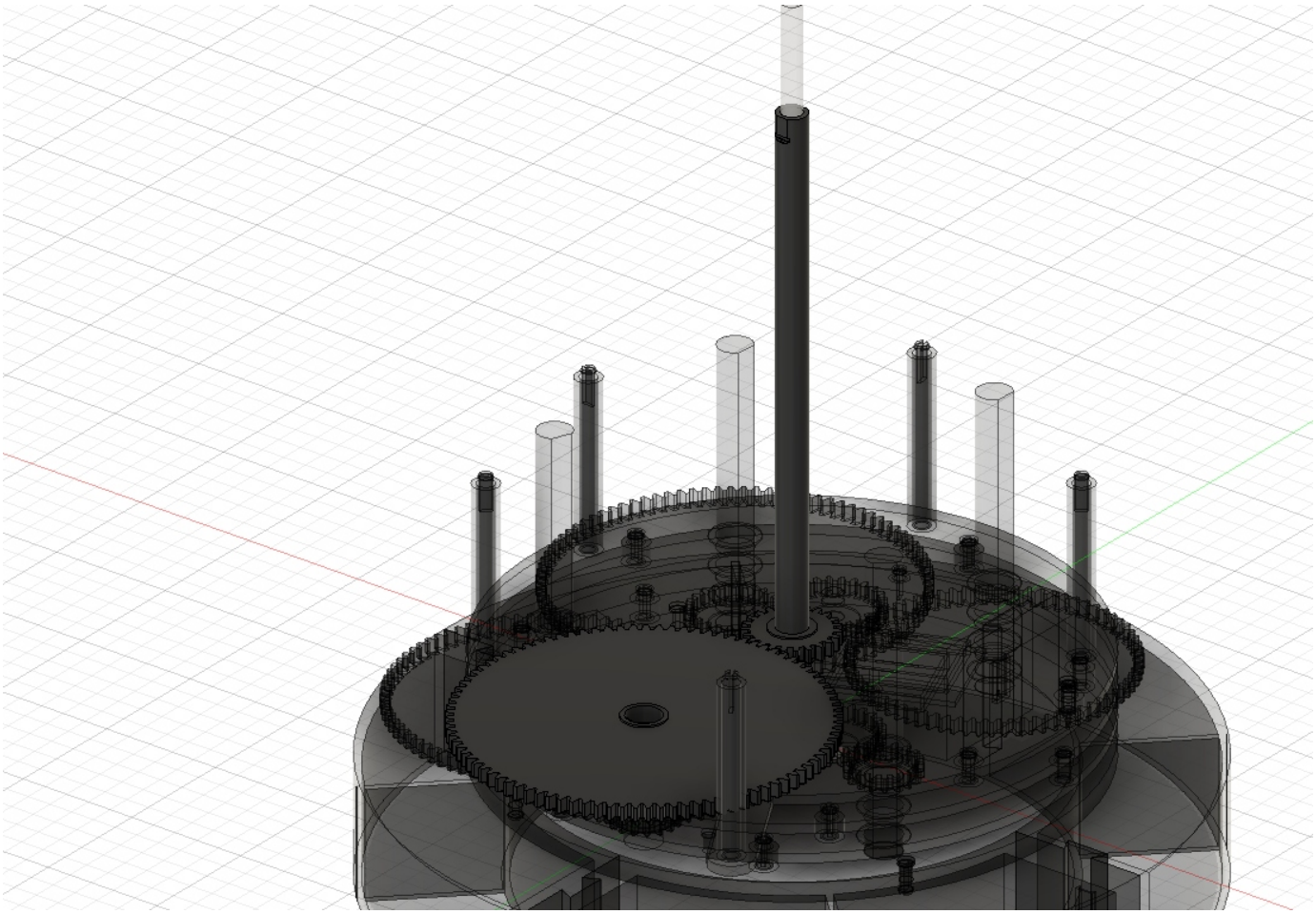
12 Tube level 1 - Mercury



1x #16
Layshaft gear 95T

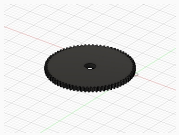


1x #44
Tube Mercury

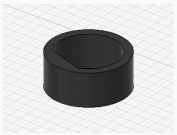


Lower the Mercury tube over the central rod and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: L_95T. Build the tube stack strictly in this order - inner tube first.

13 Tube level 2 - Venus



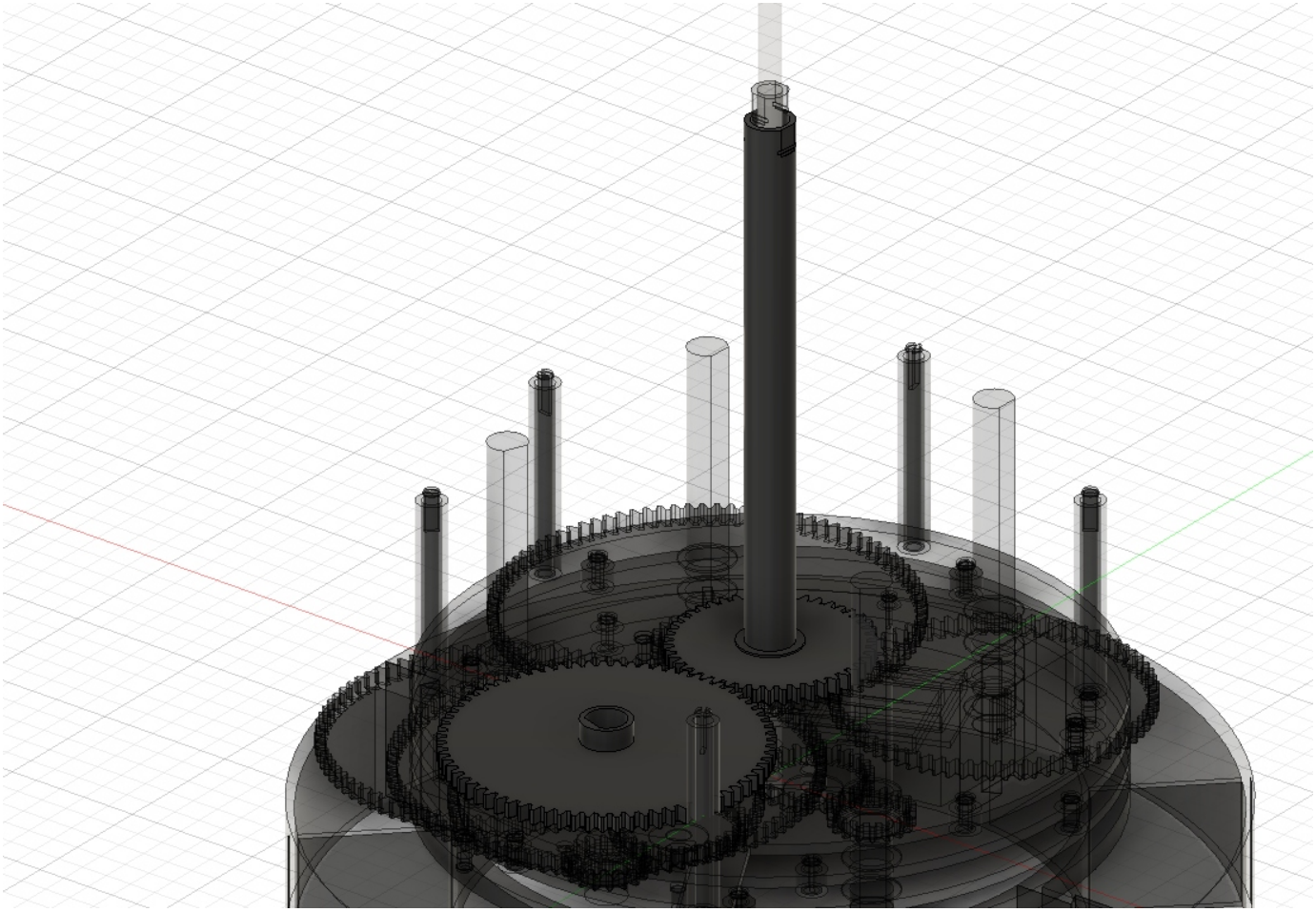
1x #15
Layshaft gear 73T



1x #33
Spacer L 1

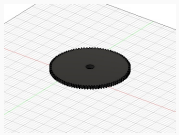


1x #50
Tube Venus

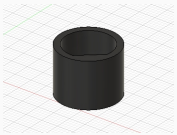


Lower the Venus tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: L_73T, Spacer_L_1. Build the tube stack strictly in this order - inner tube first.

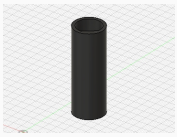
14 Tube level 3 - Moon



1x #18
Moon-shaft gear 92



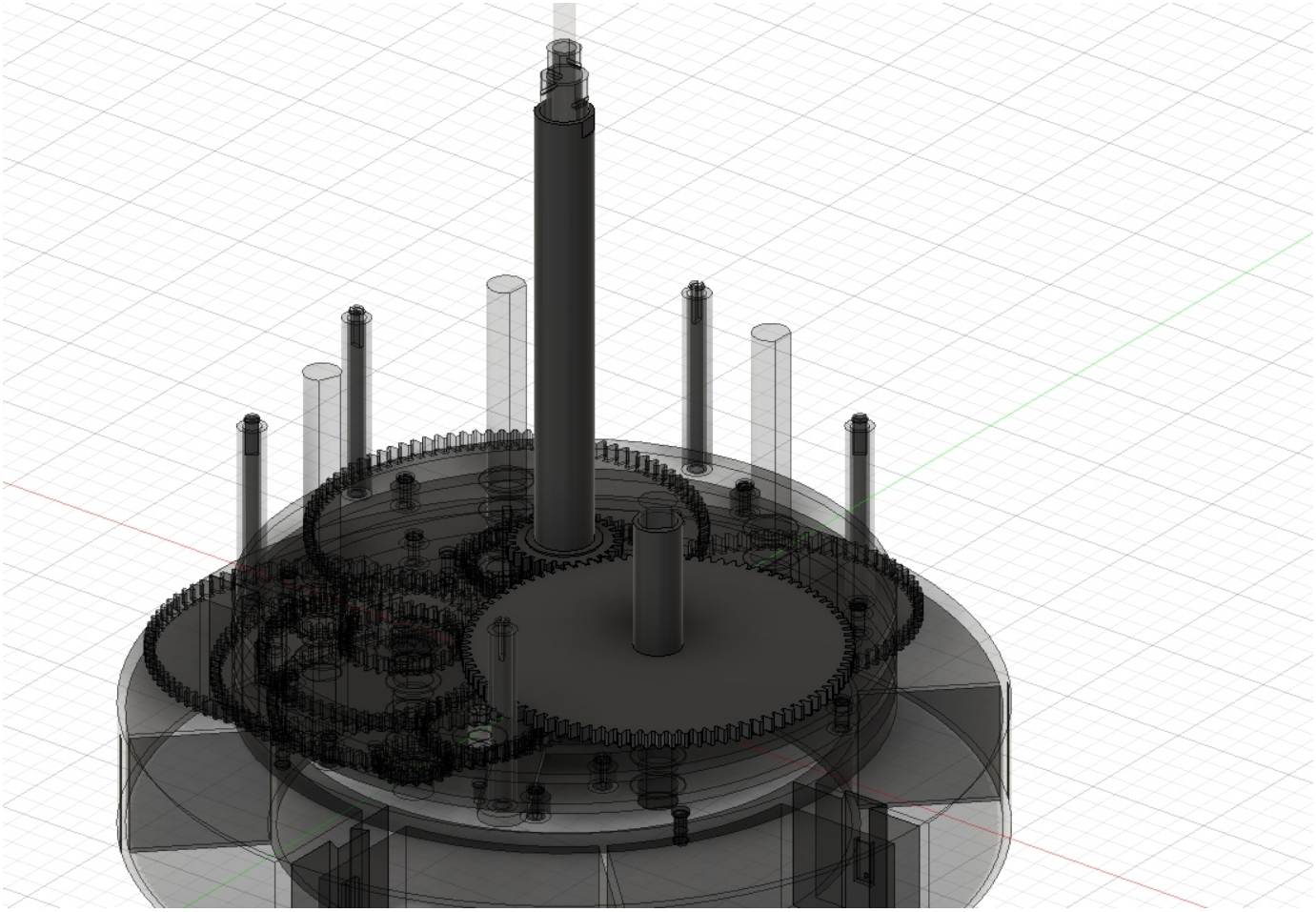
1x #35
Spacer MS 1



1x #36
Spacer MS 2

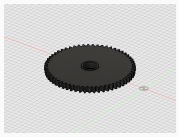


1x #45
Tube Moon



Lower the Moon tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: Spacer_MS_1, MS_92T, Spacer_MS_2. Build the tube stack strictly in this order - inner tube first.

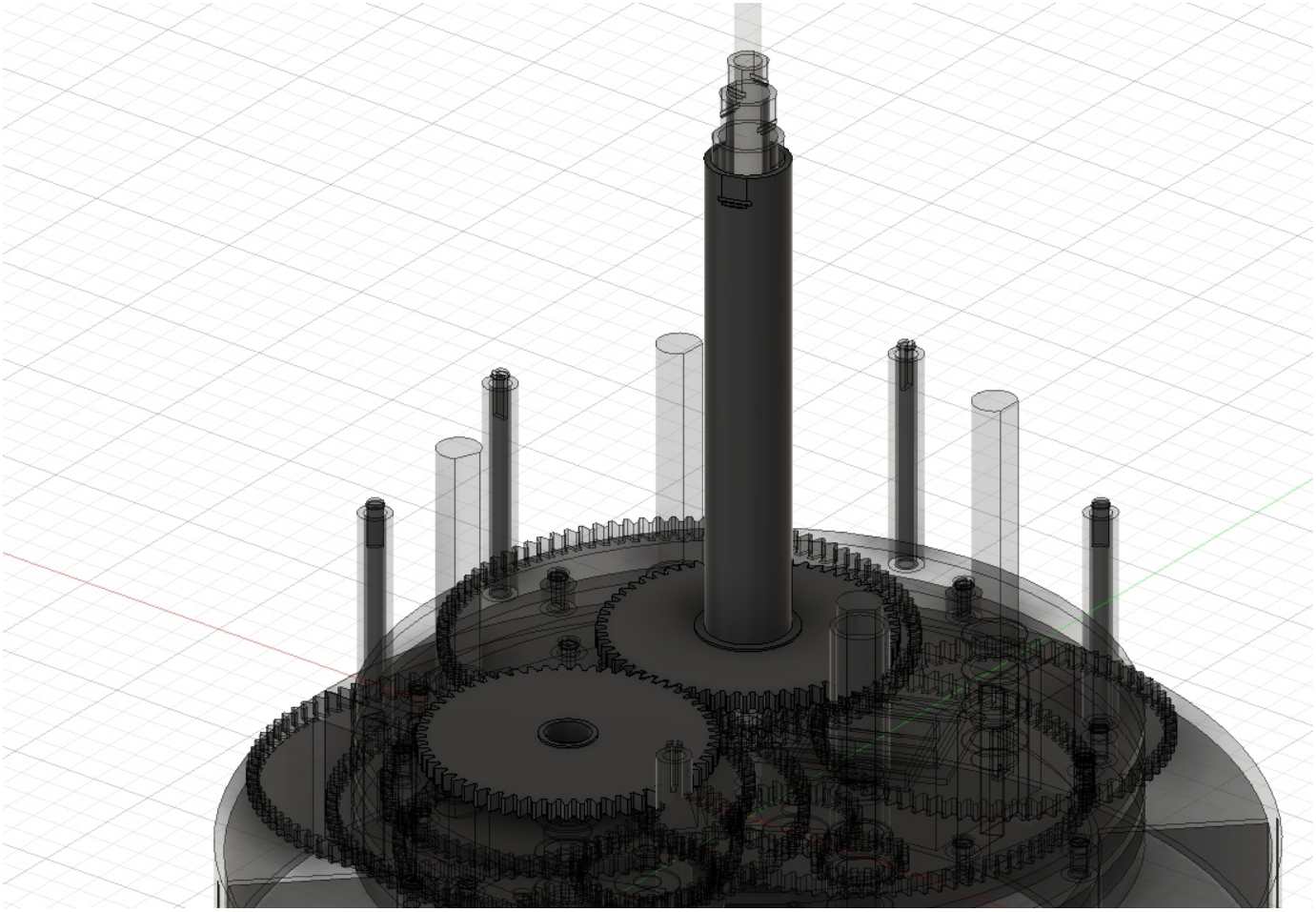
15 Tube level 4 - Earth



1x #13
Layshaft gear 59T

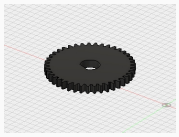


1x #41
Tube Earth

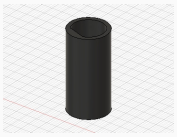


Lower the Earth tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: L_59T. Build the tube stack strictly in this order - inner tube first.

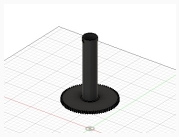
16 Tube level 5 - Mars



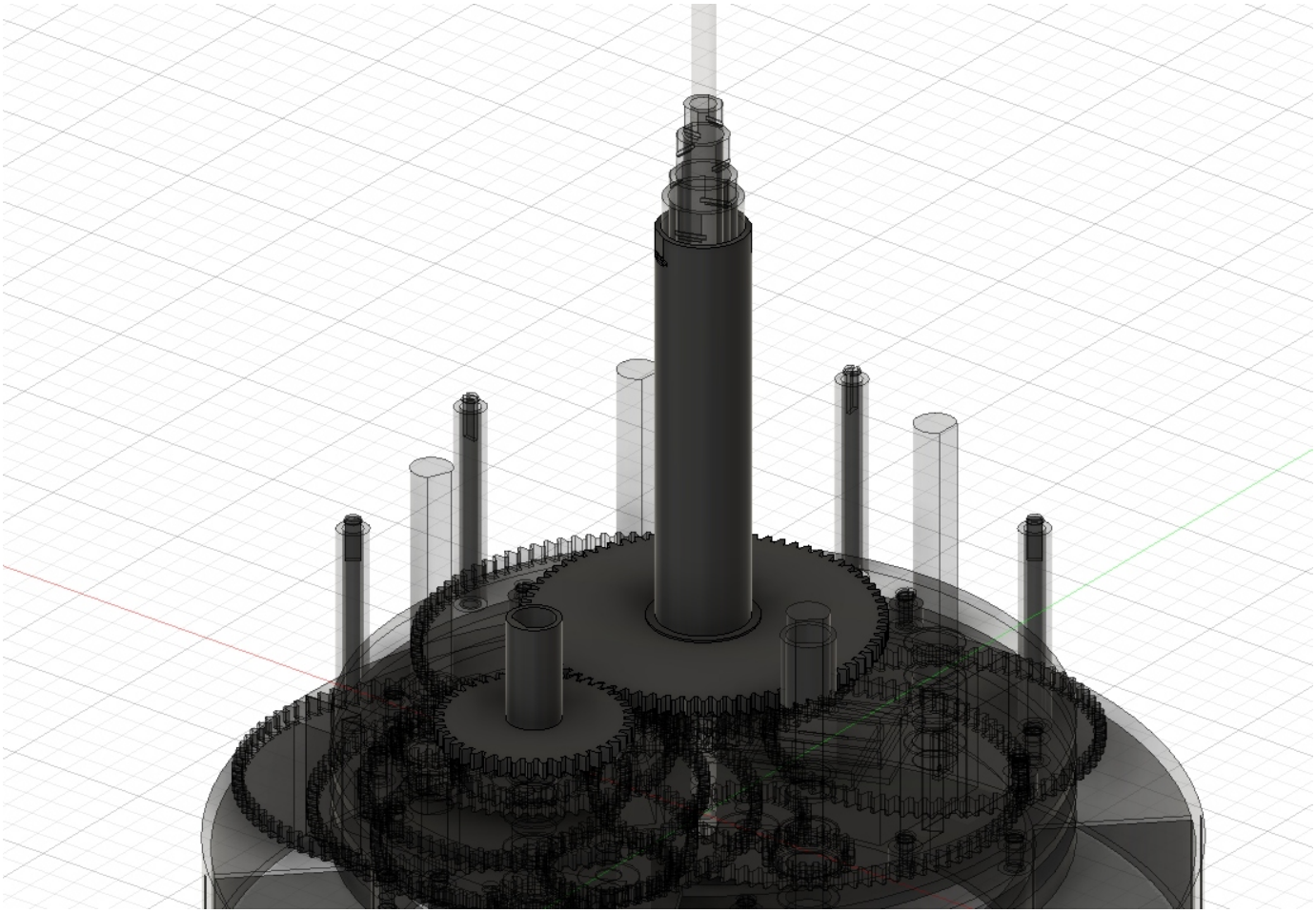
1x #12
Layshaft gear 41T



1x #34
Spacer L 2

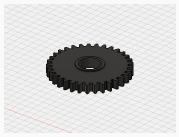


1x #43
Tube Mars

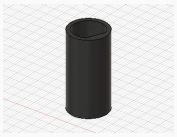


Lower the Mars tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: L_41T, Spacer_L_2. Build the tube stack strictly in this order - inner tube first.

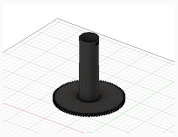
17 Tube level 6 - Jupiter



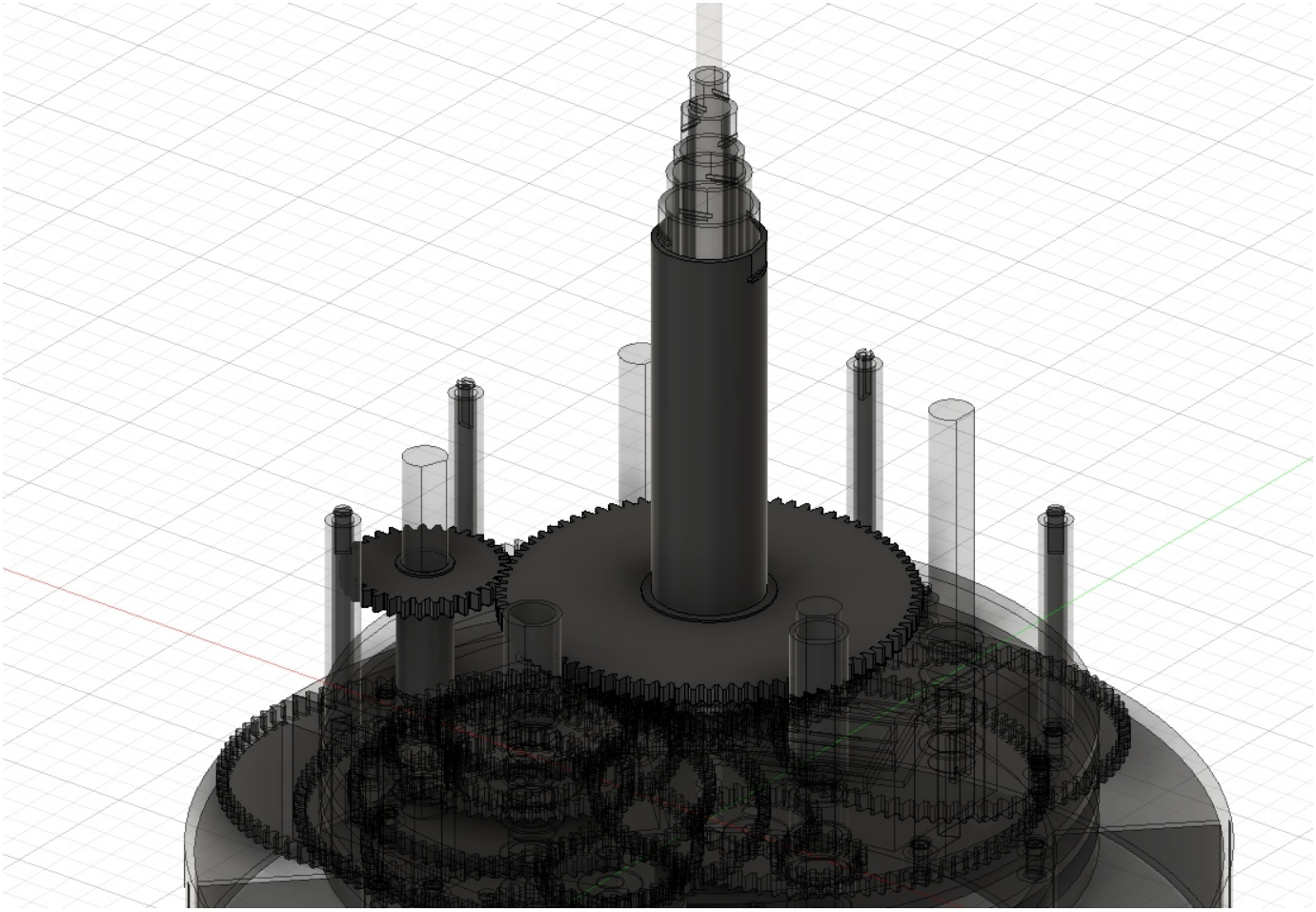
1x #03
C1 gear 33T



1x #28
Spacer C1 1



1x #42
Tube Jupiter

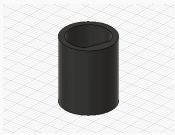


Lower the Jupiter tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: Spacer_C1_1, C1_33T. Build the tube stack strictly in this order - inner tube first.

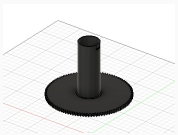
18 Tube level 7 - Saturn



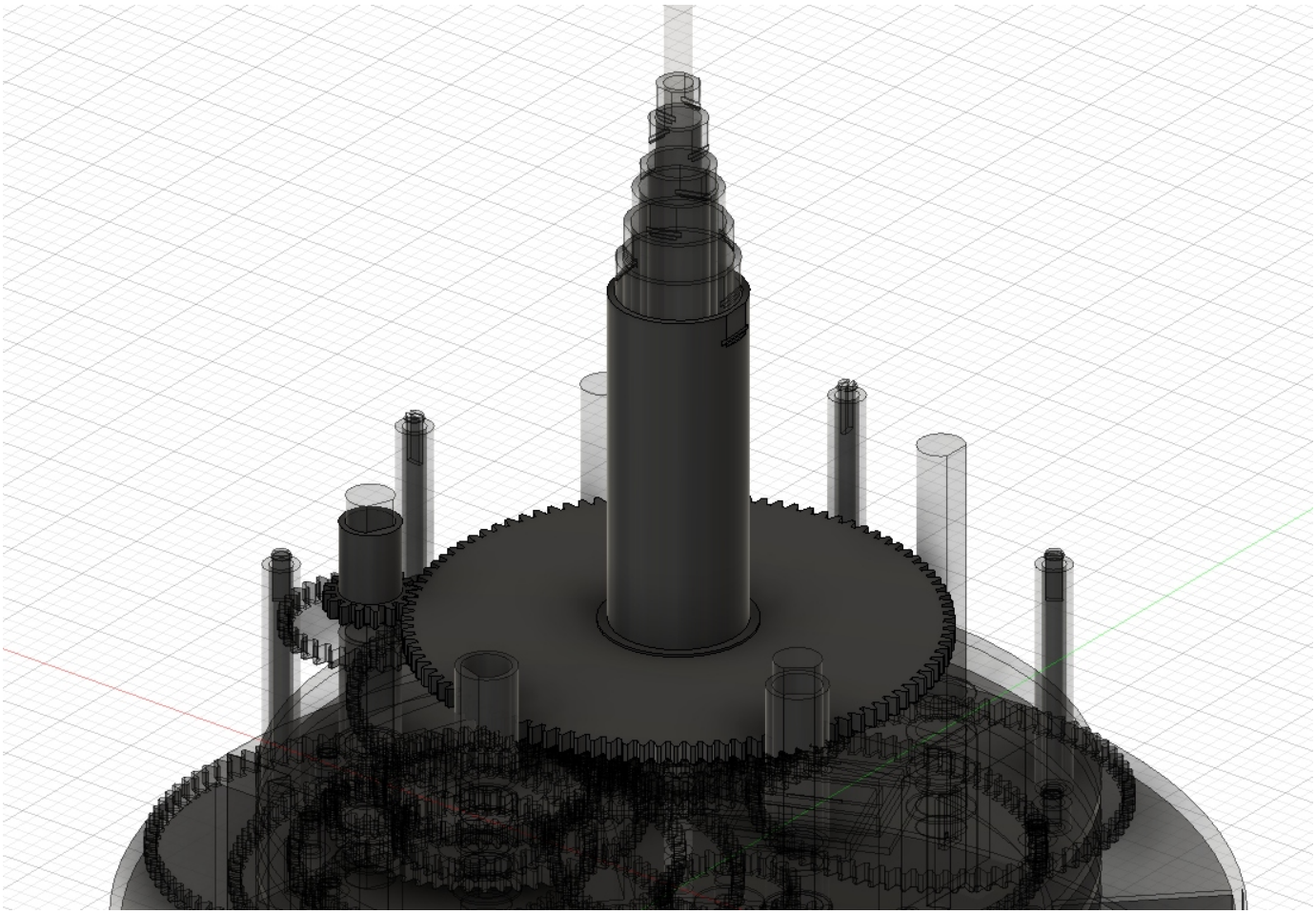
1x #01
C1 16T Saturn



1x #29
Spacer C1 2

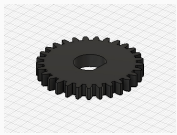


1x #48
Tube Saturn



Lower the Saturn tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: C1_16T_Saturn, Spacer_C1_2. Build the tube stack strictly in this order - inner tube first.

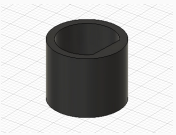
19 Tube level 8 - Uranus



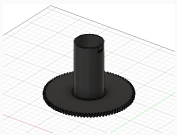
1x #06
C2 gear 29T



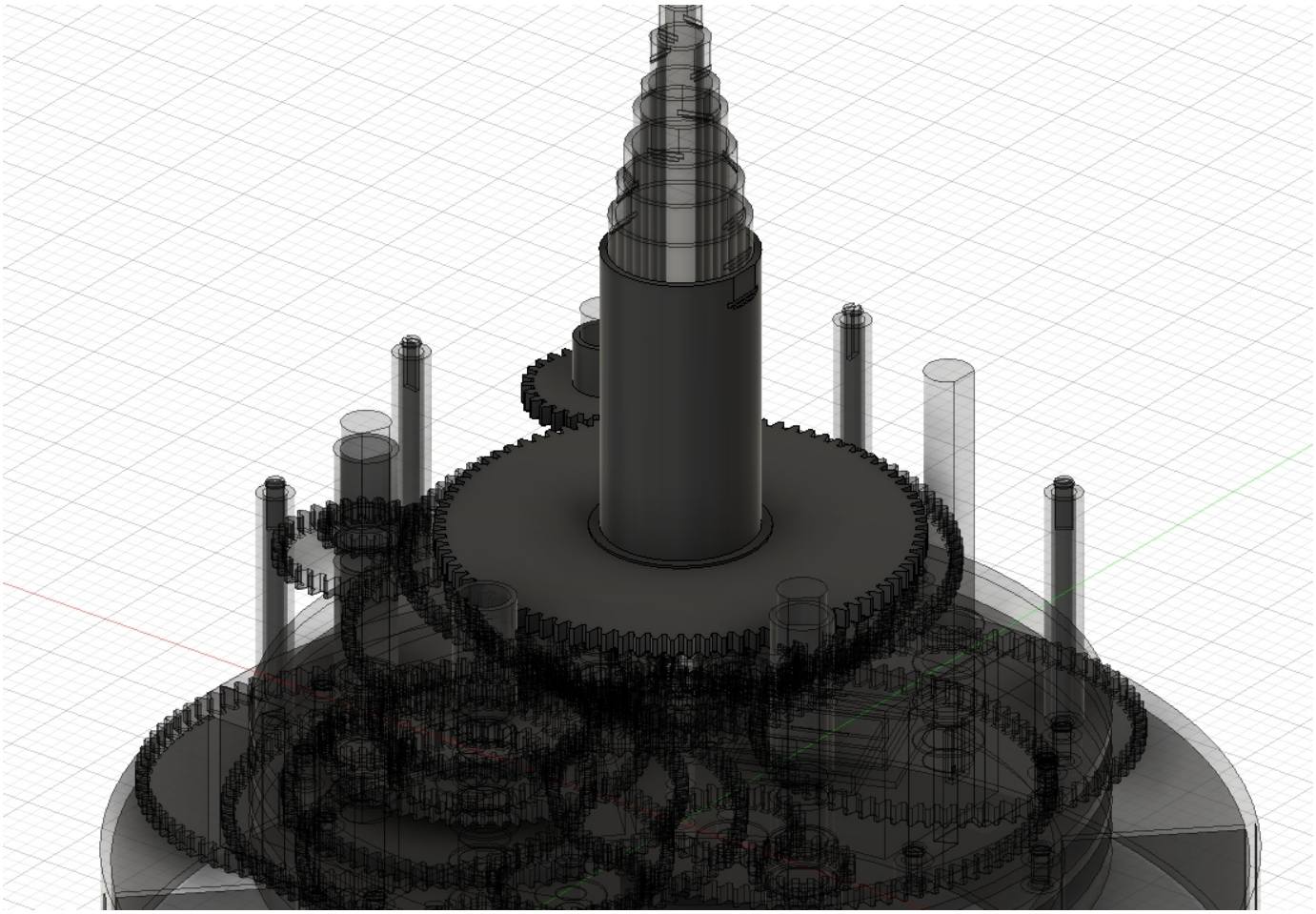
1x #30
Spacer C2 1



1x #31
Spacer C2 2



1x #49
Tube Uranus

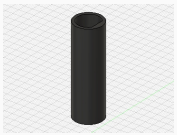


Lower the Uranus tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: Spacer_C2_1, C2_29T, Spacer_C2_2. Build the tube stack strictly in this order - inner tube first.

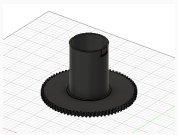
20 Tube level 9 - Neptune



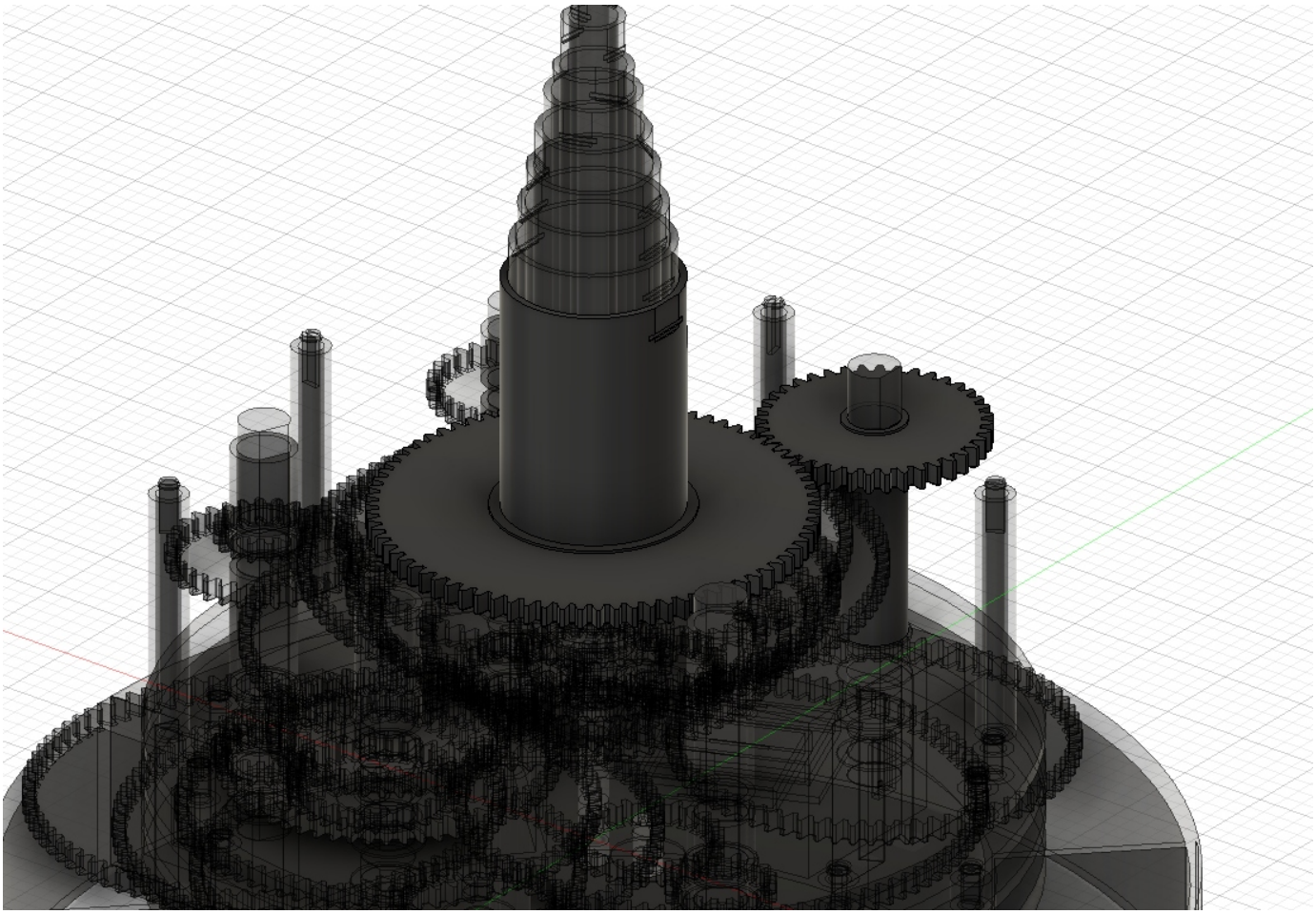
1x #09
C3 gear 40T



1x #32
Spacer C3 1



1x #46
Tube Neptune

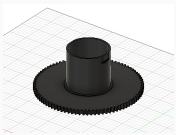


Lower the Neptune tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: Spacer_C3_1, C3_40T. Build the tube stack strictly in this order - inner tube first.

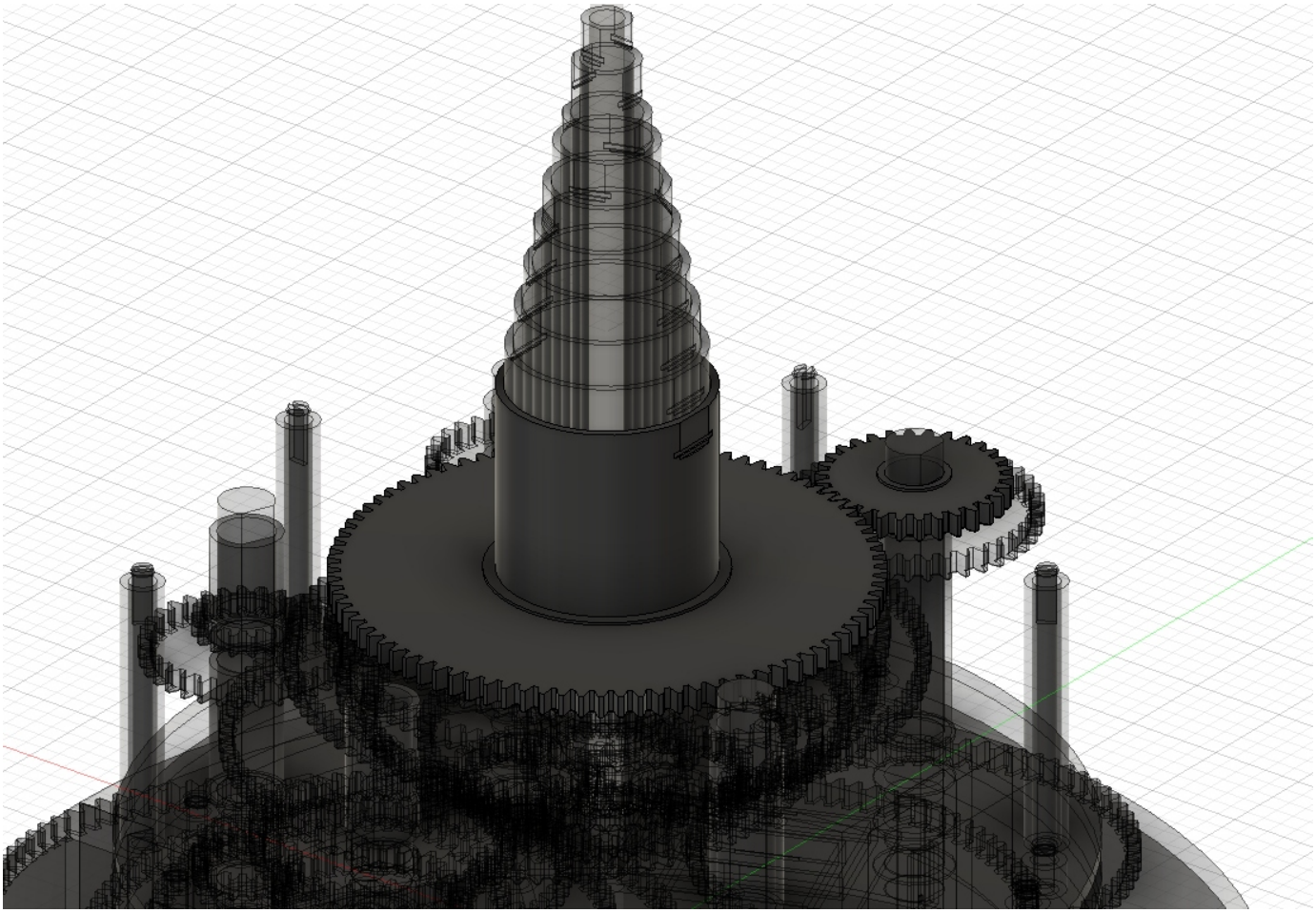
21 Tube level 10 - Pluto



1x #08
C3 gear 30T

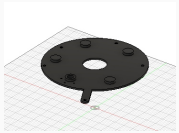


1x #47
Tube Pluto

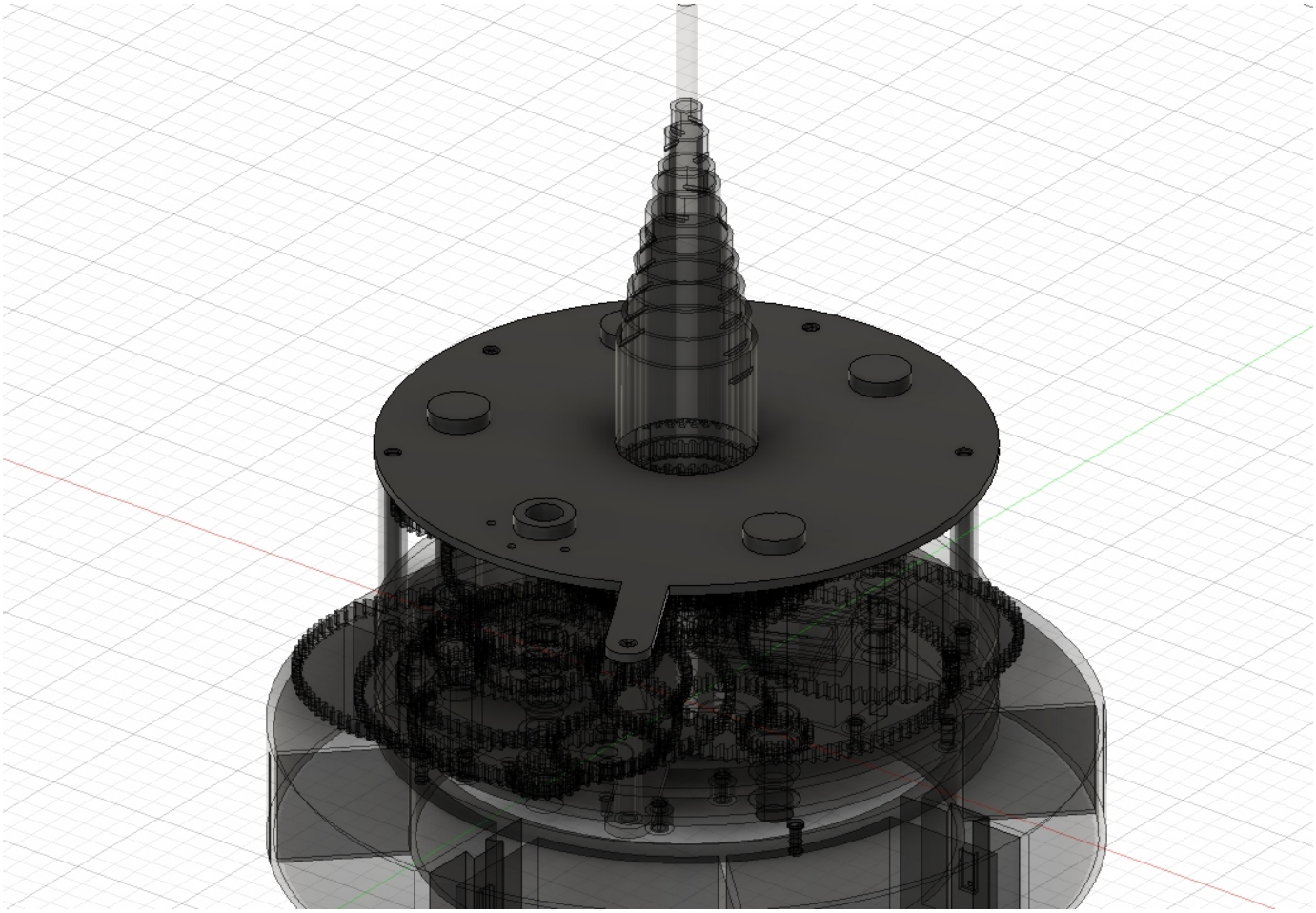


Lower the Pluto tube over the tubes already fitted and onto the stack (its gear rests on the thrust ring below). Then add the shaft parts for this level: C3_30T. Build the tube stack strictly in this order - inner tube first.

22 Lid



1x #62
Lid



Snap the lid onto the five D3 pillars; the shaft tops drop into the blind sockets on the lid bosses.

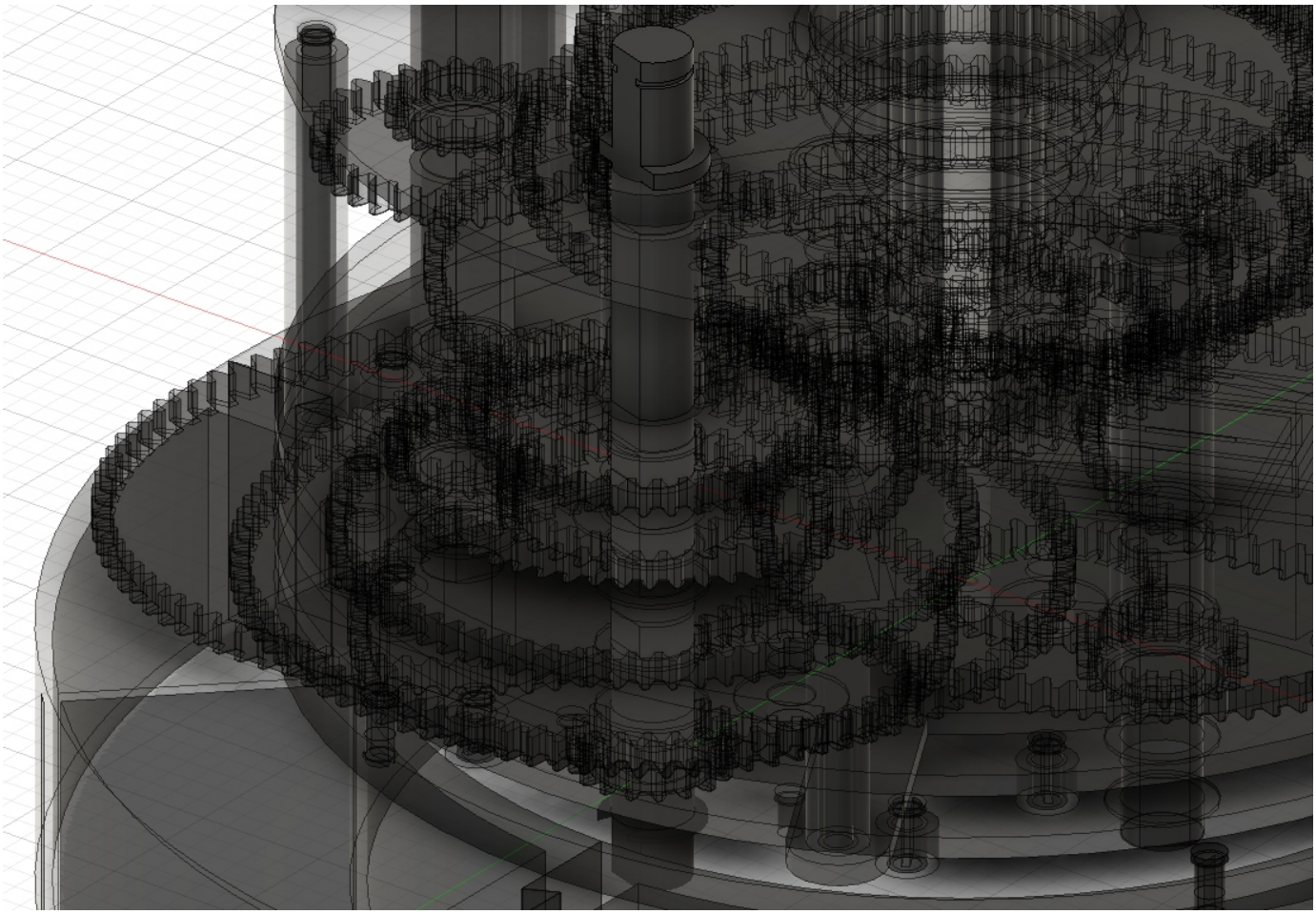
23 Layshaft



1x #26
Shaft L



1x #38
LayshaftClip

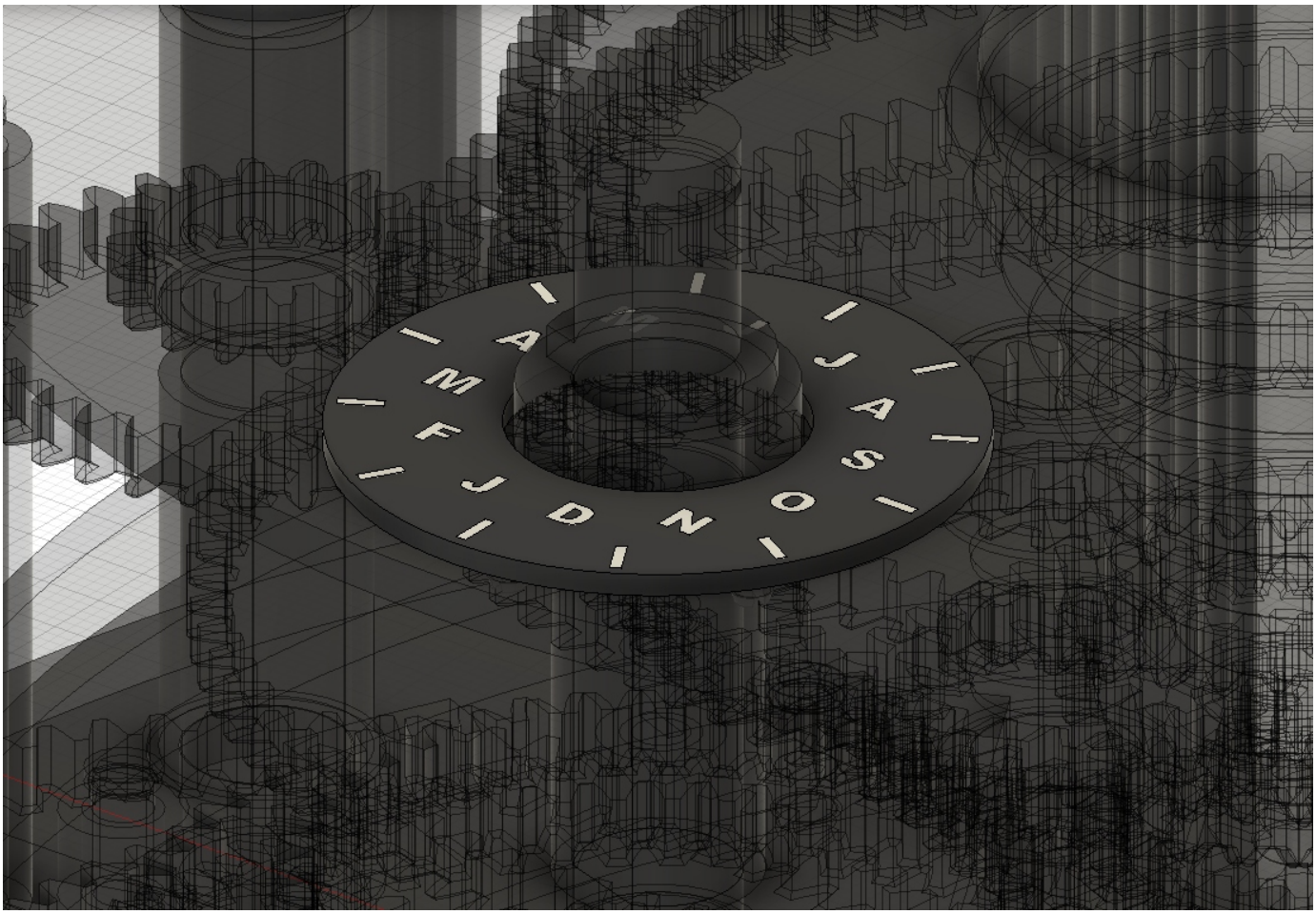


Push the layshaft down through the lid boss, turning it until the D-flat lines up with every layshaft gear and spacer, and on through D0. From below, snap the C-clip into the groove under D0.

24 Year dial

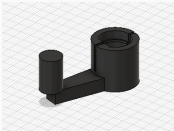


1x #63
YearDial

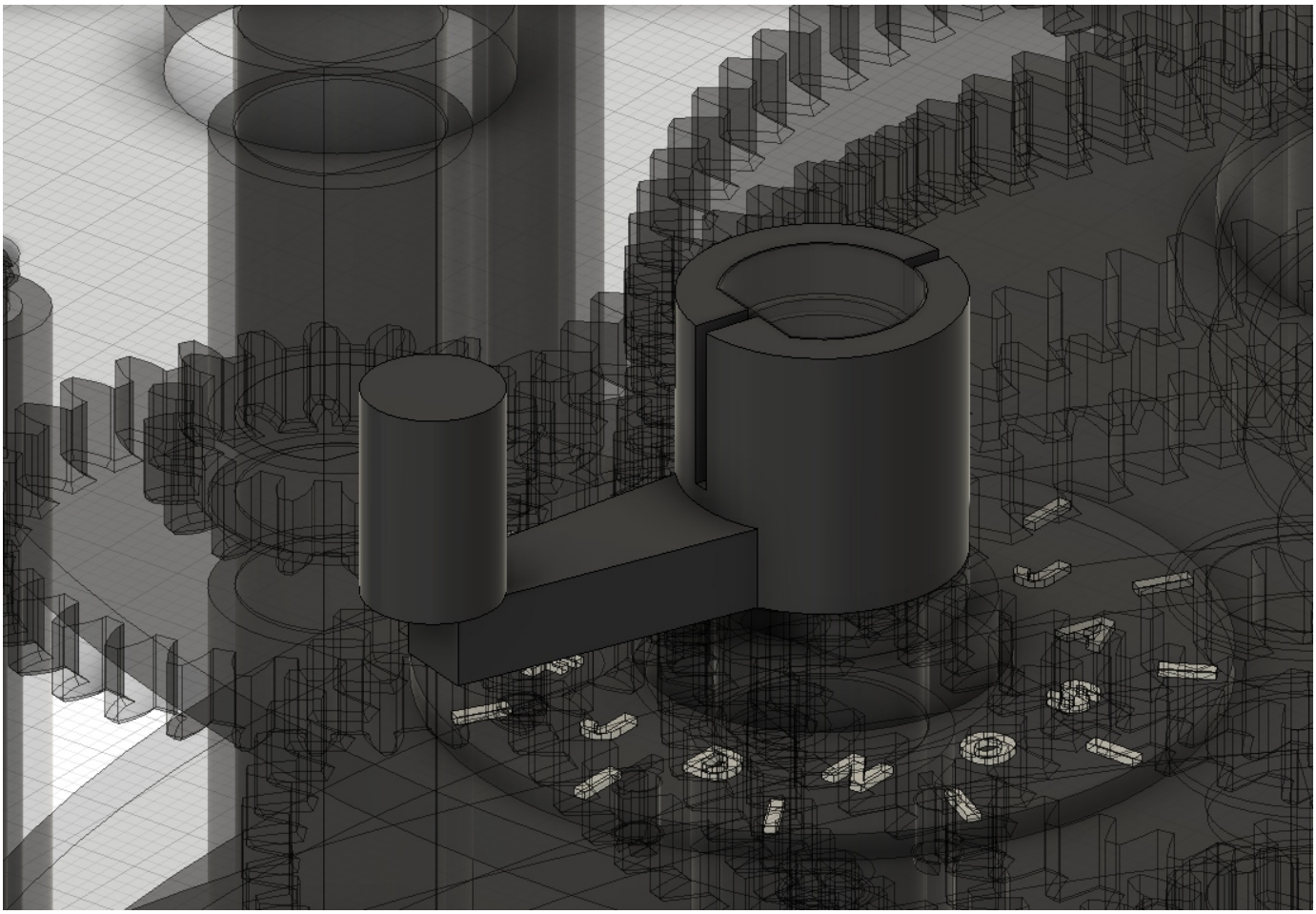


Press the year dial onto the lid around the layshaft - its three pins snap through the lid. January points to the front.

25 Crank

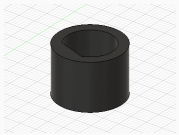


1x #37
CrankKnob

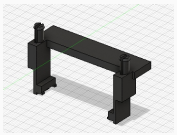


Push the crank knob onto the top of the layshaft (D-flat aligned) until the collet clicks into the groove.

26 Motor drive (optional)

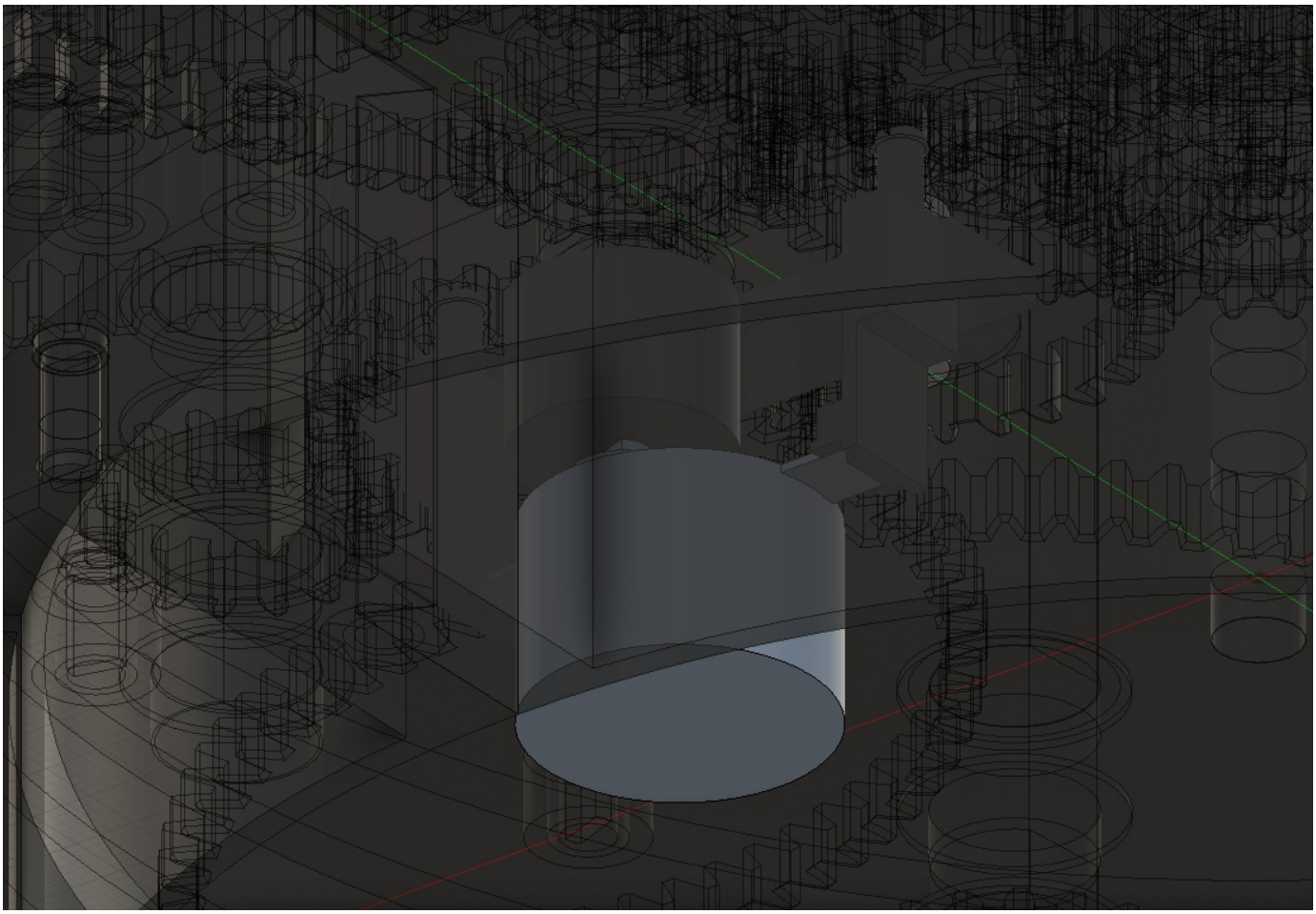


1x #39
MotorCoupler



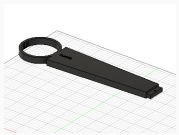
1x #40
MotorCradle

1x
28BYJ-48 stepper mot

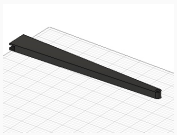


Push the coupler onto the bottom of the layshaft. Snap the 28BYJ-48 into the cradle (ears click under the lips), fit its shaft into the coupler and push the cradle pins up through D0 until they click. Route the motor cable to the ULN2003 board.

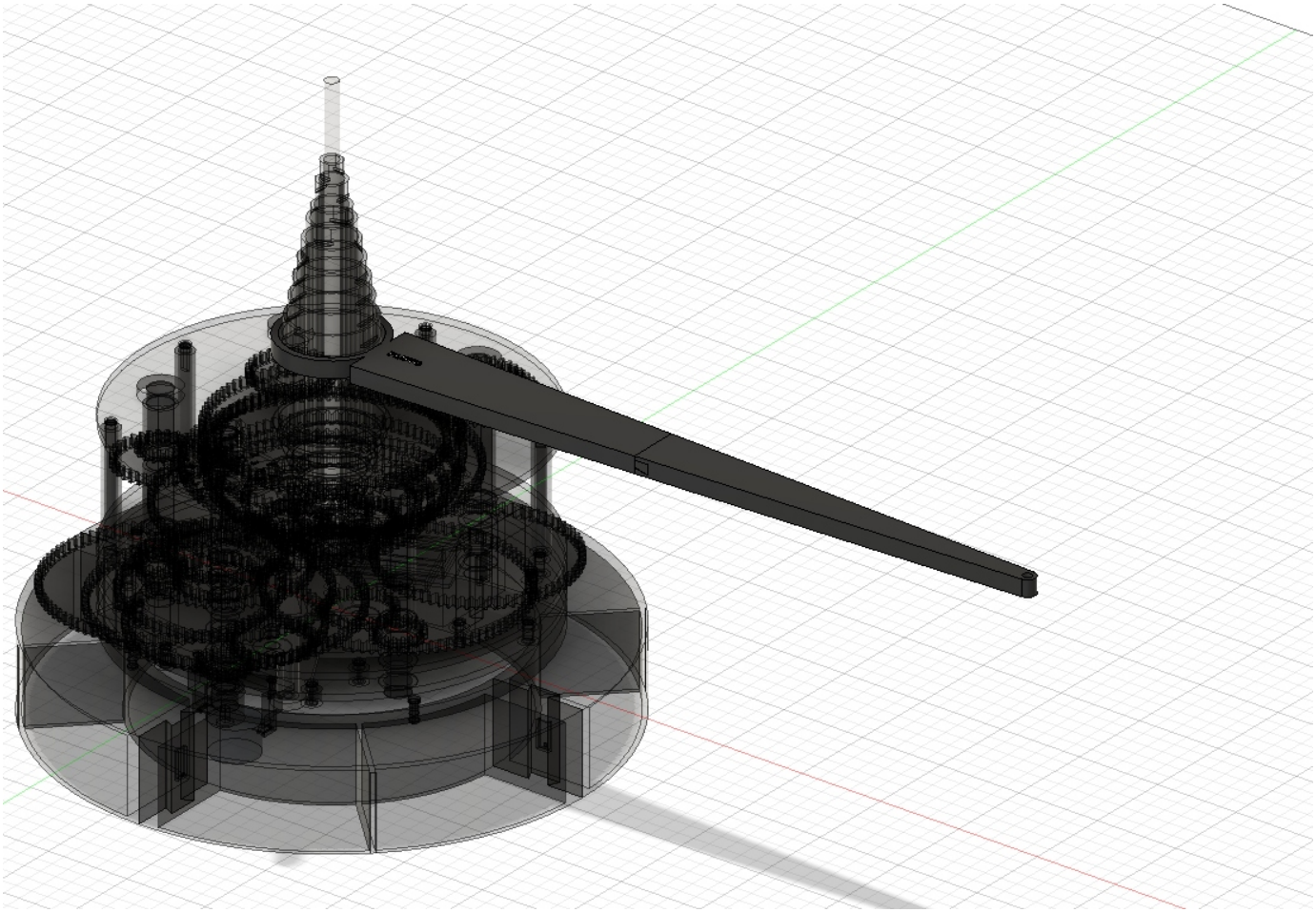
27 Pluto arm



1x #73
Arm Pluto 1



1x #74
Arm Pluto 2



Slide the two Pluto arm halves together sideways on the dovetail until the detent clicks.
Slide the Pluto collar down onto its tube flats until the latch clicks.

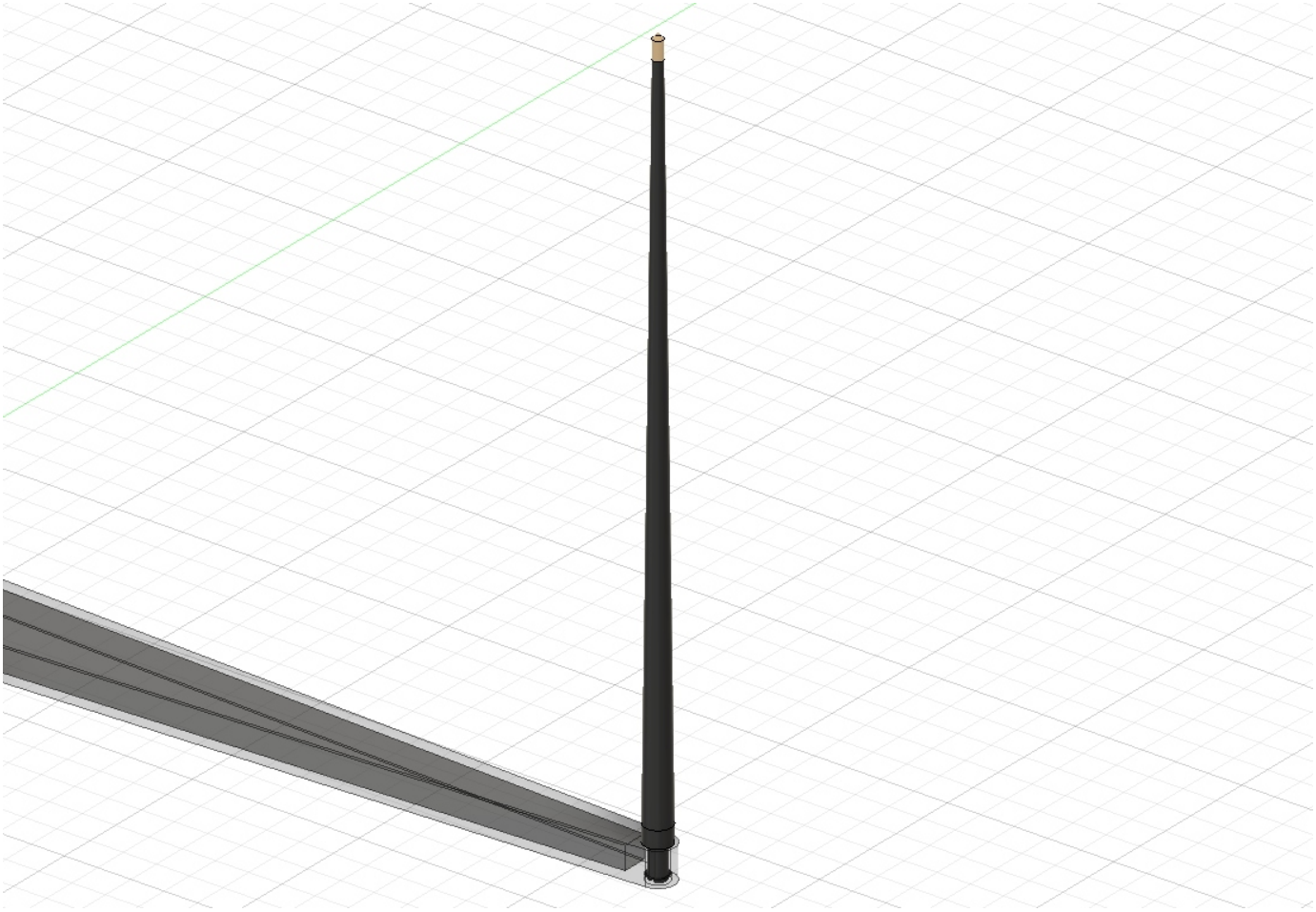
28 Pluto post and body



1x #84
Post Pluto



1x #96
PlutoTip

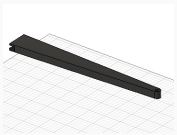


Snap the Pluto post into the arm tip (split pin clicks under the arm), then press the Pluto on top.

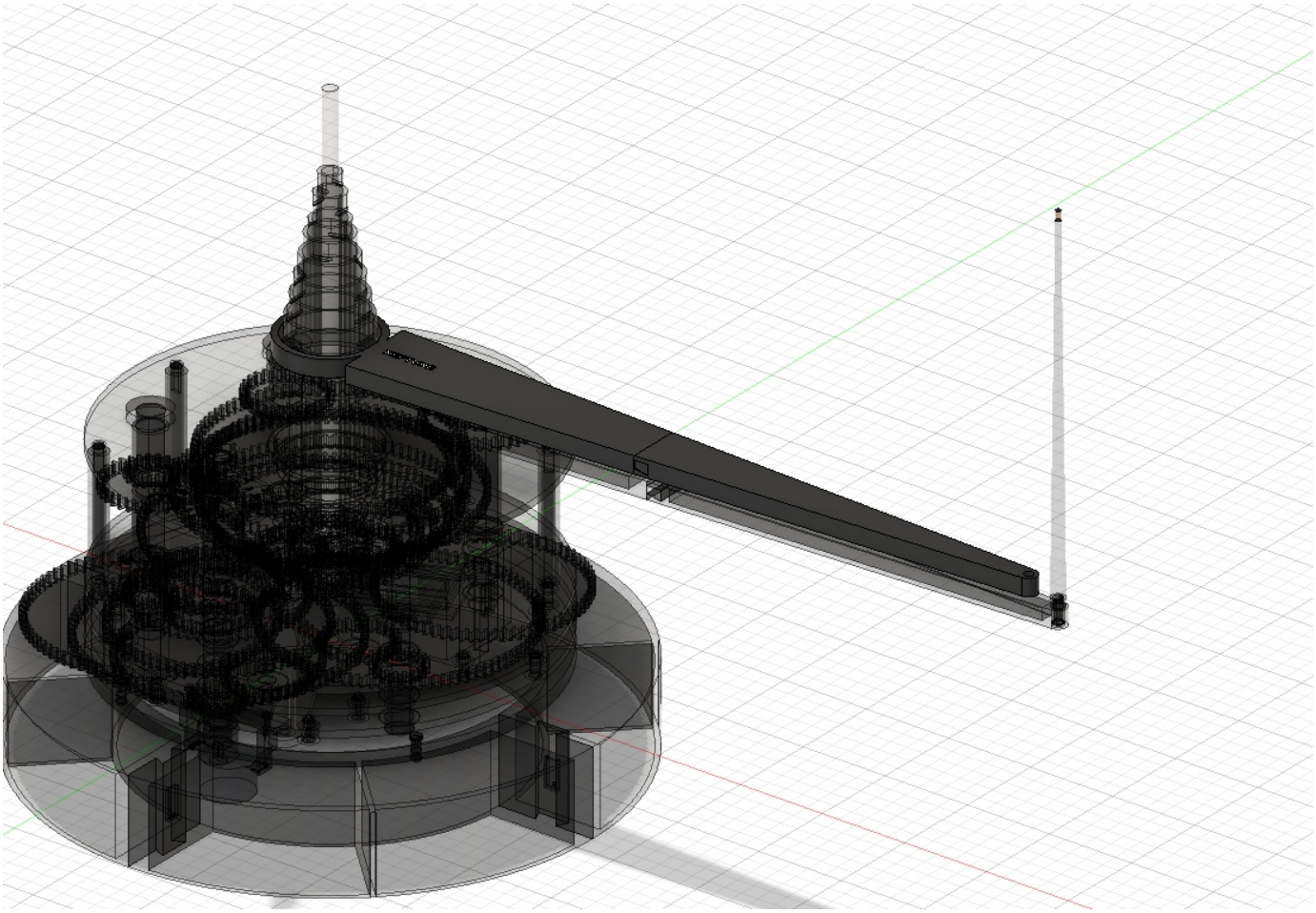
29 Neptune arm



1x #71
Arm Neptune 1



1x #72
Arm Neptune 2

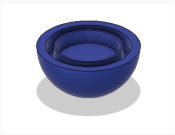


Slide the two Neptune arm halves together sideways on the dovetail until the detent clicks.
Slide the Neptune collar down onto its tube flats until the latch clicks.

30 Neptune post and body



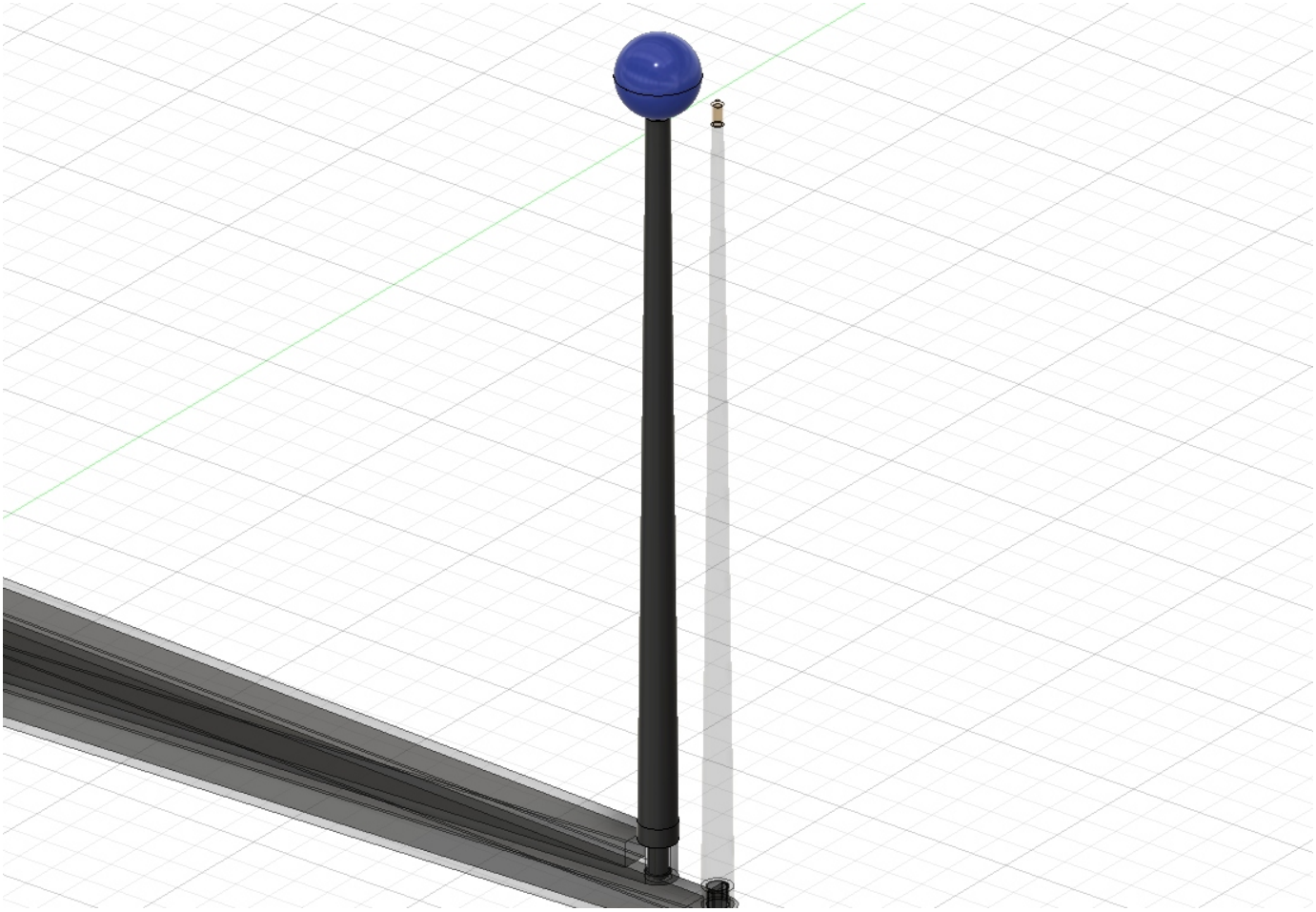
1x #83
Post Neptune



1x #94
Neptune lower



1x #95
Neptune upper

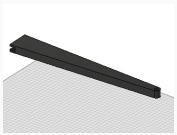


Snap the Neptune post into the arm tip (split pin clicks under the arm), then press the Neptune on top.

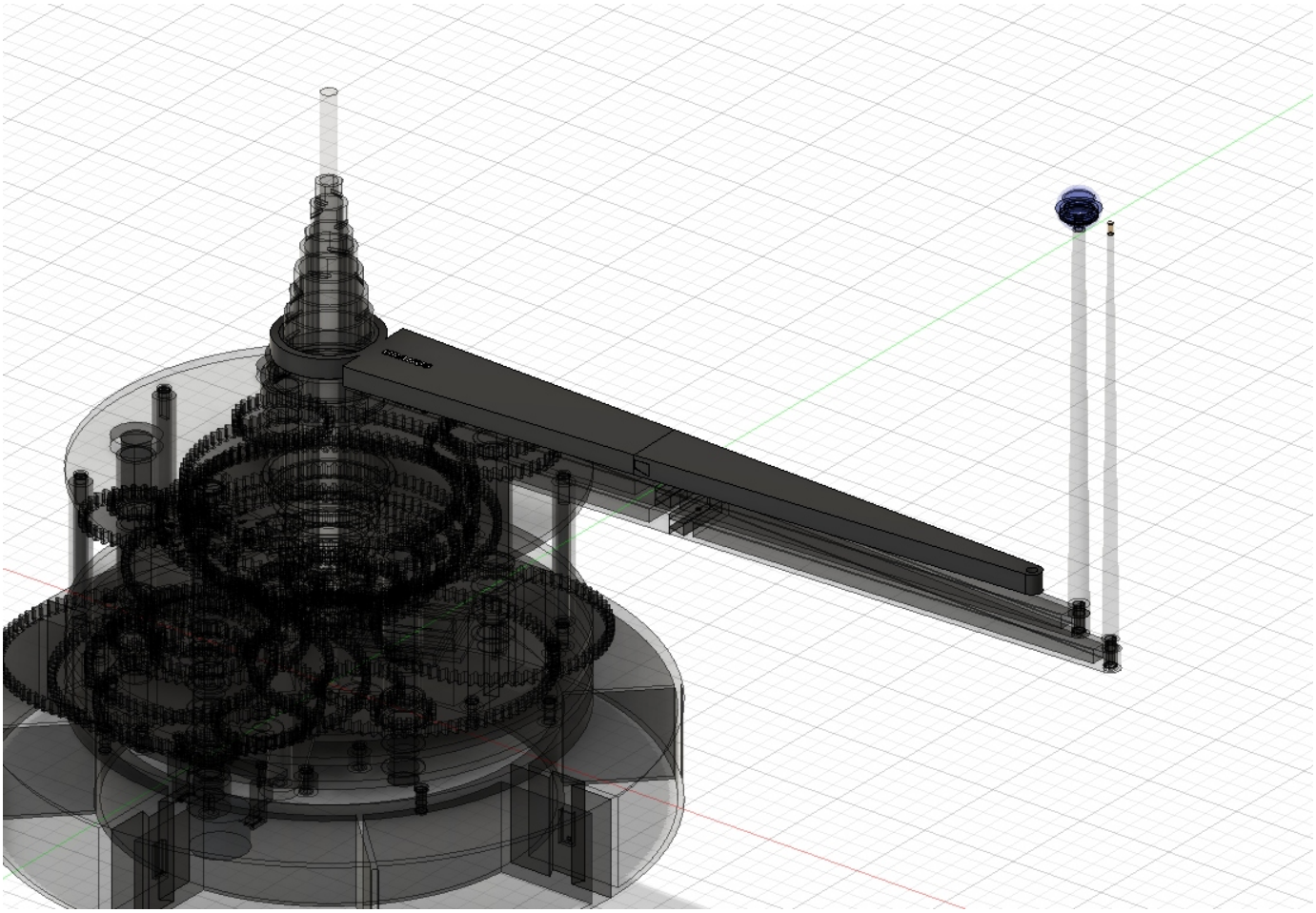
31 Uranus arm



1x #77
Arm Uranus 1



1x #78
Arm Uranus 2

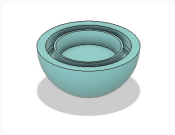


Slide the two Uranus arm halves together sideways on the dovetail until the detent clicks.
Slide the Uranus collar down onto its tube flats until the latch clicks.

32 Uranus post and body



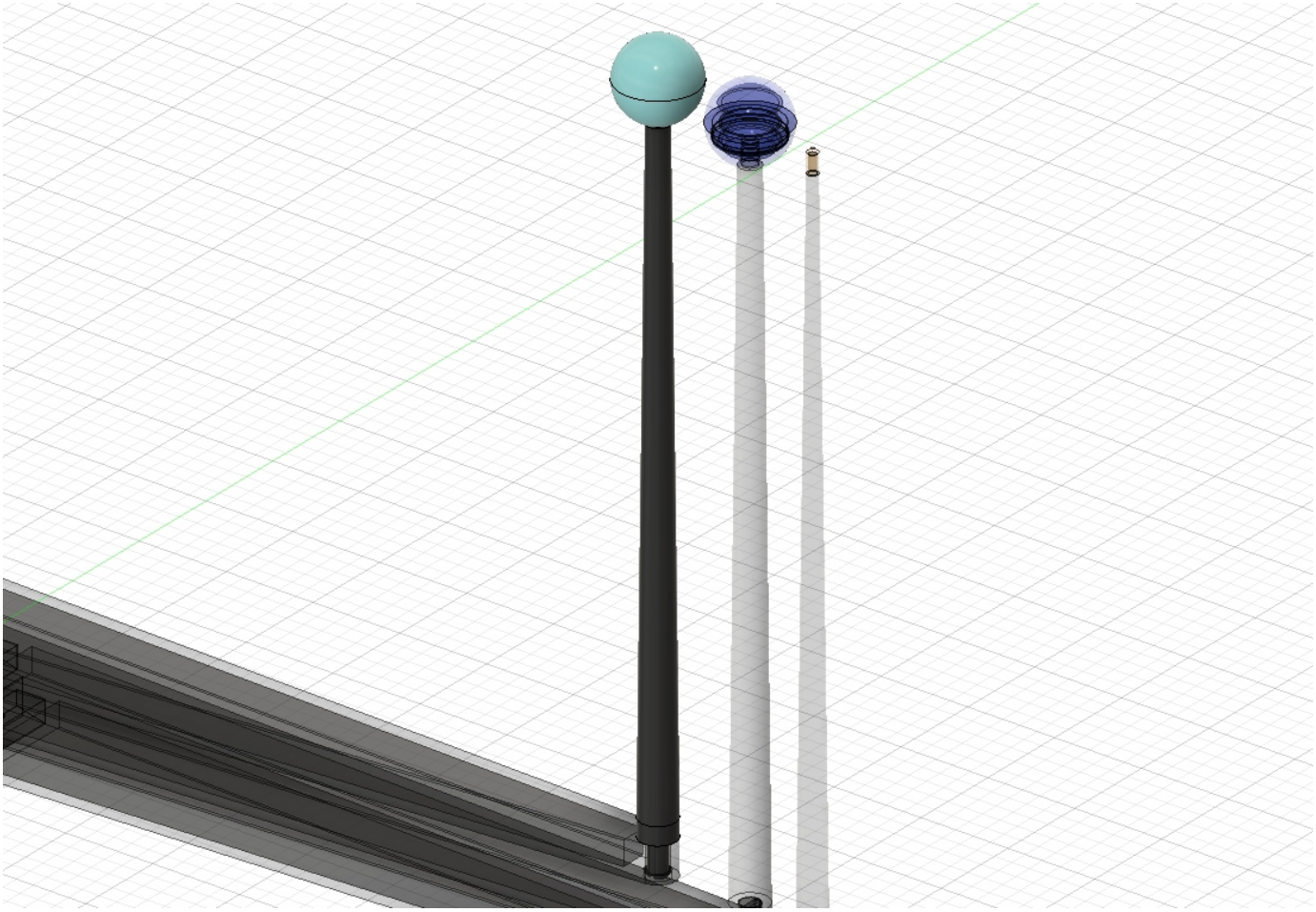
1x #86
Post Uranus



1x #100
Uranus lower



1x #101
Uranus upper

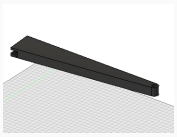


Snap the Uranus post into the arm tip (split pin clicks under the arm), then press the Uranus on top.

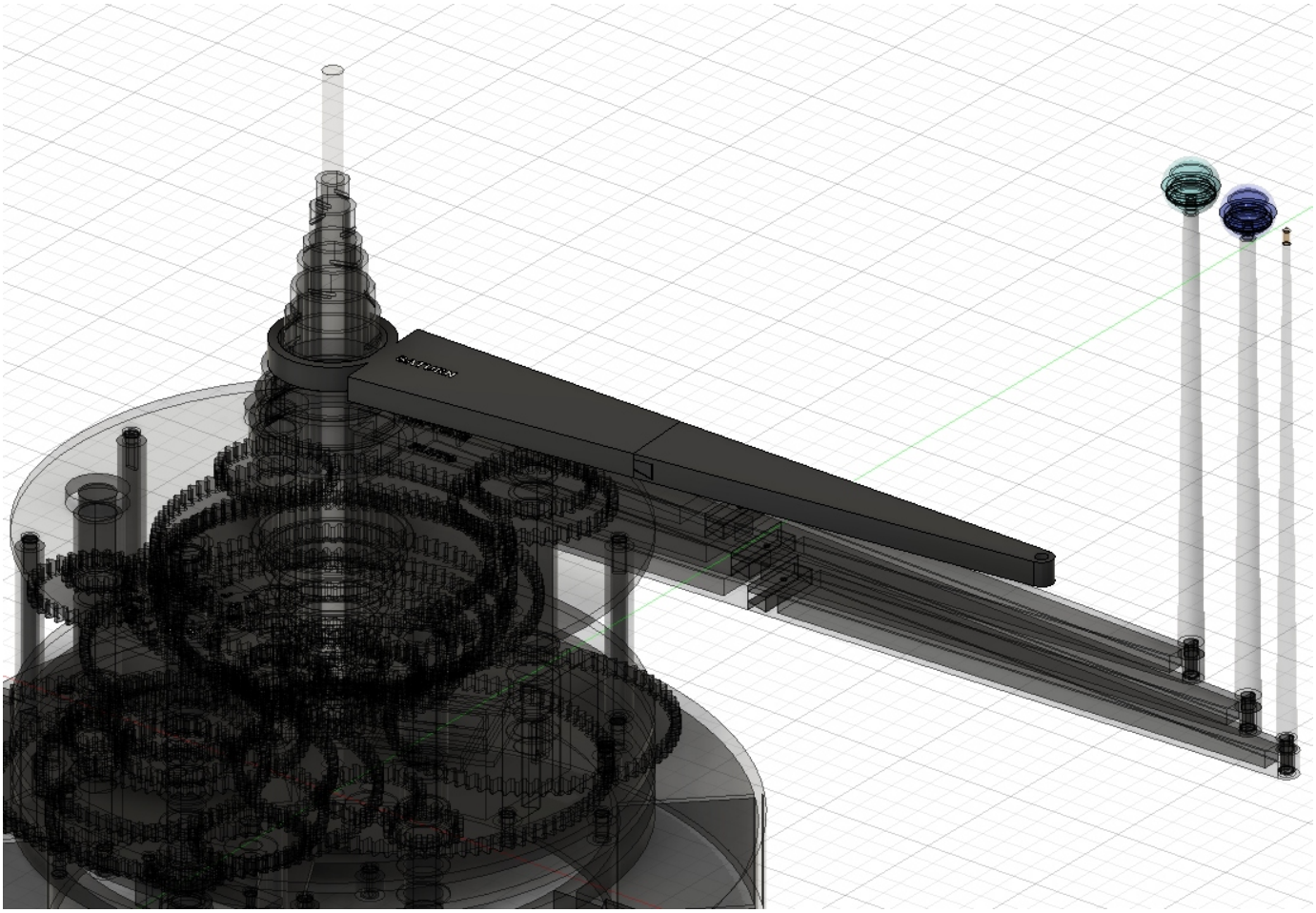
33 Saturn arm



1x #75
Arm Saturn 1



1x #76
Arm Saturn 2

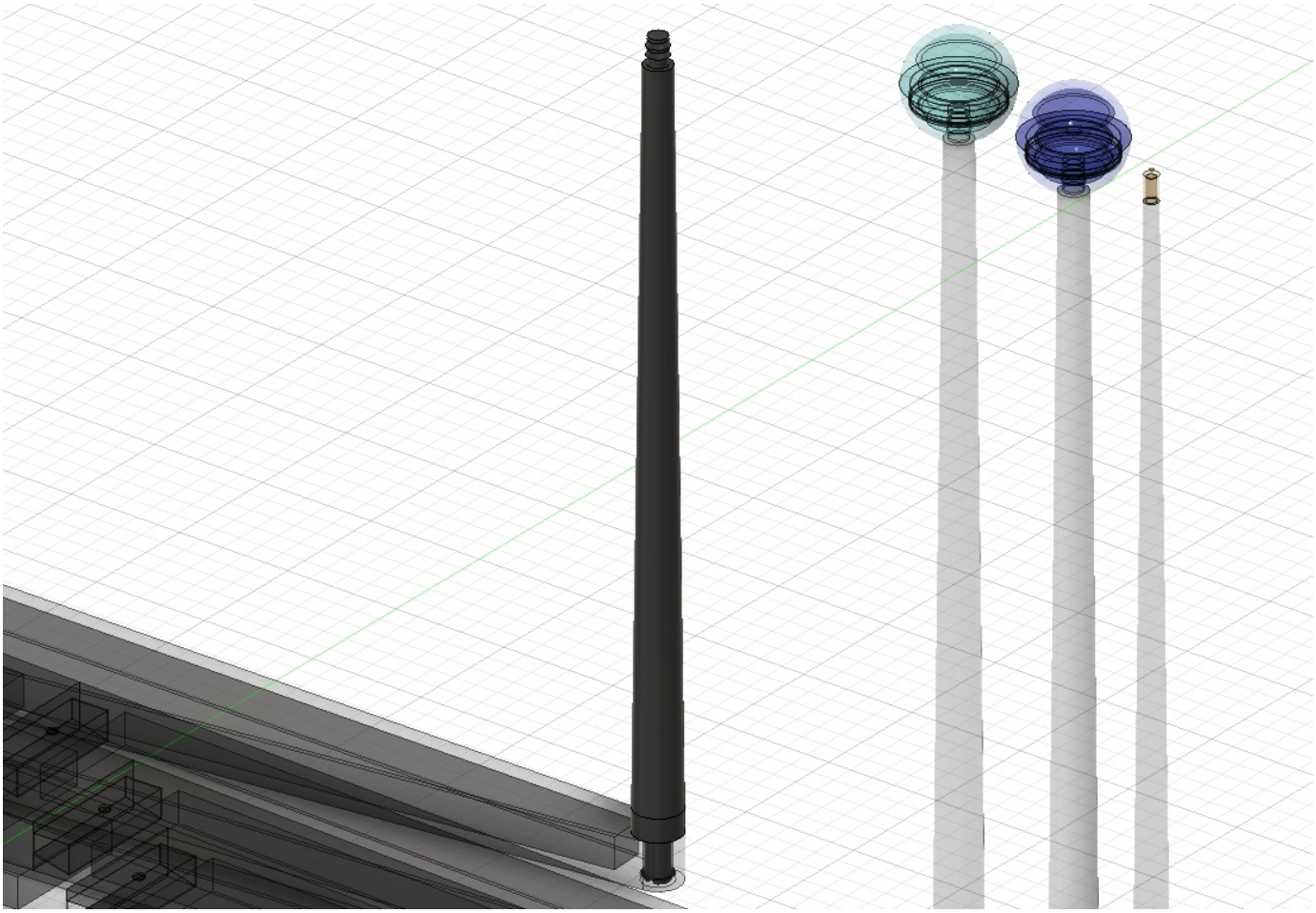


Slide the two Saturn arm halves together on the dovetail until the detent clicks, then slide the collar onto the Saturn tube until the latch clicks.

34 Saturn post



1x #85
Post Saturn



Snap the Saturn post into the arm tip.

35 Saturn



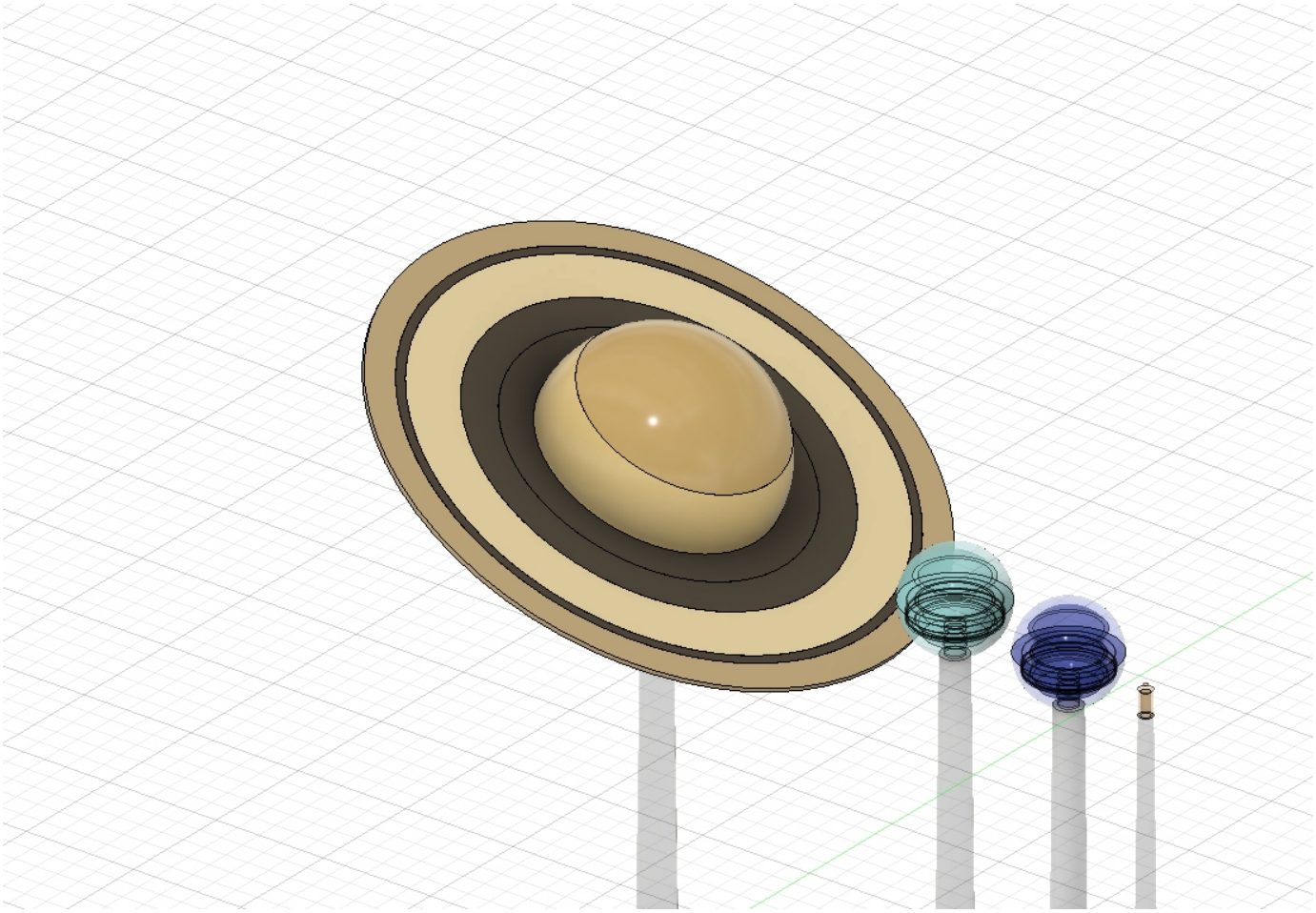
1x #97
Saturn lower



1x #98
Saturn rings



1x #99
Saturn upper

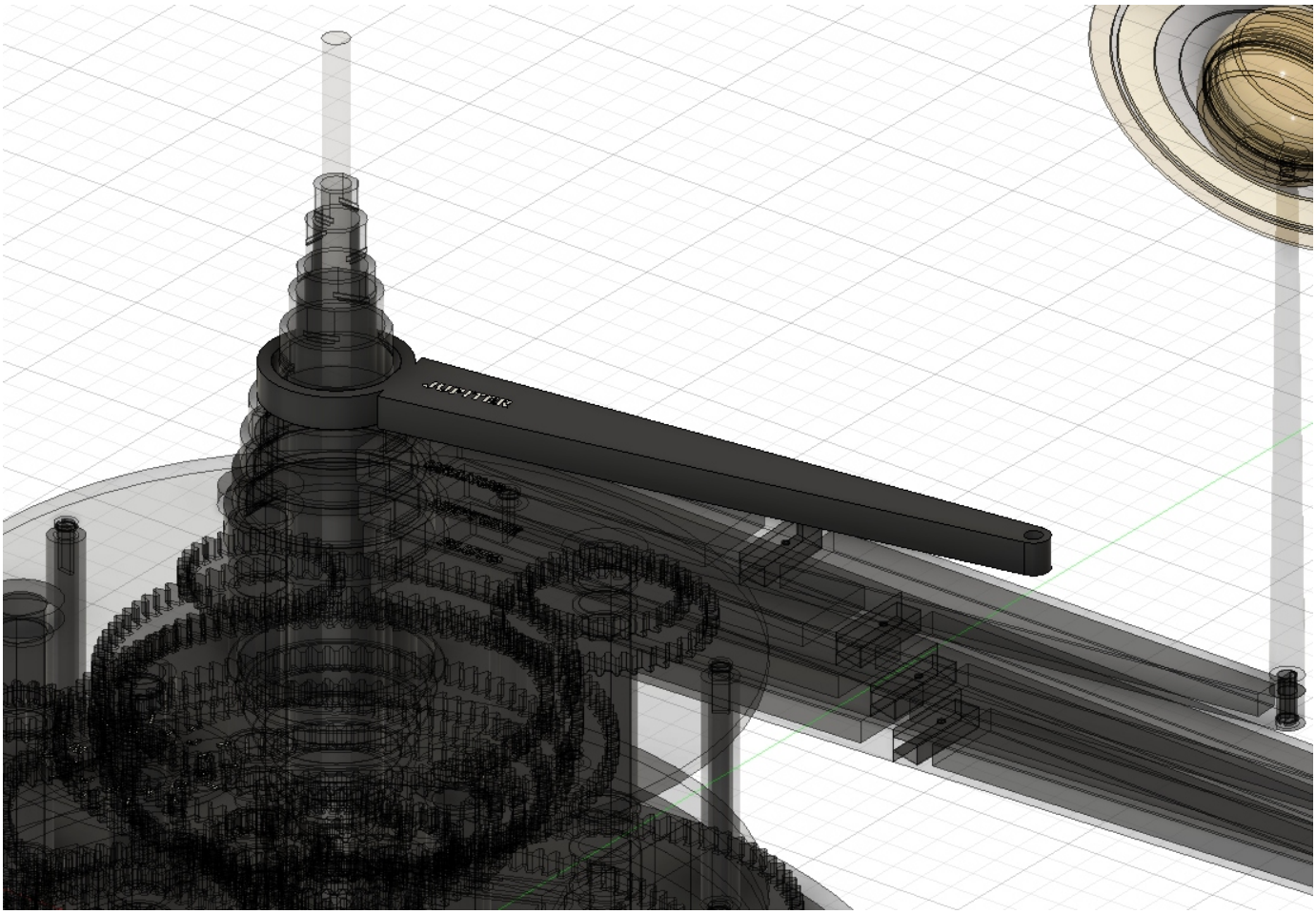


Lay the ring on the lower hemisphere rim, snap the upper hemisphere on (the ring is clamped in the seam), then press Saturn onto the post peg.

36 Jupiter arm



1x #68
Arm Jupiter



Slide the Jupiter collar onto its tube until the latch clicks.

37 Jupiter post and body



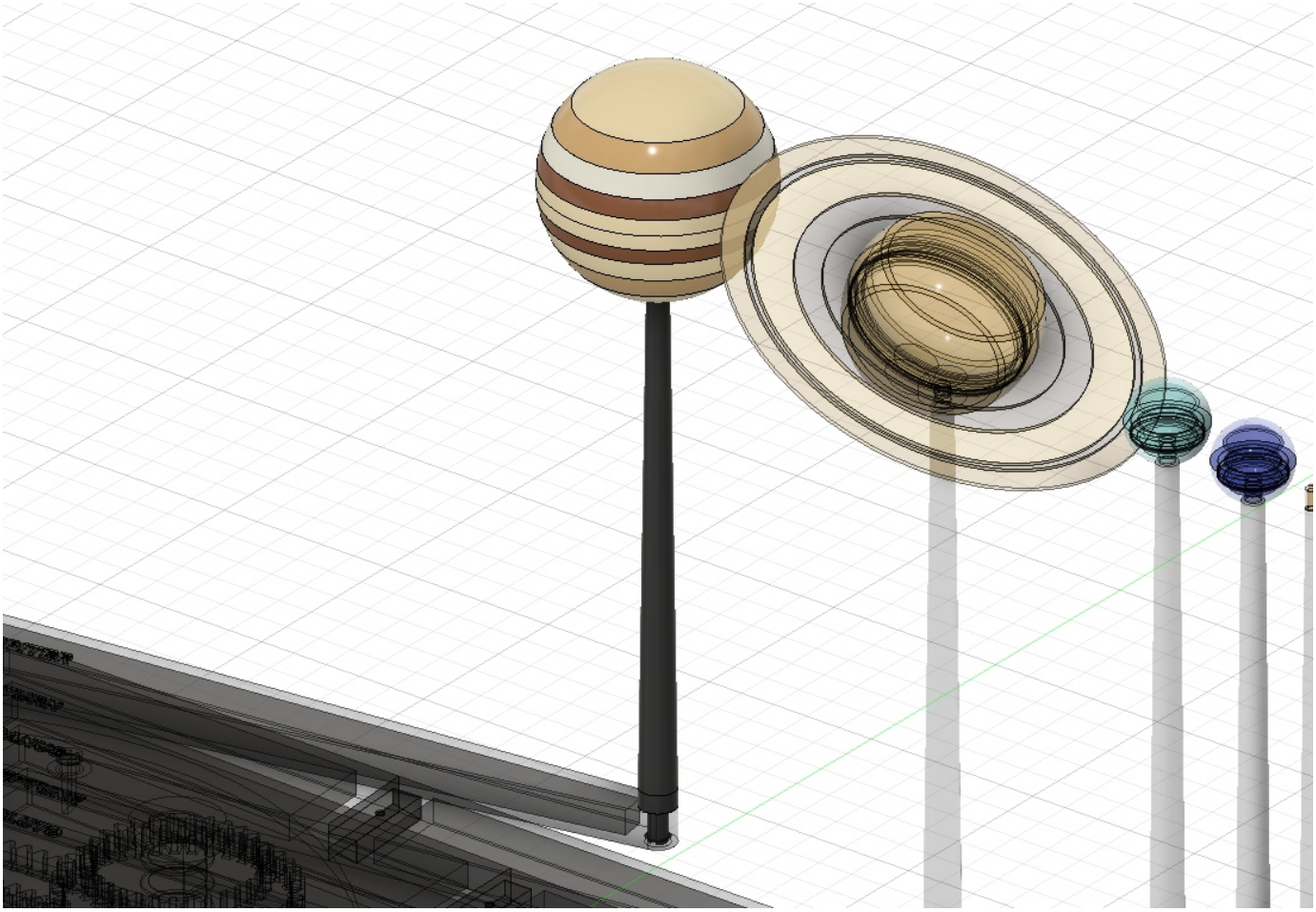
1x #80
Post Jupiter



1x #89
Jupiter lower



1x #90
Jupiter upper

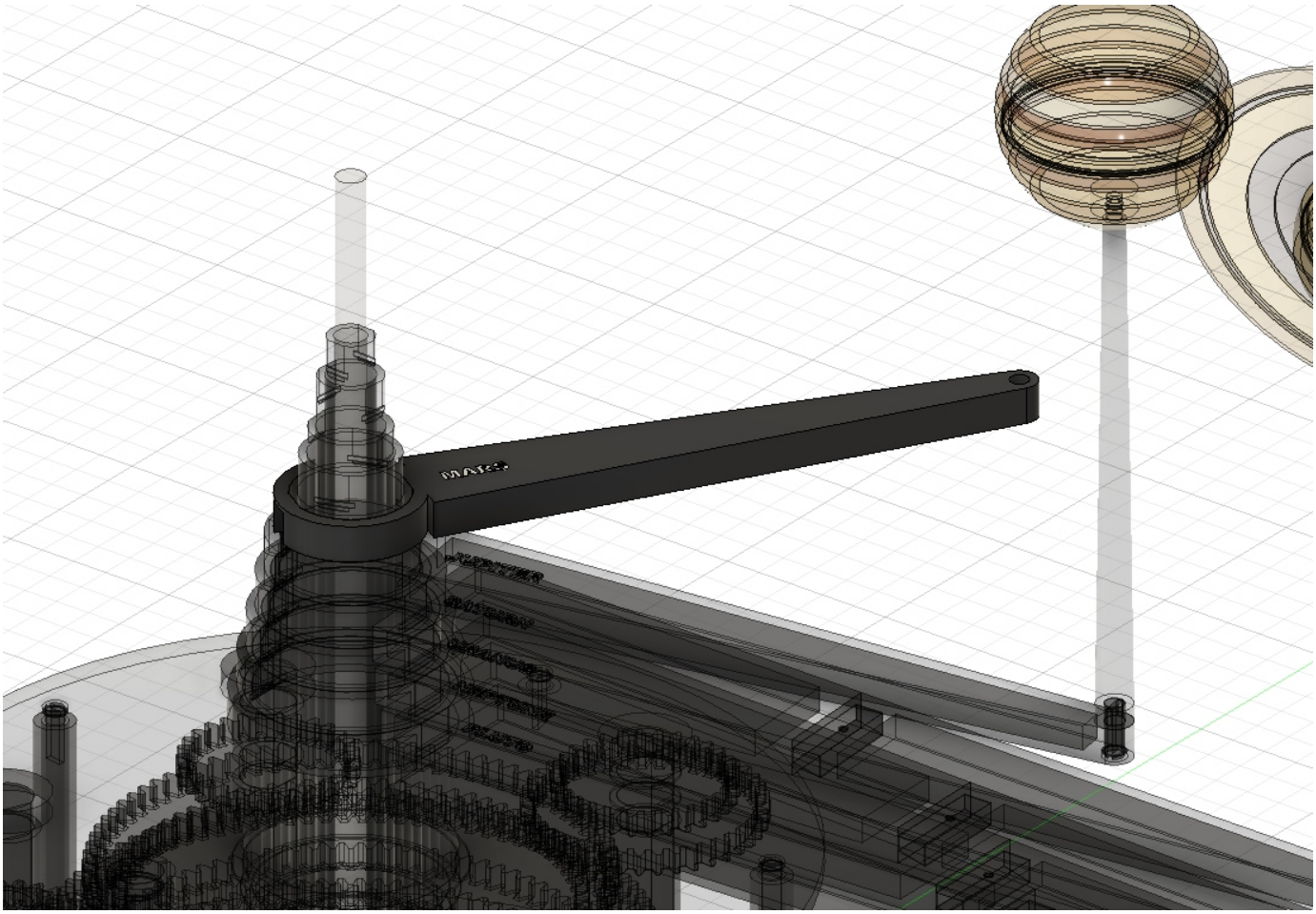


Snap in the post. Snap the two banded hemispheres together (Great Red Spot on the lower half) and press Jupiter onto the peg.

38 Mars arm



1x #69
Arm Mars



Slide the Mars collar down onto its tube flats until the latch clicks.

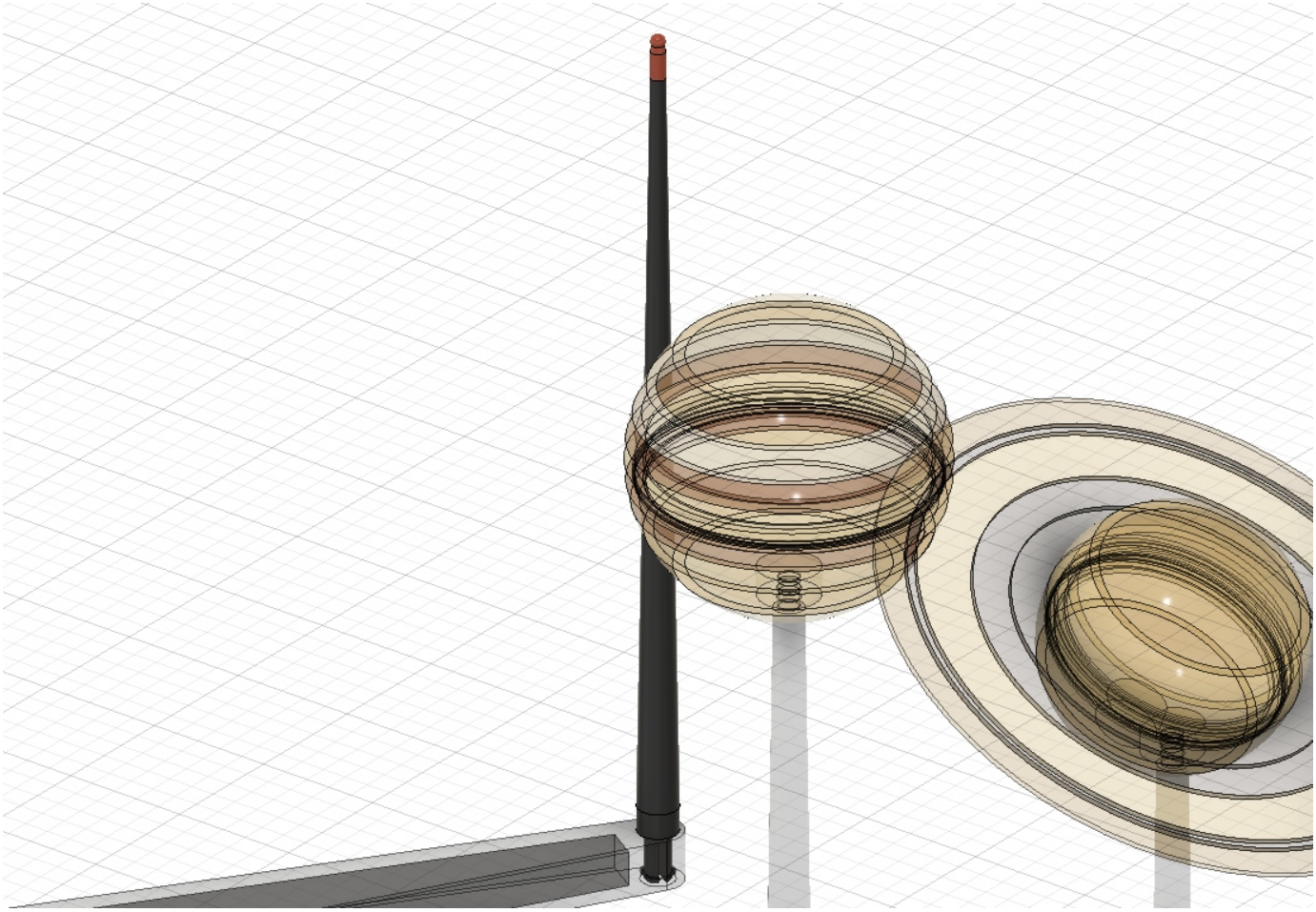
39 Mars post and body



1x #81
Post Mars



1x #91
MarsTip



Snap the Mars post into the arm tip (split pin clicks under the arm), then press the Mars on top.

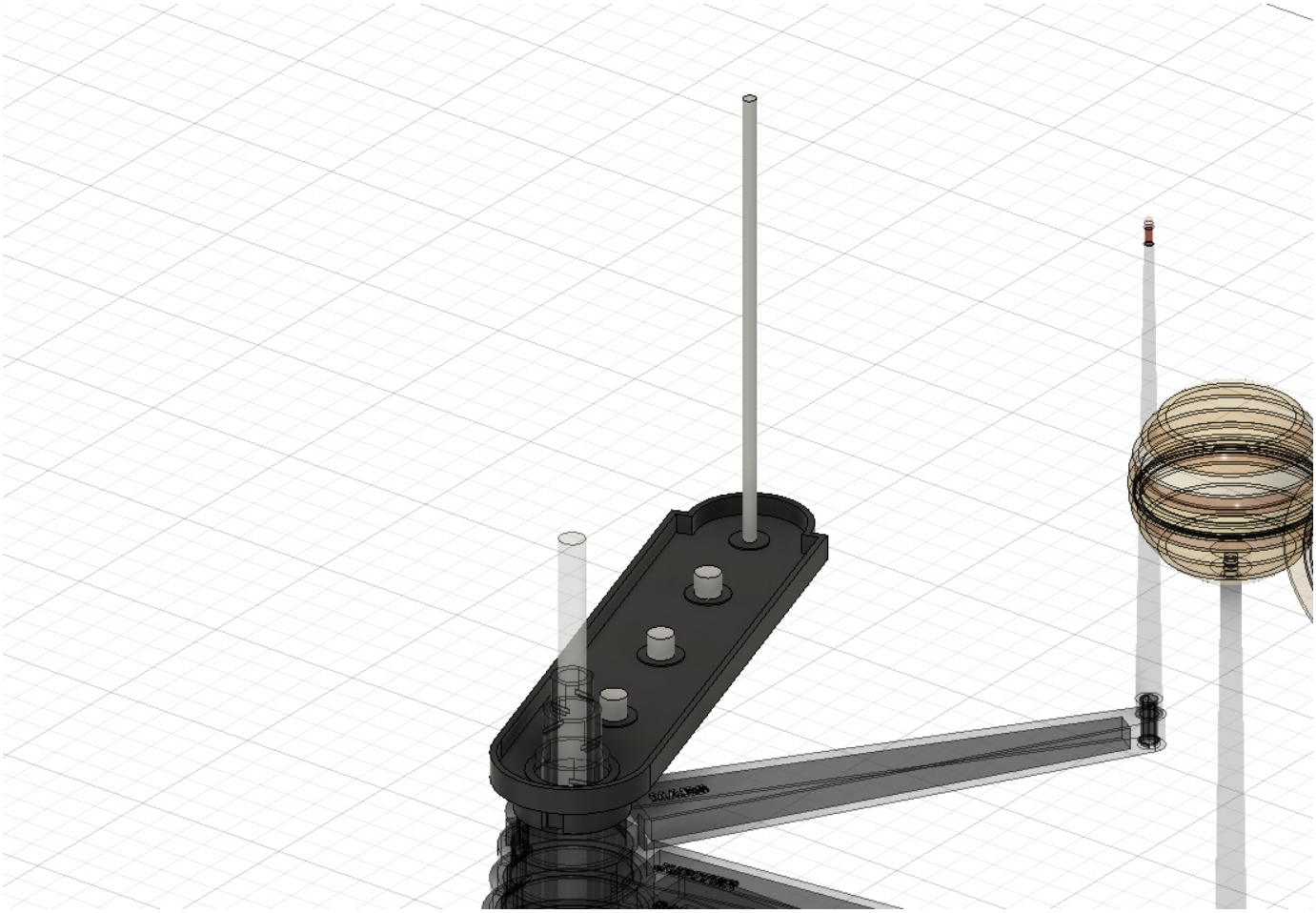
40 Earth arm



1x #54
EarthArm

1x
4 mm steel
rod x 155.5 mm

3x
8 mm steel
pin x 14.5 mm



Press the three 8 mm pins and the 4 mm Earth post into the Earth arm box. Slide the arm collar onto the Earth tube until the latch clicks.

41 Moon gear train



1x #51
Earth-arm idler EI



1x #52
Earth-arm idler EI



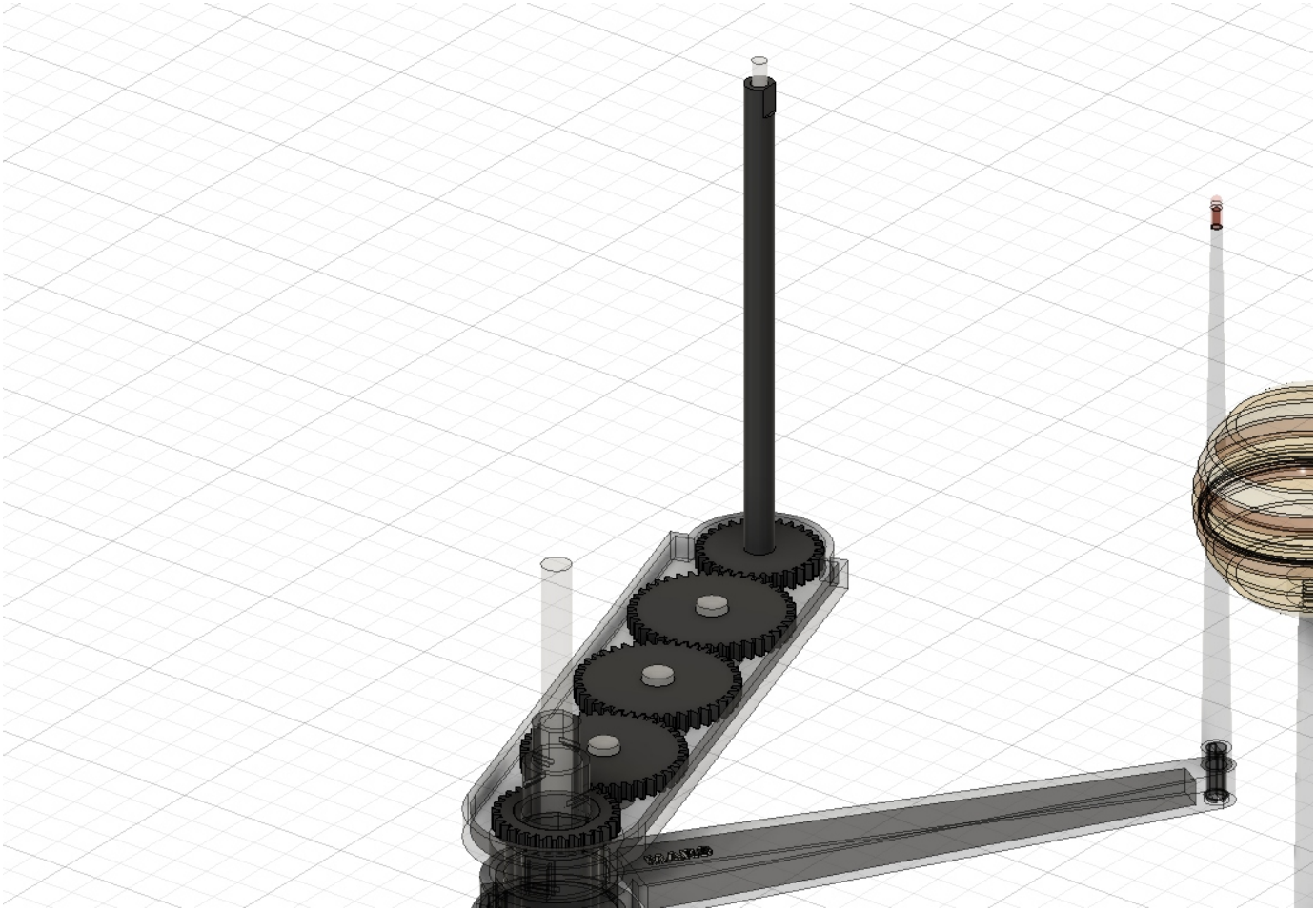
1x #53
Earth-arm idler EI



1x #56
MoonCentre 31T



1x #57
MoonGearSleeve

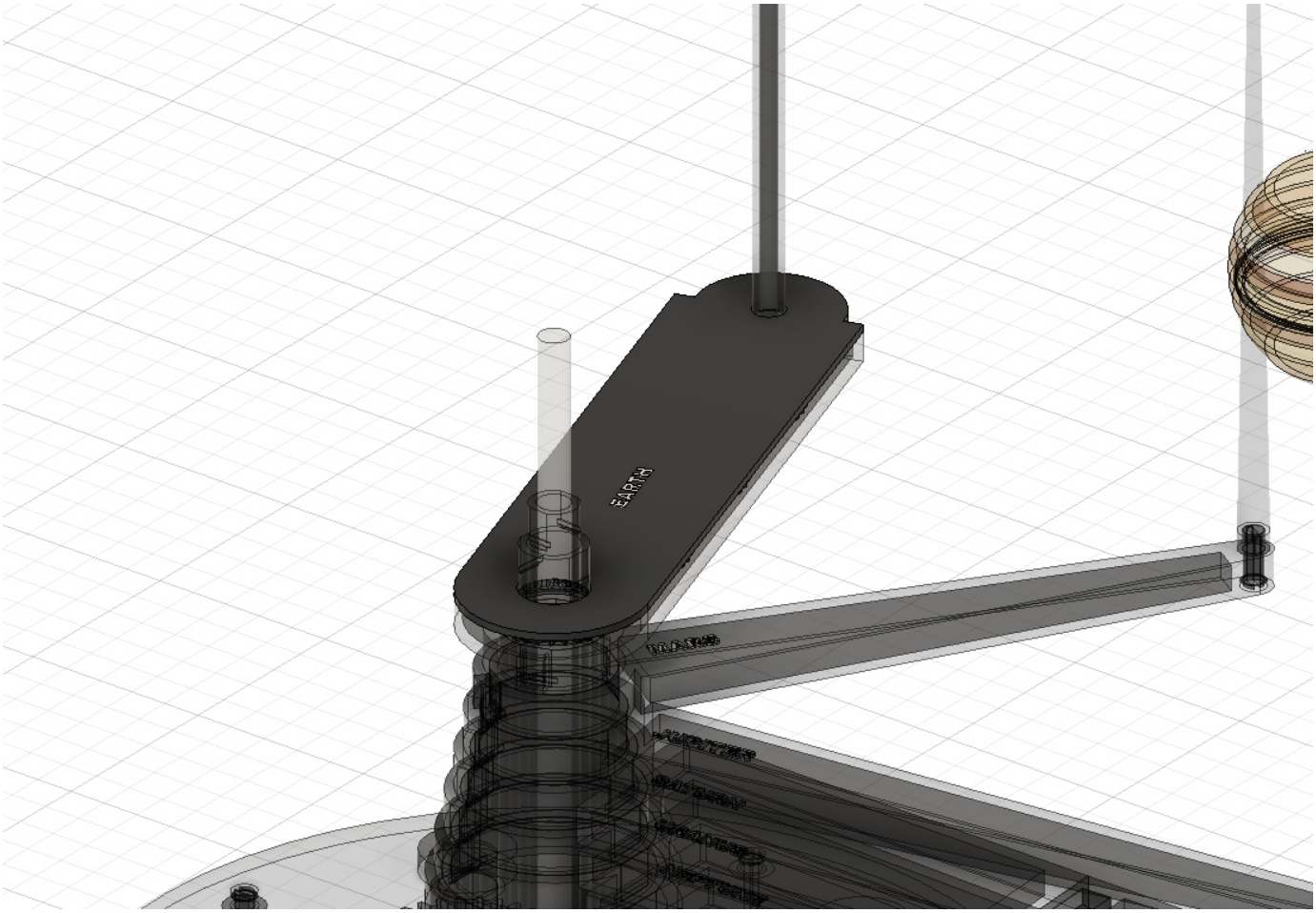


Push the 31T centre gear onto the Moon tube flats, drop the three 41T idlers onto their pins and slide the Moon gear sleeve over the Earth post.

42 Earth arm lid



1x #55
EarthArmLid

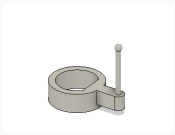


Press the box lid onto the three idler pins.

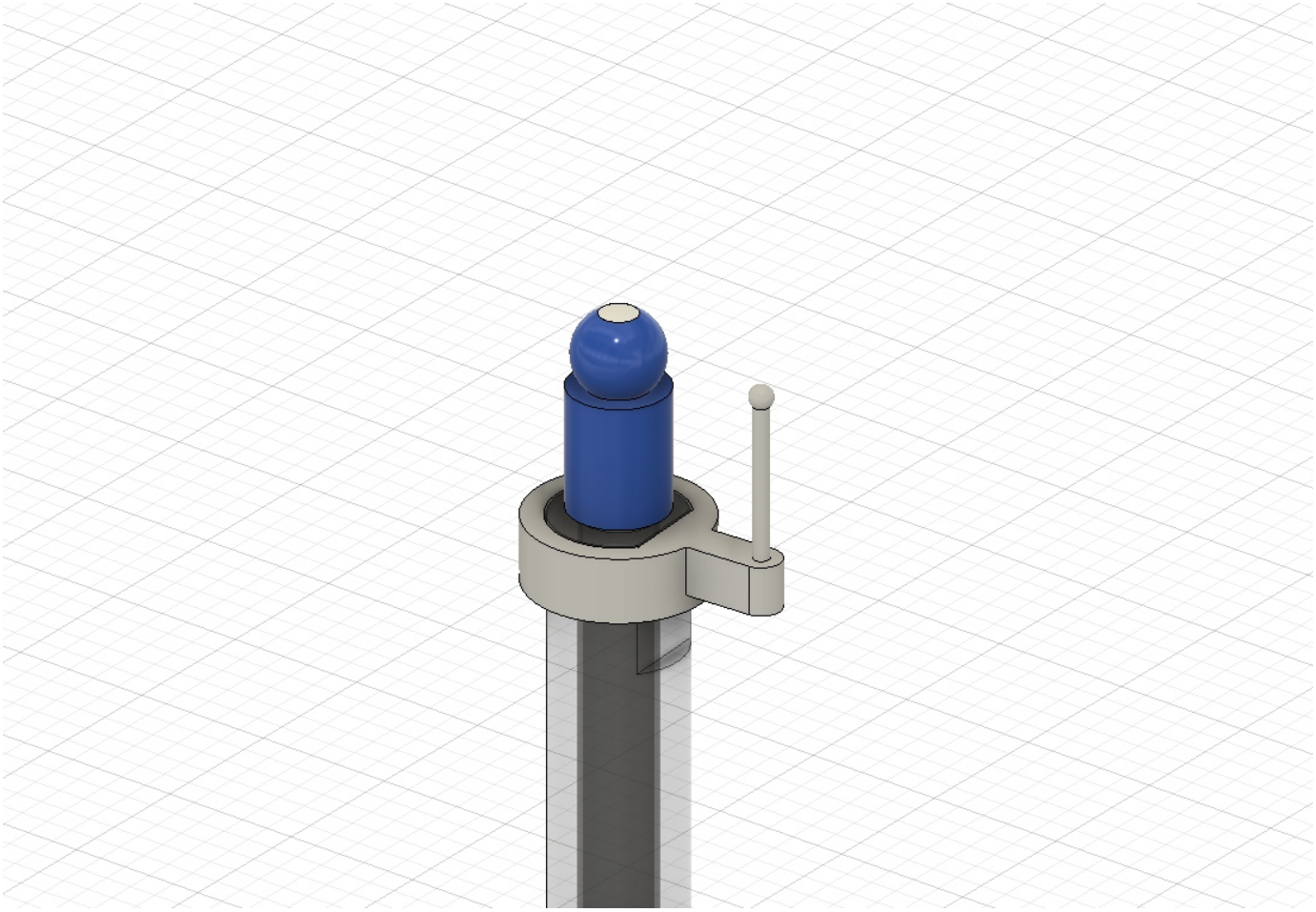
43 Earth and Moon



1x #88
EarthTip



1x #93
MoonArm

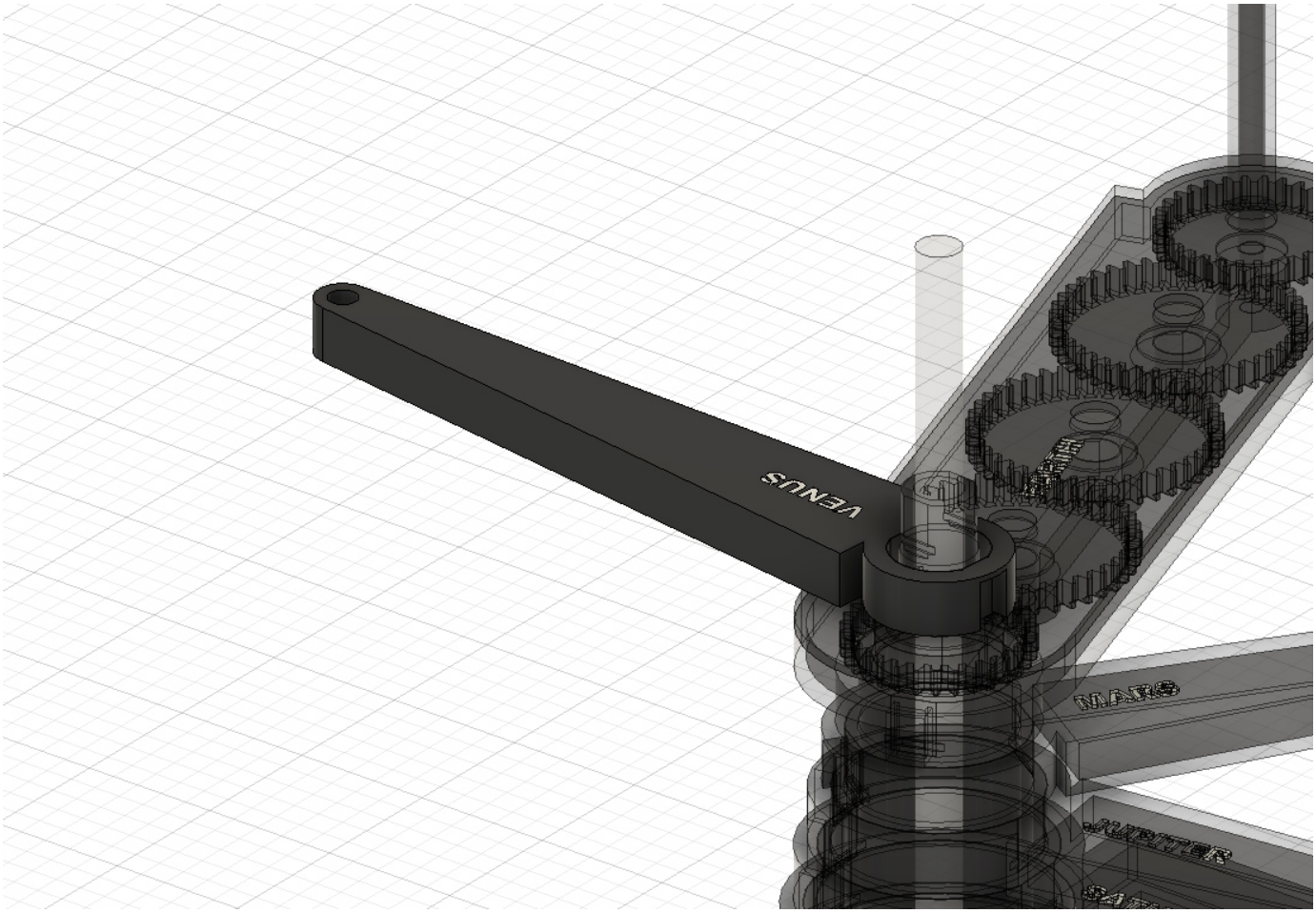


Press the Moon arm onto the D-flat at the top of the sleeve and the Earth onto the top of the post.

44 Venus arm



1x #79
Arm Venus



Slide the Venus collar down onto its tube flats until the latch clicks.

45 Venus post and body

1x #87
Post Venus



1x #102
VenusTip

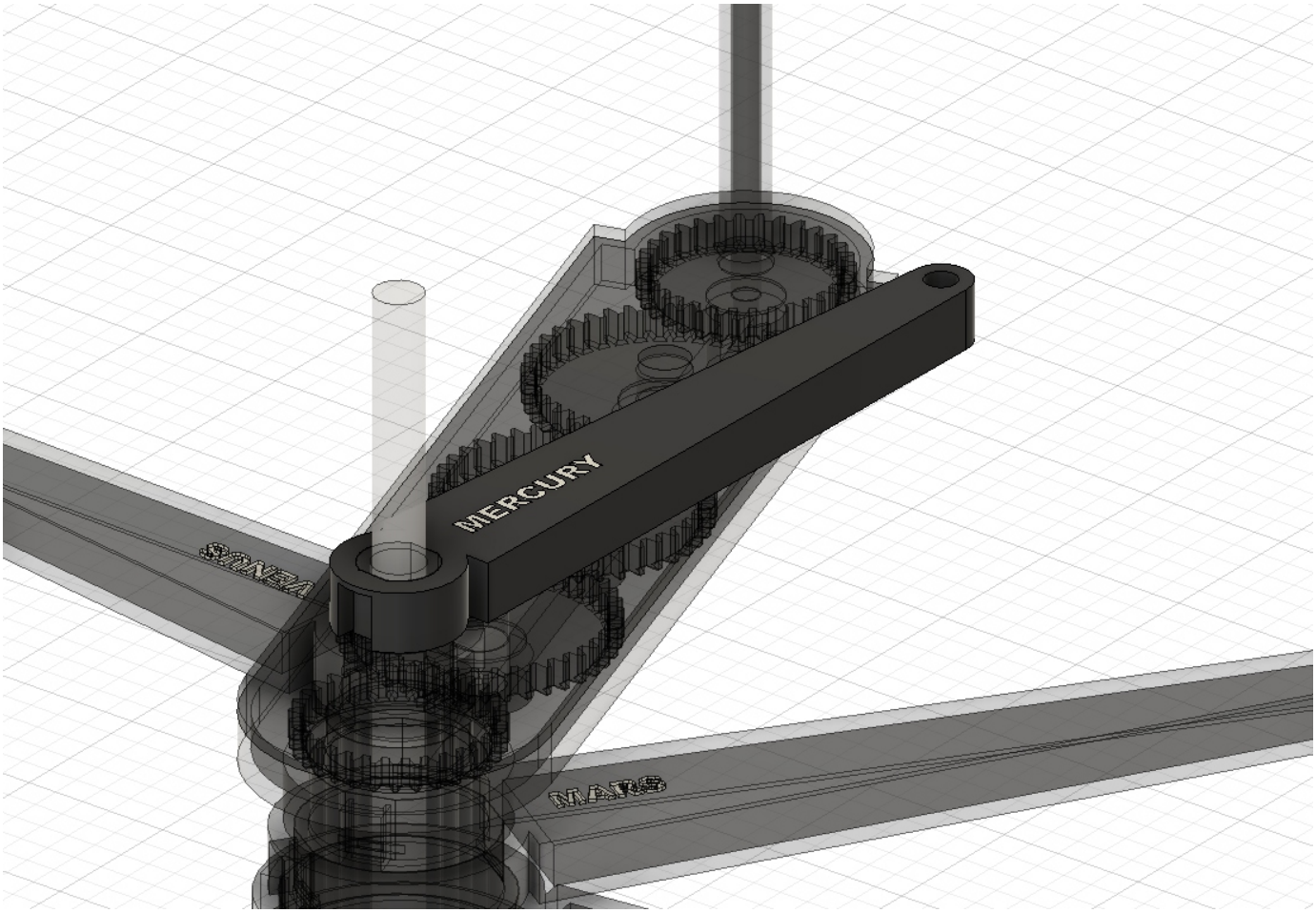


Snap the Venus post into the arm tip (split pin clicks under the arm), then press the Venus on top.

46 Mercury arm



1x #70
Arm Mercury



Slide the Mercury collar down onto its tube flats until the latch clicks.

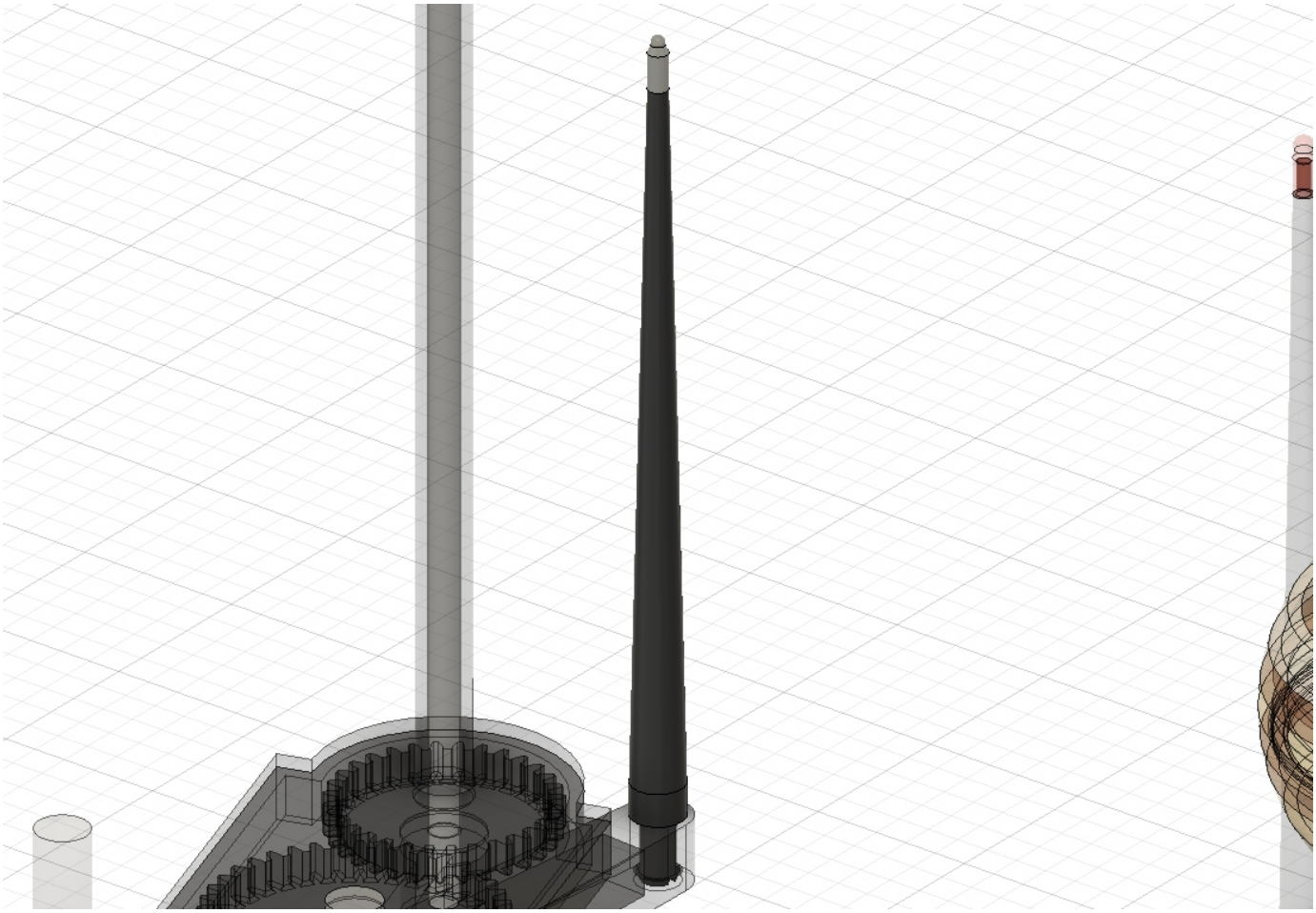
47 Mercury post and body



1x #82
Post Mercury



1x #92
MercuryTip

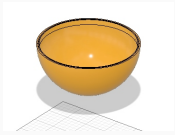


Snap the Mercury post into the arm tip (split pin clicks under the arm), then press the Mercury on top.

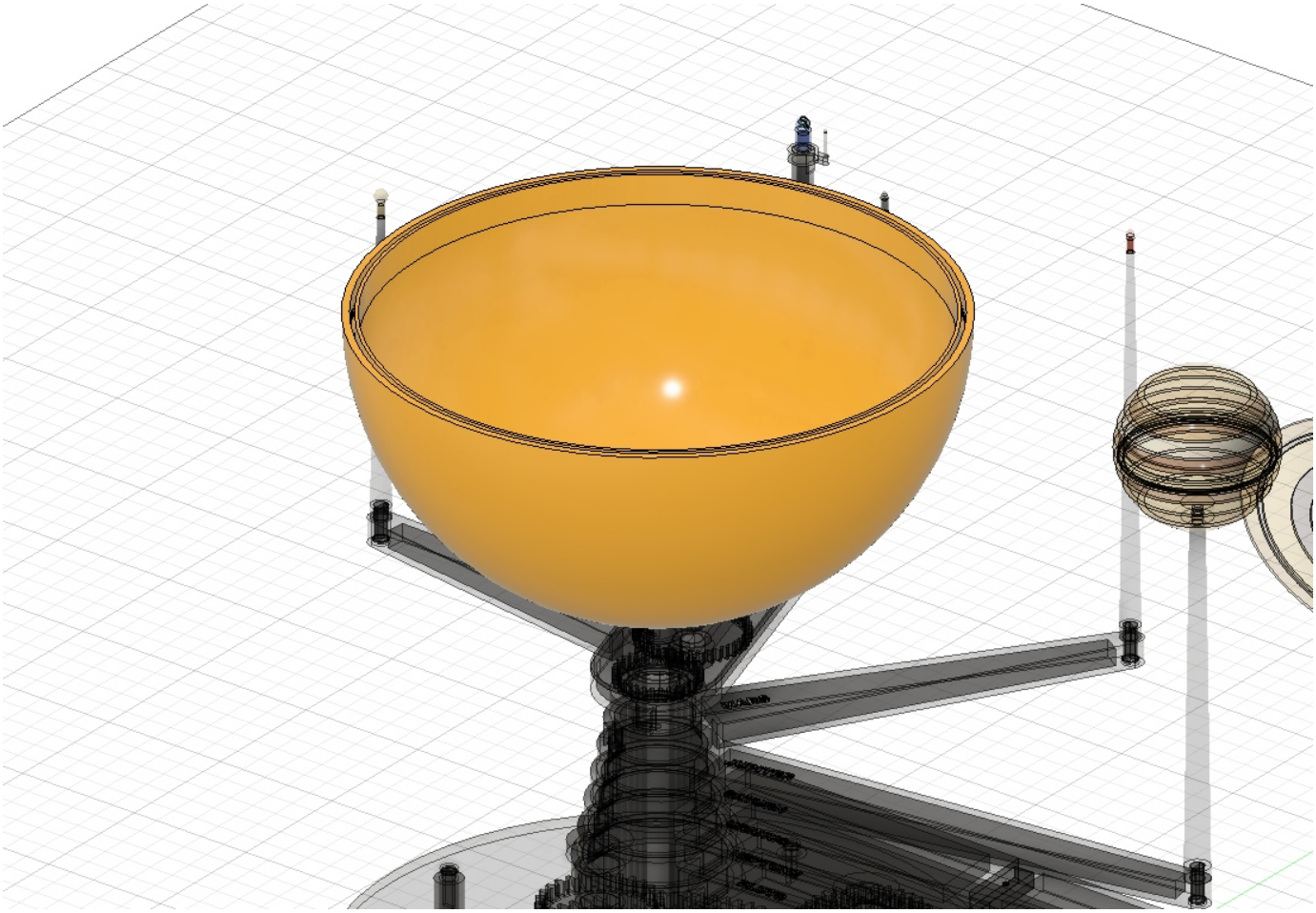
48 Sun hub



1x #103
Sun hub



1x #104
Sun lower

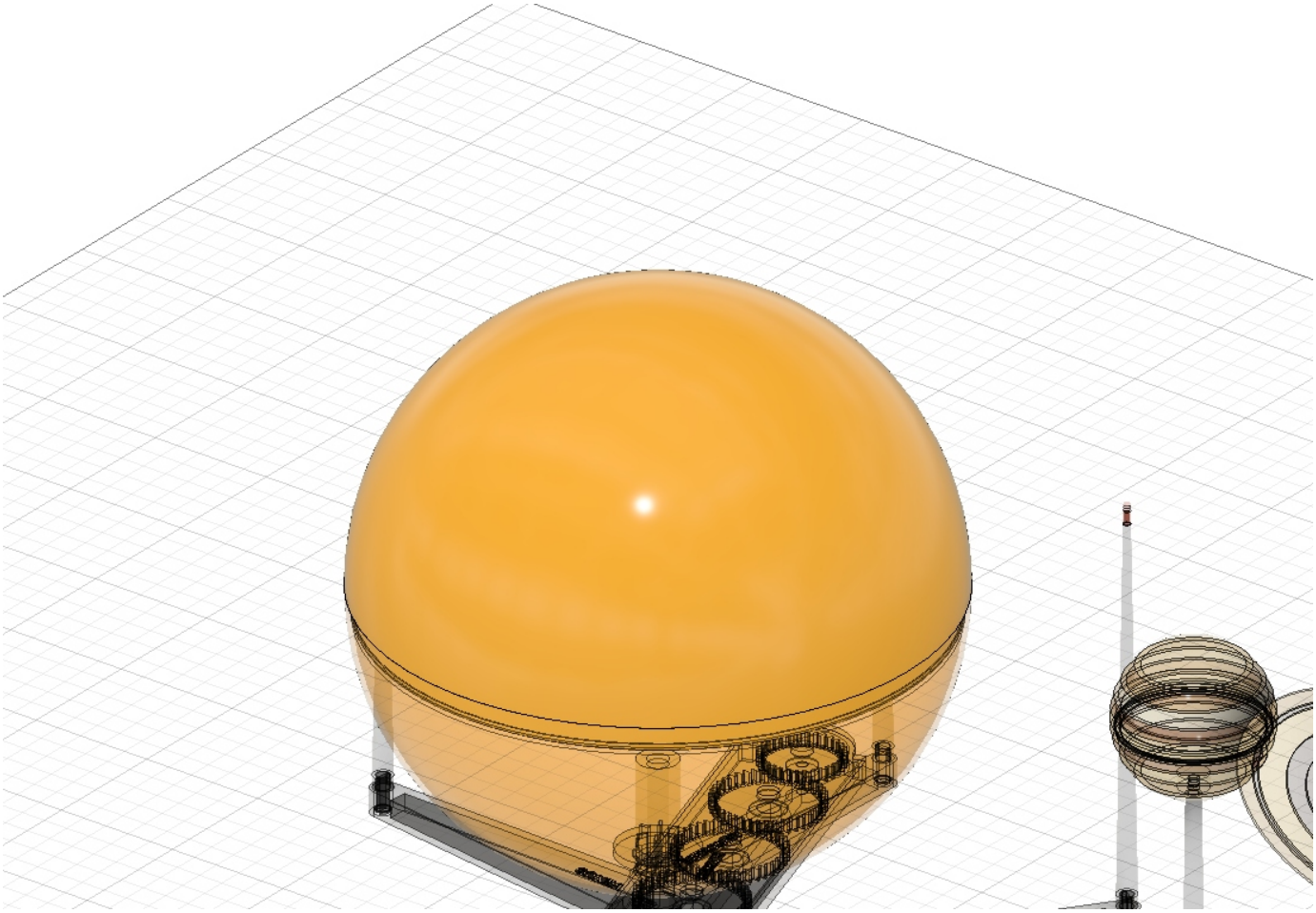


Push the hub up through the pole hole of the lower Sun hemisphere until its barb clicks, then press the lower hemisphere onto the top of the central rod. (Optional: drop an LED into the hollow Sun.)

49 Sun



1x #105
Sun upper



Snap the upper hemisphere onto the lower one.

DONE!

Turn the crank clockwise: one turn is one Earth year. Every planet orbits anticlockwise; the Moon laps the Earth 13.37 times a year.

