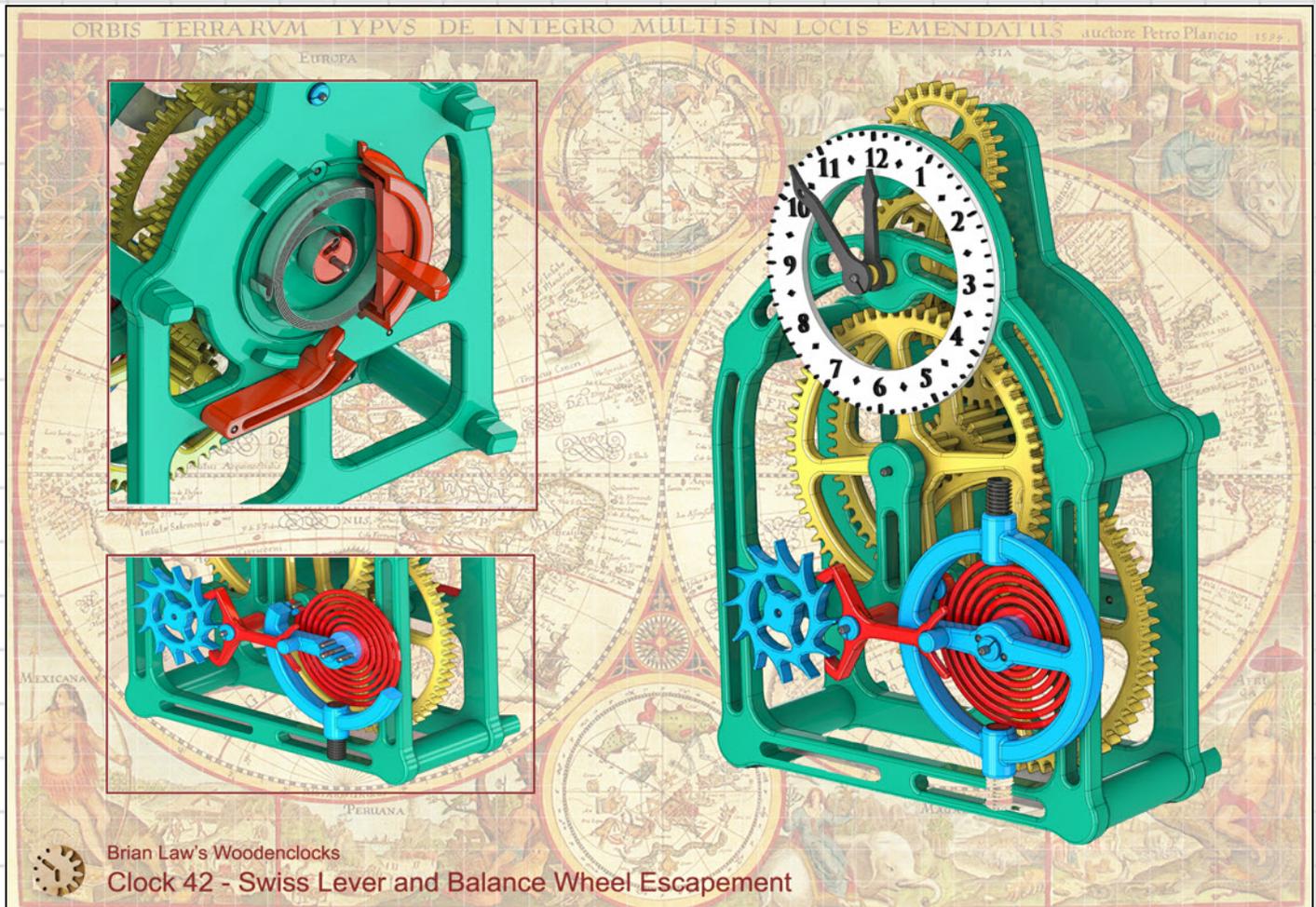


# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42



The basis for this latest clock development was the design of what I termed the Minute engine and the story of that engine can be found here

<https://brianlawswoodenclocks.blogspot.com/2020/09/a-design-for-minute-engine.html>

It lacked a dial and hands to read off the minutes and hours but it served the purpose of developing the escapement mechanism to be used. Unfortunately the Hair spring needed to drive the Balance wheel, I could not get to work when made from wood so in the end the clock finished up being designed for 3D printing only.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

### Equipment and Materials

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**3D Printer** - obviously

**Pedestal Drill** There are a lot of holes to be drilled and cleaned up after CNC machining and fabrication so the drill is pretty much essential. It may be possible to get away with an ordinary electric drill in a stand but a work holding vice is still necessary.

**Drill Bits** in the following sizes, Ø2mm, Ø1.9mm, Ø2.2mm, OR if you are working in inches No 49, No 47, No 45

### Consumables

Sand paper in various grades from rough to fine.

Acetone or Super glue

Dry Film Lubricant in a spray can for the gears after everything is finished.

### For all the Plastic Parts I used ABS

Mostly you will require one of each of the STL parts, but the following parts will require multiples listed below

End stop	5
Plastic Screw	4
Button Spacer-8	3

### For all the other parts

Ø2 mm Silver Steel 300 mm long

M6 bolts to be cut down to 20 mm long removing the head.

If you can't find the sizes I have used you can easily modify the design to suit what you can find. Note these are the minimum amounts of material necessary to build the clock I used more in the prototype and you may well be advised to buy extra to cover those accidental losses that occur. If I have missed anything here you will find them in the parts list for the clock anyway.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

### Hints and Tips

1 Silver steel is common tool steel that is supplied as a centreless ground round bar (with tolerances similar to that of drill rod). The name comes from the highly polished appearance of the rods. The American equivalent is tools steel or Drill Rod. Typical American supplier is [www.speedymetals.com/ps-3356-17-2532-rd-o-l-drill-rod.aspx](http://www.speedymetals.com/ps-3356-17-2532-rd-o-l-drill-rod.aspx). The nearest equivalent to the Ø2 mm used for this project is Ø 5/64".

2 To enable you to modify the models I have supplied IGS or STP files for all of the parts which should be easier to modify than the original STL. See this web page for a list of suitable CAD programs, several of which are free <http://alternativeto.net/software/freecad/>

3 I used ABS throughout for this model and it has worked well, I won't try to advice on the settings for your printers as I only have experience of the Zortrax printer, and I am sure you are more experienced at this than I am.

4 To bond together the plastic parts together I use a liquid solvent adhesive applied with a syringe like applicator or if necessary a small brush, this latter can be a bit messy.

5 When the clock is first assembled, screw the two threaded weights into the top and bottom positions of the balance wheel so that the screws are just level with the inside face of the wheel. This should give you a good position to start fine adjustment. Scew in to speed up and Visa Versa.

6 I have sized the parts mainly so that the small holes come out under size to allow you to drill out the part to get the correct fit. You are going to need tight and loose fits at different points in the assembly so you will need to have Ø1.9 mm Ø2 mm and Ø2.2 mm drills.

Drill size	Diameter (in)	Diameter (mm)
#49	0.0730	1.8542
1.9 mm	0.0748	1.9000
#48	0.0760	1.9304
5/64 in	0.0781	1.9844
#47	0.0785	1.9939
2 mm	0.0787	2.0000
#46	0.0810	2.0574
#45	0.0820	2.0828
2.1 mm	0.0827	2.1000
#44	0.0860	2.1844

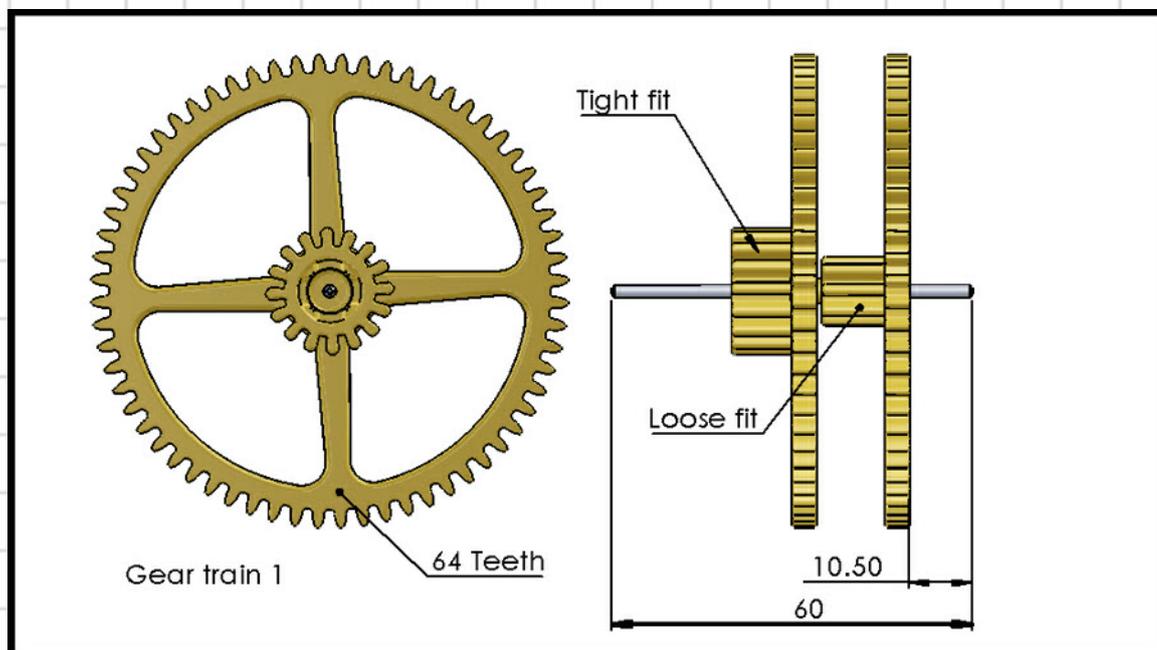
7 The gears should be positioned on the shafts so they line up with the mating gears, the dimensions given on the instructions should be used as a starting point to achieve this.

8 Clean up all the gears to make sure they are burr and swarf free. All the gears should run absolutely smoothly when assembled into the frames, check by slowly turning the first driving gear and feel for any restrictions, if you find one track it down and remove them with sharp knife blade, and continue till the all run freely. If the clock keeps stopping in the same place or places, then there is still a restriction in there somewhere, as a last resort assemble the clock without the Escape wheel in place, wind up fully and then let it run, repeat several times and the retry running fully assembled, it will then hopefully work.

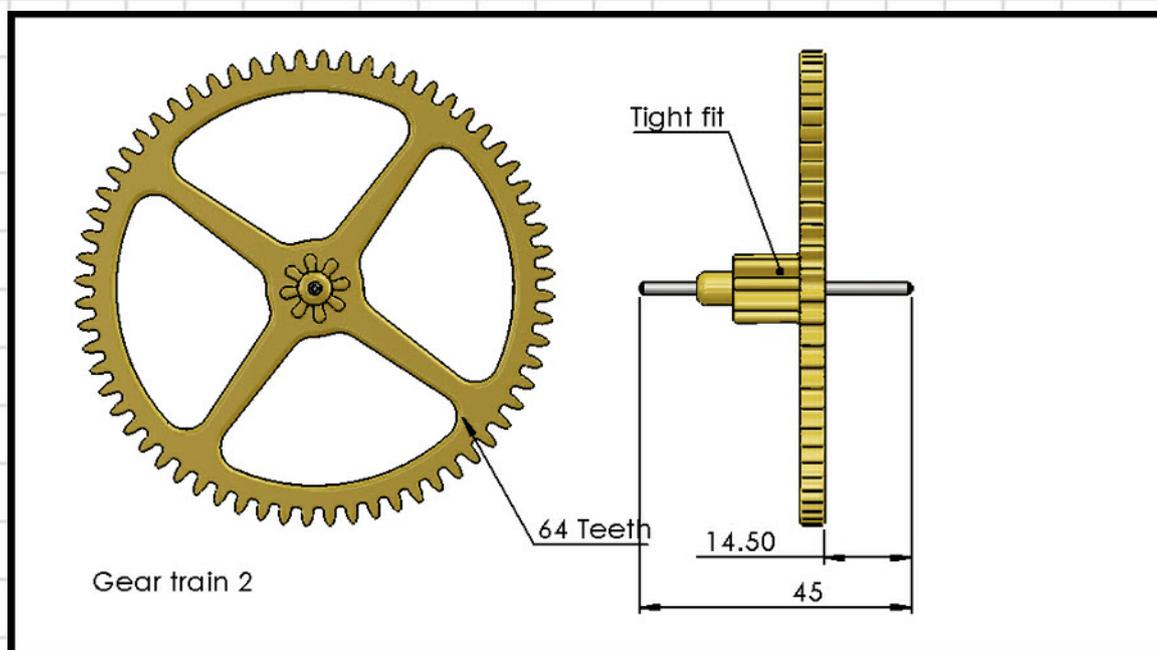
# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

Step 1 Assemble the Gears onto their shafts for each Geartrain



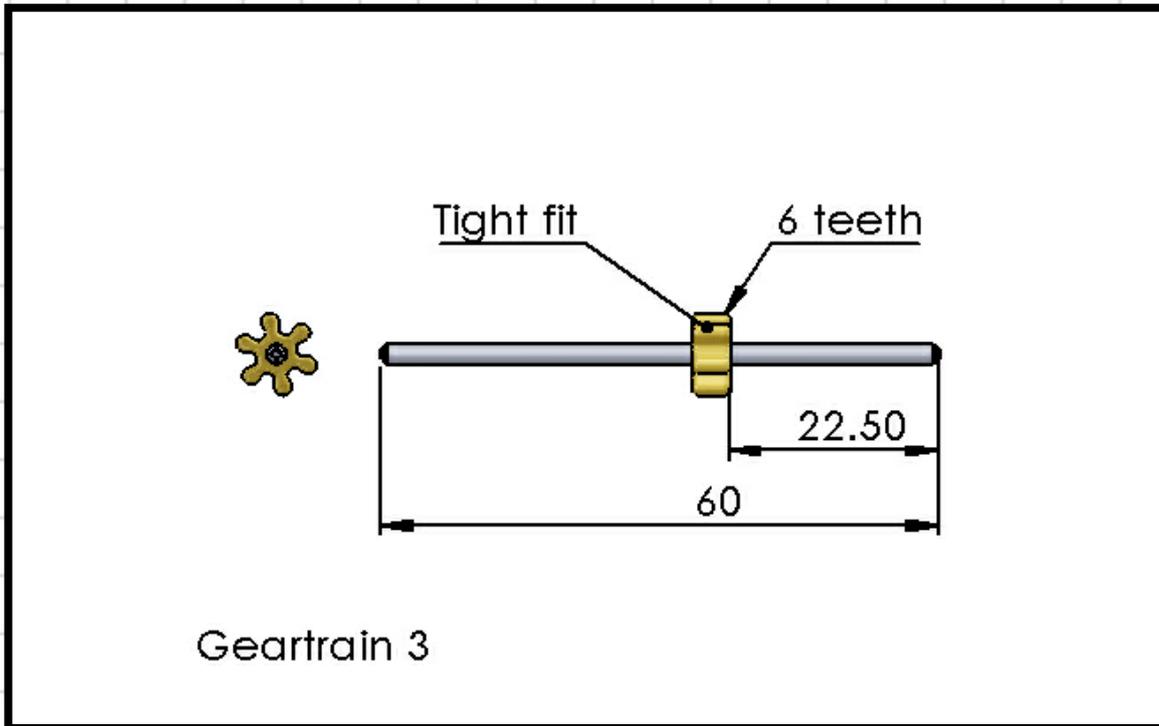
Geartrain 1 shown above will be split when actually fitted to the back frame at the next step with the loose fitting gear being initially slid off the shaft so that the next gear down it the train can be fitted more easily



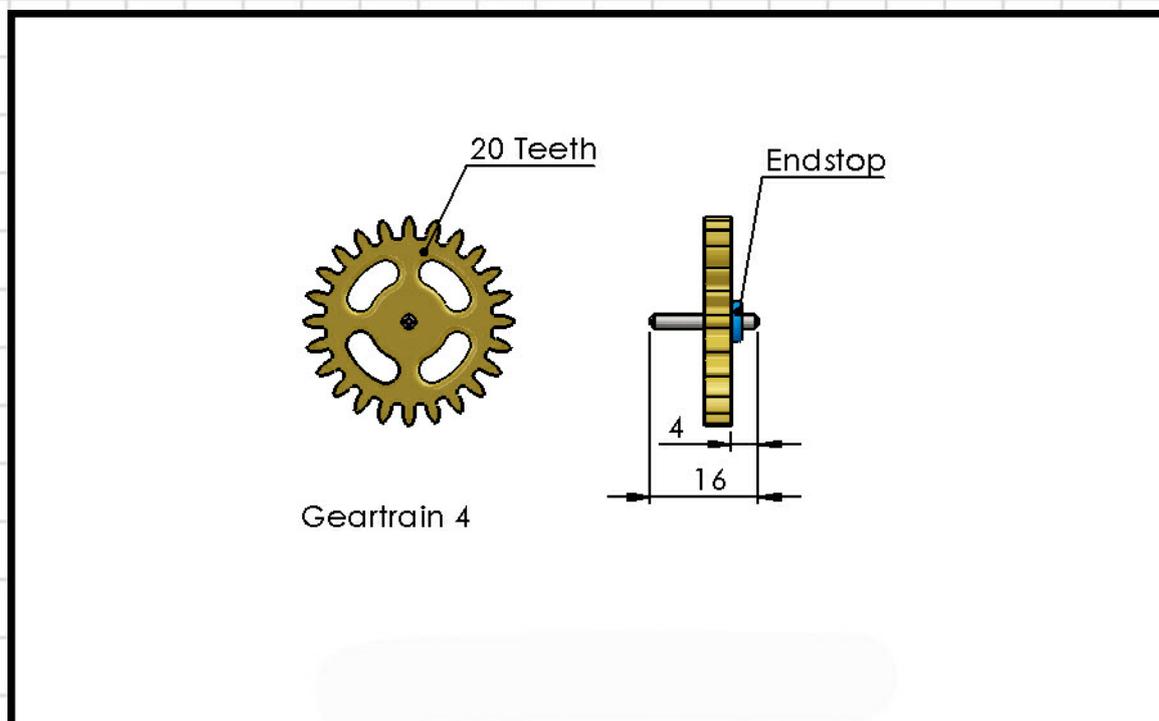
Geartrain 2 is printed in one piece and is a tight fit on the  $\varnothing 2$  mm shaft.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42



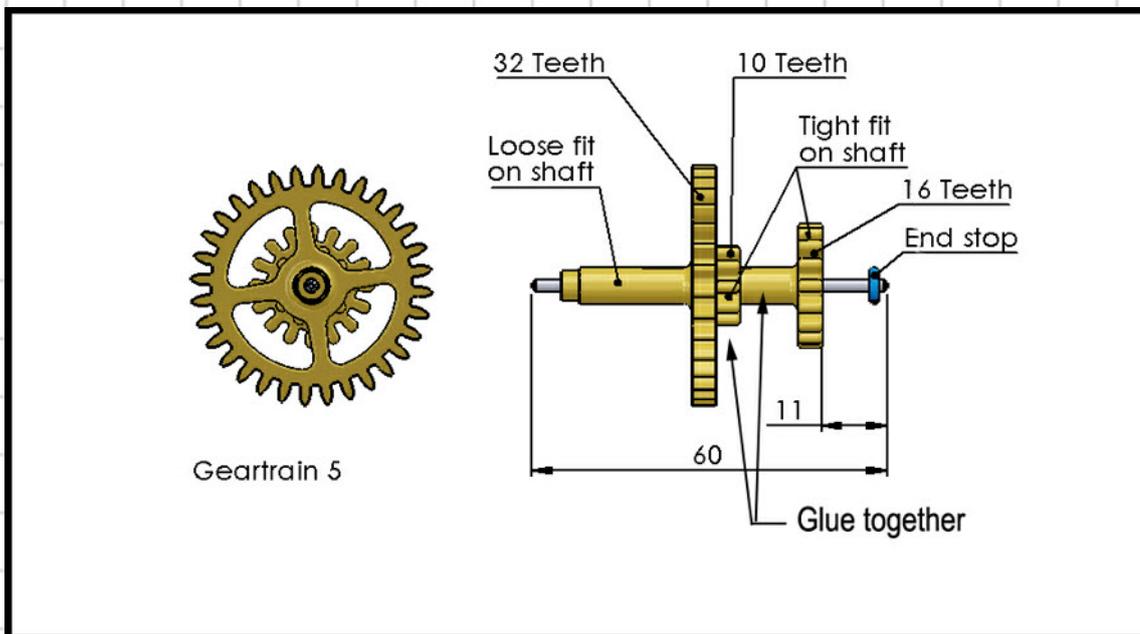
Geartrain 3 requires the gear to be a tight fit onto the shaft



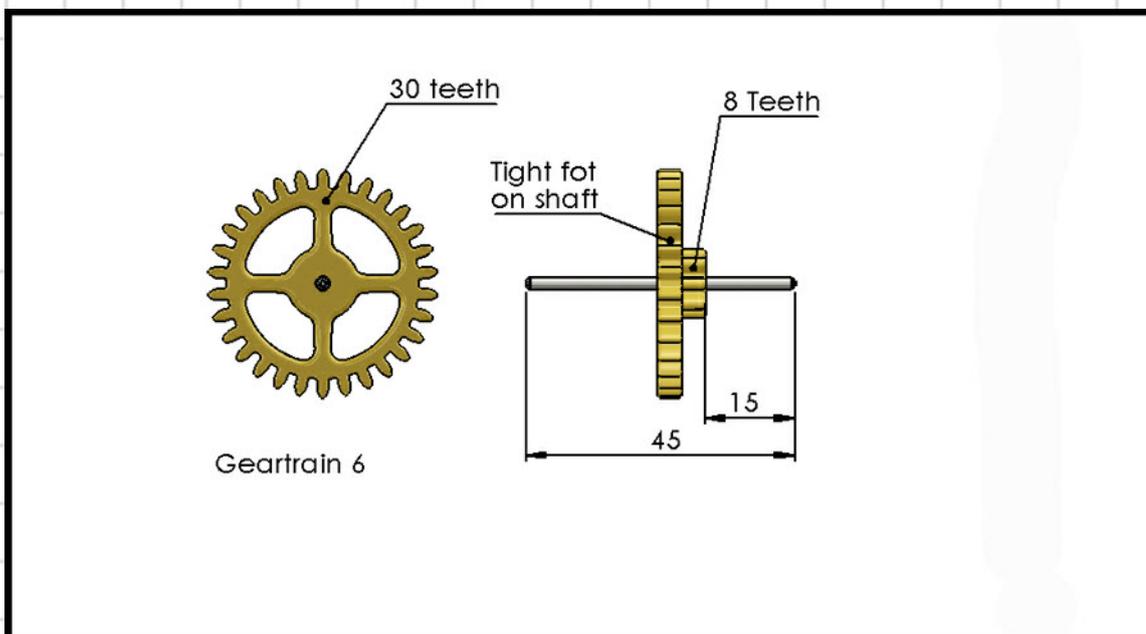
Geartrain 4 the 20 tooth gear is a loose fit on the shaft and so requires the endstop to be fitted to prevent the gear coming off.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42



Geartrain 5 shown above will be split when actually fitted to the back frame at the next step with the loose fitting gear being initially slid off the shaft so that the next gear down it the train can be fitted more easily. The Endstop is added to the end of the shaft outside the Back Frame to stop the assembly sliding forward.

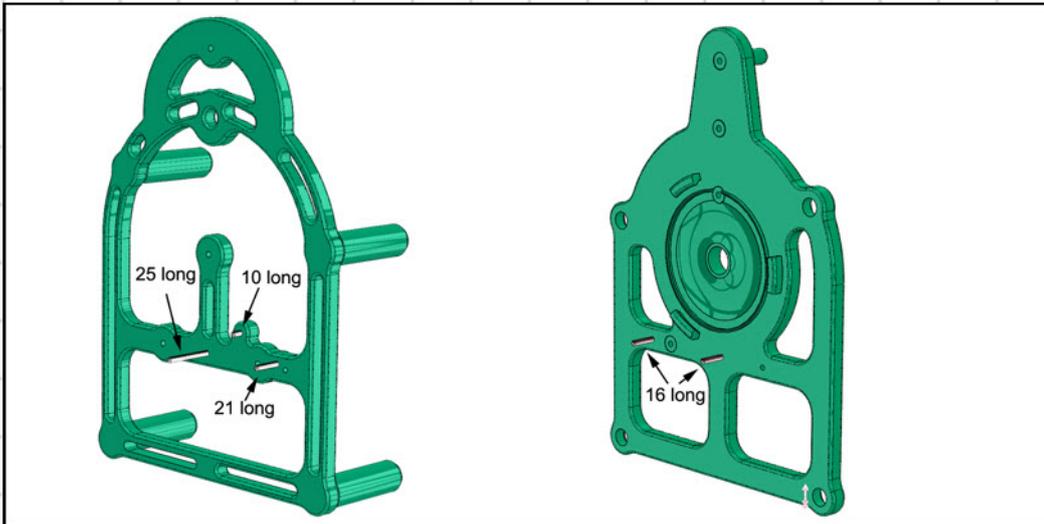


Geartrain 6 a tight fit on the shaft .

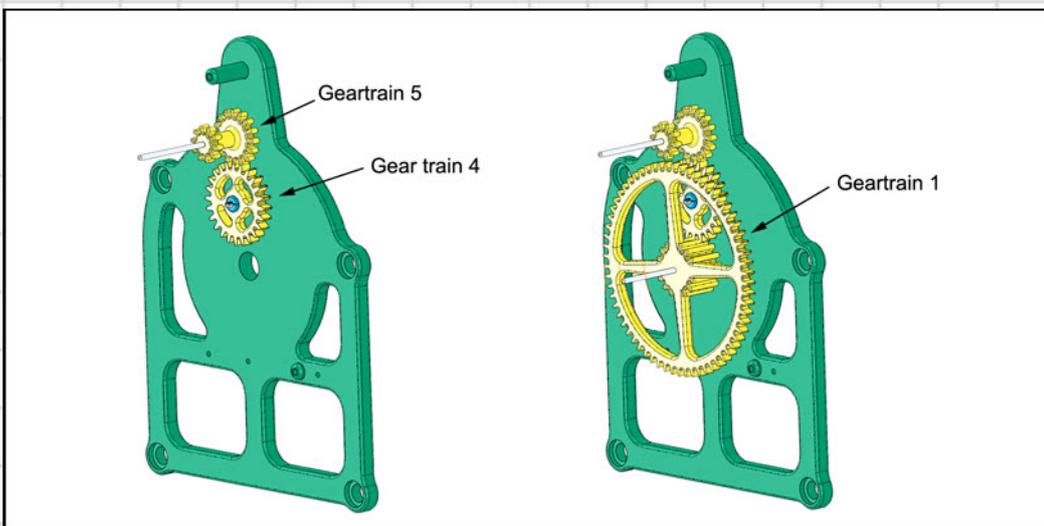
# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

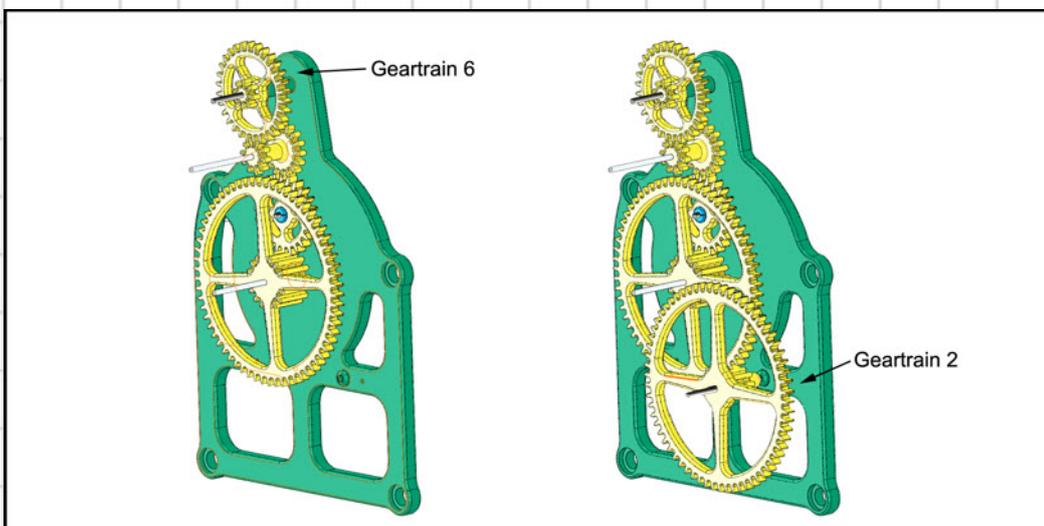
### Step 2 Preparation of the Frames and fitting the Geartrain assemblies



First step is to fit the pins shown into the front and Back Frames, these will need to be a tight fit and in the case of the shortest 10 mm pin it is important that it protrudes no more than 4 mm otherwise it will interfere with the movement of the Hair spring.



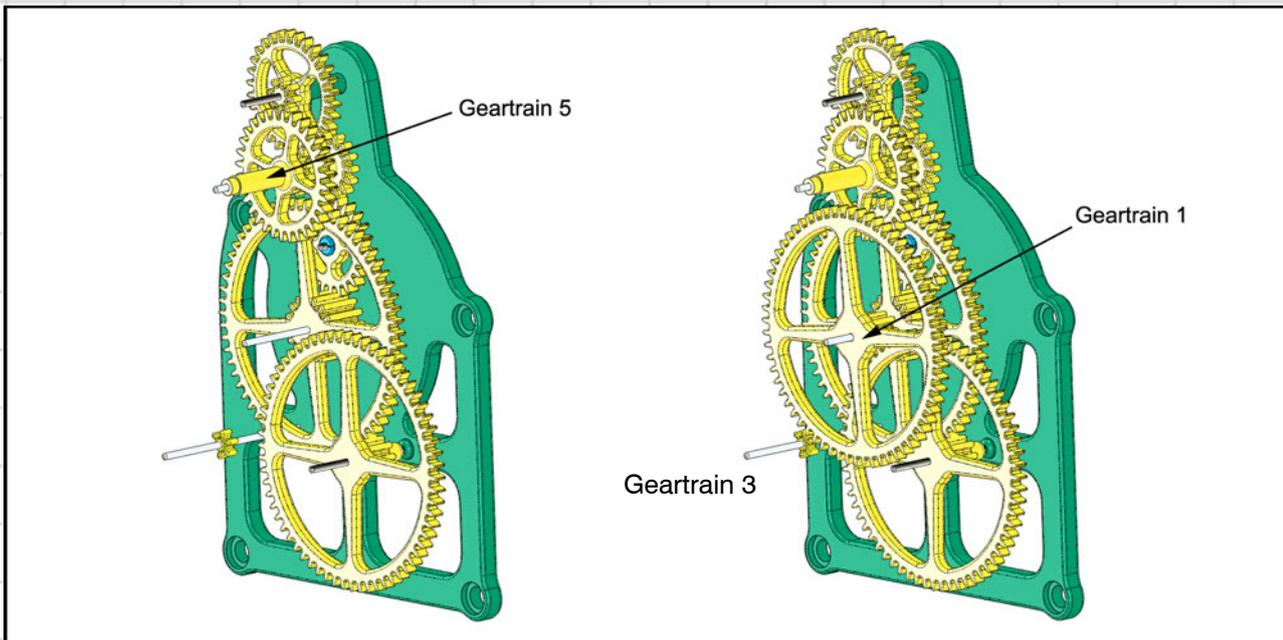
Place the rear part of Geartrain 5 as shown opposite and then press the shaft of Geartrain 4 into the Back Frame making sure that it can rotate freely. Then fit the rear gear of Geartrain 1 into position



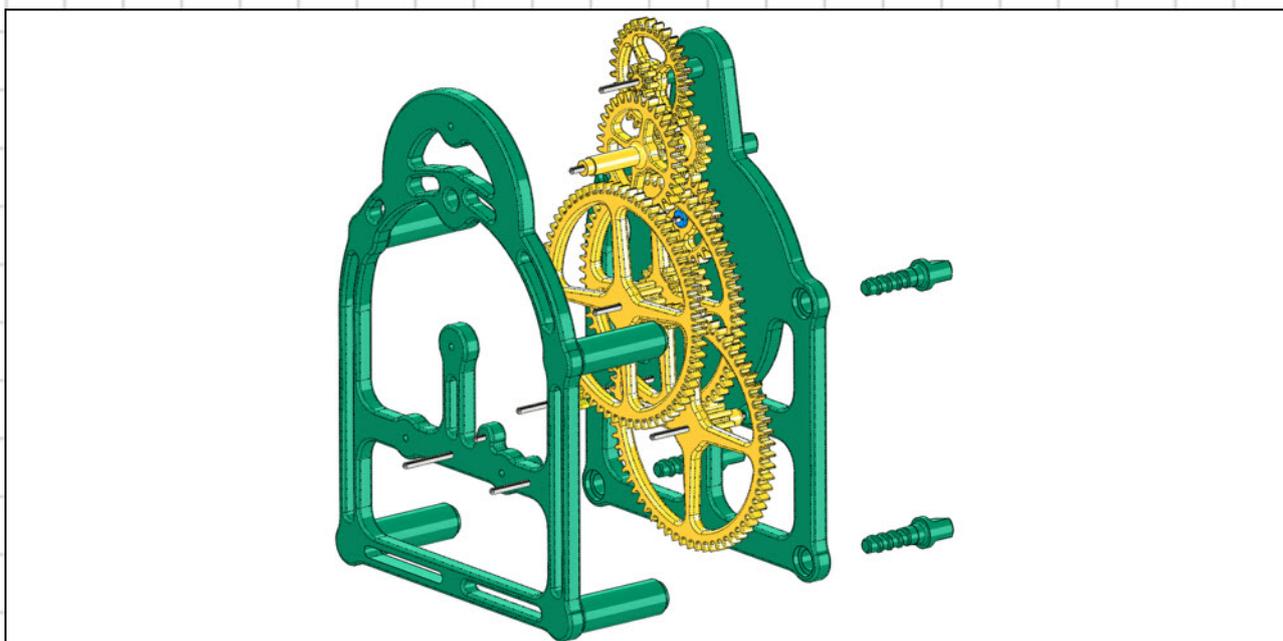
Now fit Geartrain 6 into the topmost position and Geartrain 2 into the lowest position

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42



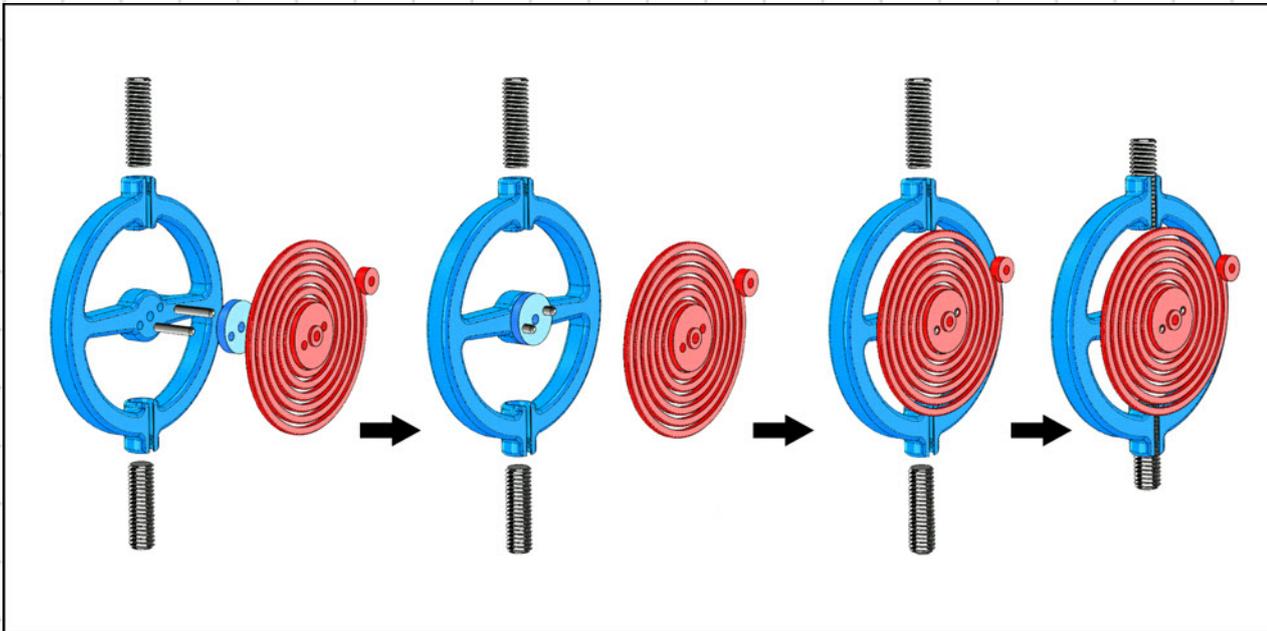
Now fit the front gears to Geartrains 1, 3 and 5 , that's the last parts to be assembled inside the Frames so now we come to the really tricky bit where you have to offer up the Front frame to engage each of the Geartrain shafts and the bosses protruding from the front frame, goof luck with that but once its done use the 4 plastic screws to secure the assembly together. Do not tighten the plastic screws too much as they have a tendency to break if you do.



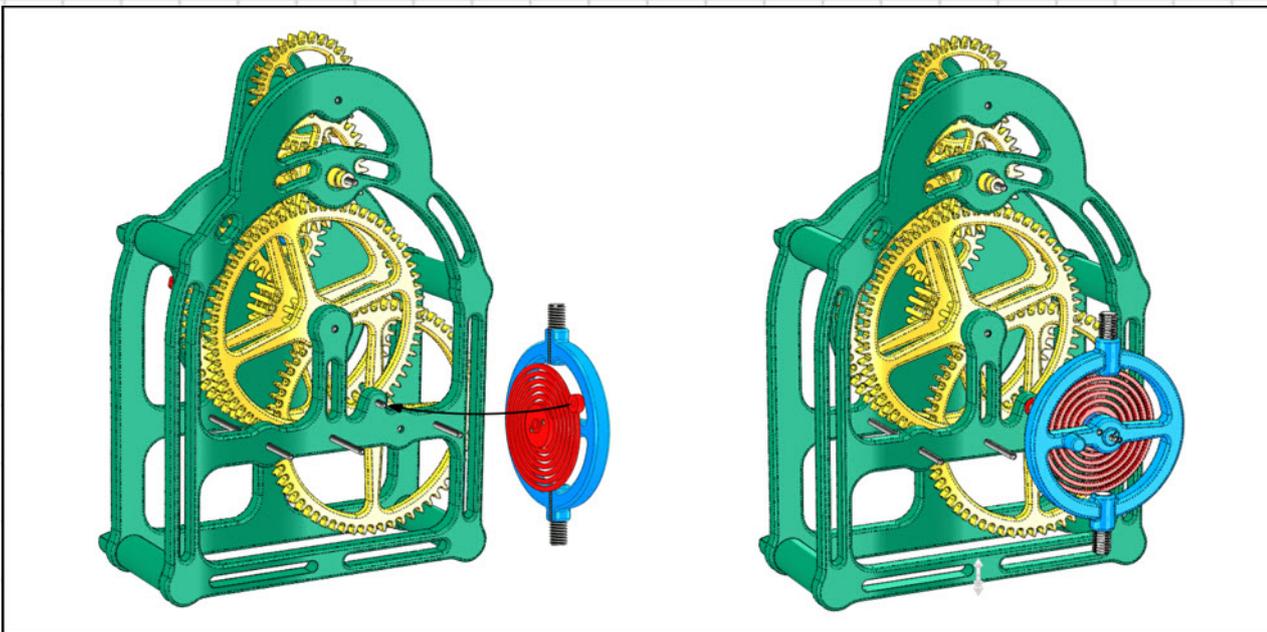
# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

### Step 3 Fitting the Escapement and the Drive



Next step then is to assemble the Balance wheel with its Hair spring, I call it a hair spring because that's how you would identify it in a watch, but here it is a carefully printed ABS part printed solid so that it has some consistency. It is mounted onto the inside of the Balance wheel using 2 pins and a spacer piece. The two threaded rods are fitted equally top and bottom by screwing into position so that the leading edge of the screw is flush with the inside of the ring. This should give you a reasonably accurate setting. To adjust the clock to speed it up screw in further and to slow it down unscrew.

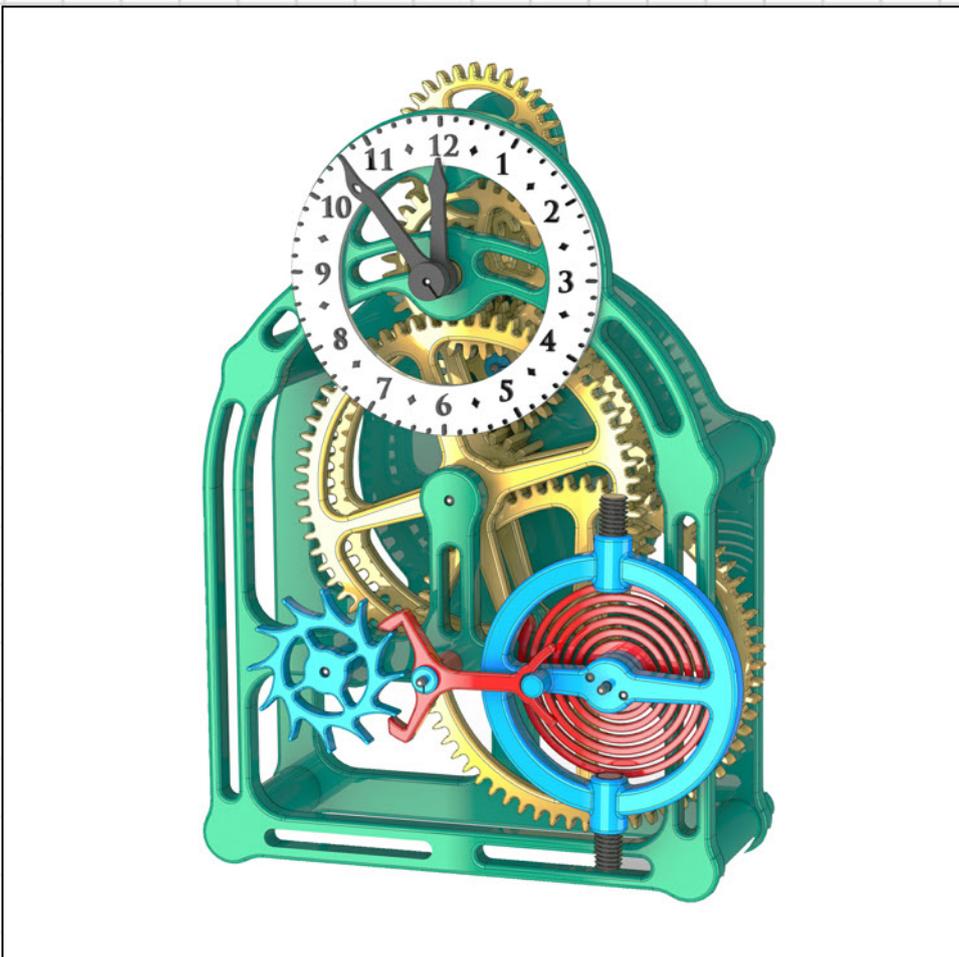
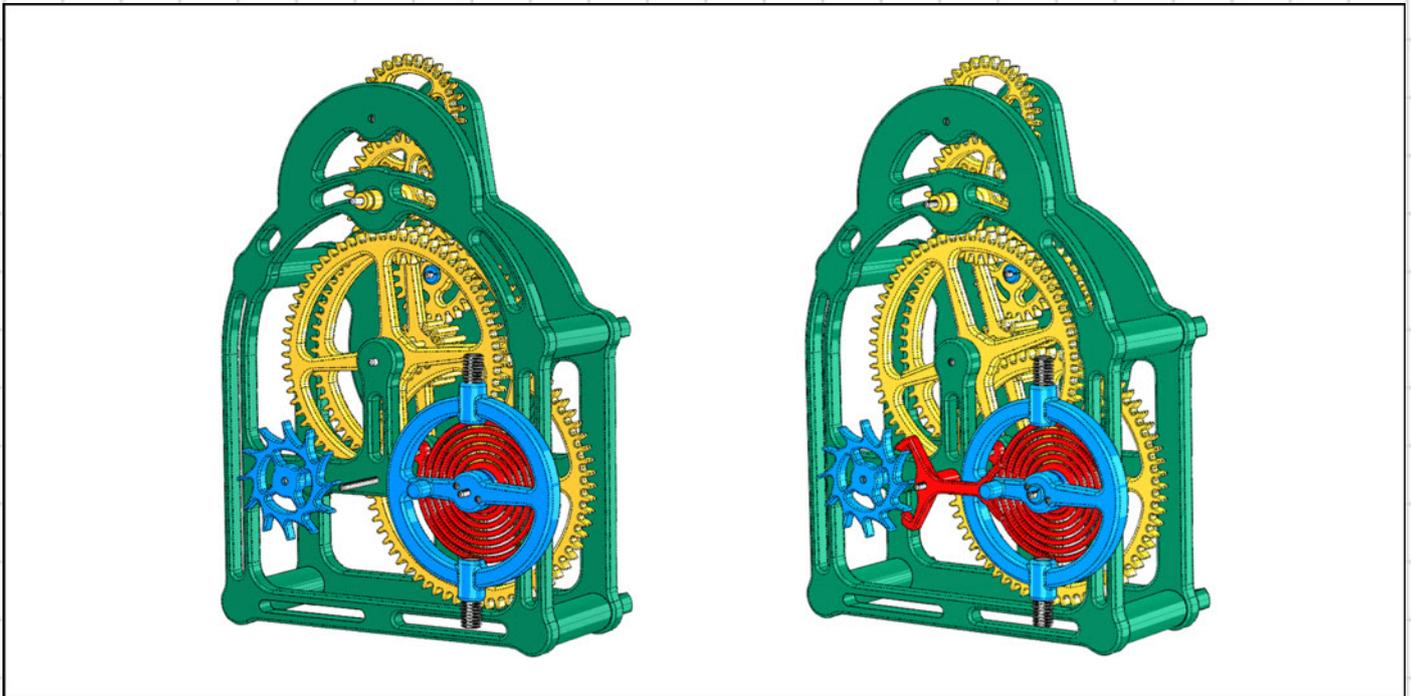


Now fit the Balance wheel onto the end pin, and the loop at the end of the hair spring over the pin shown above, and then fit an Endstop over the Balance wheel pin to hold it in place.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

### Step 4 Fitting the Escapement parts



The Escape wheel is the next to be fitted to the end of the Geartrain 3 and then the Lever between the Balance wheel and the Escape wheel, secured with an Endstop.

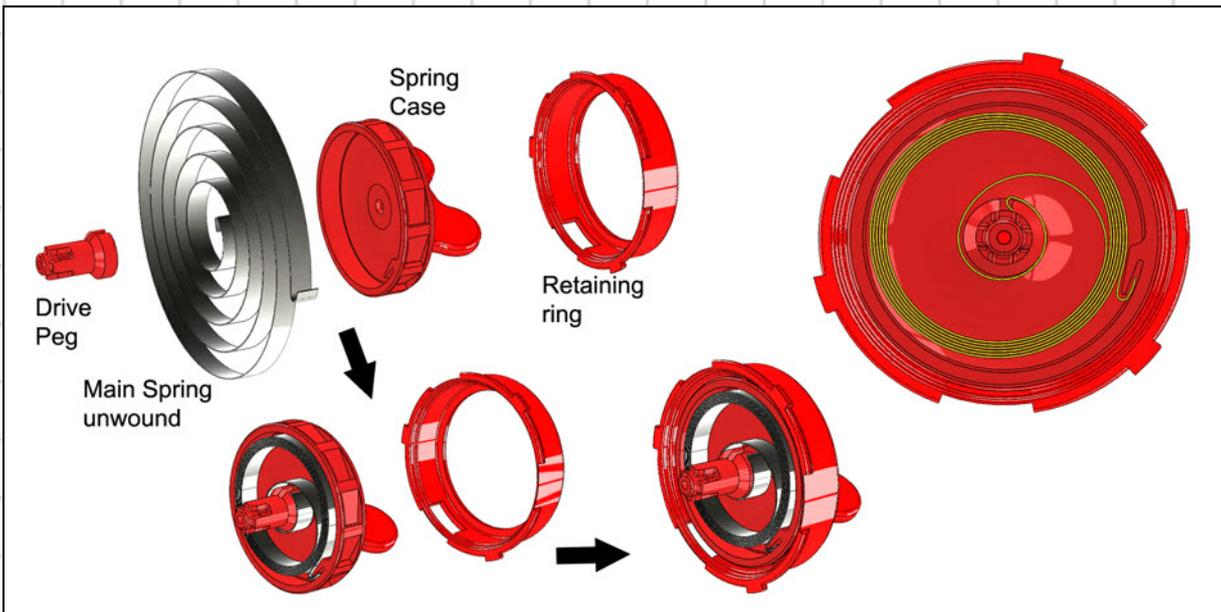
Finally to finish of at the front of the clock glue the Dial to the Front frame and fit the Hands.

If you can not 3D print the dial, I have included a PDF file of the dial numerals that can be cut out and stuck to a blank version of the dial.

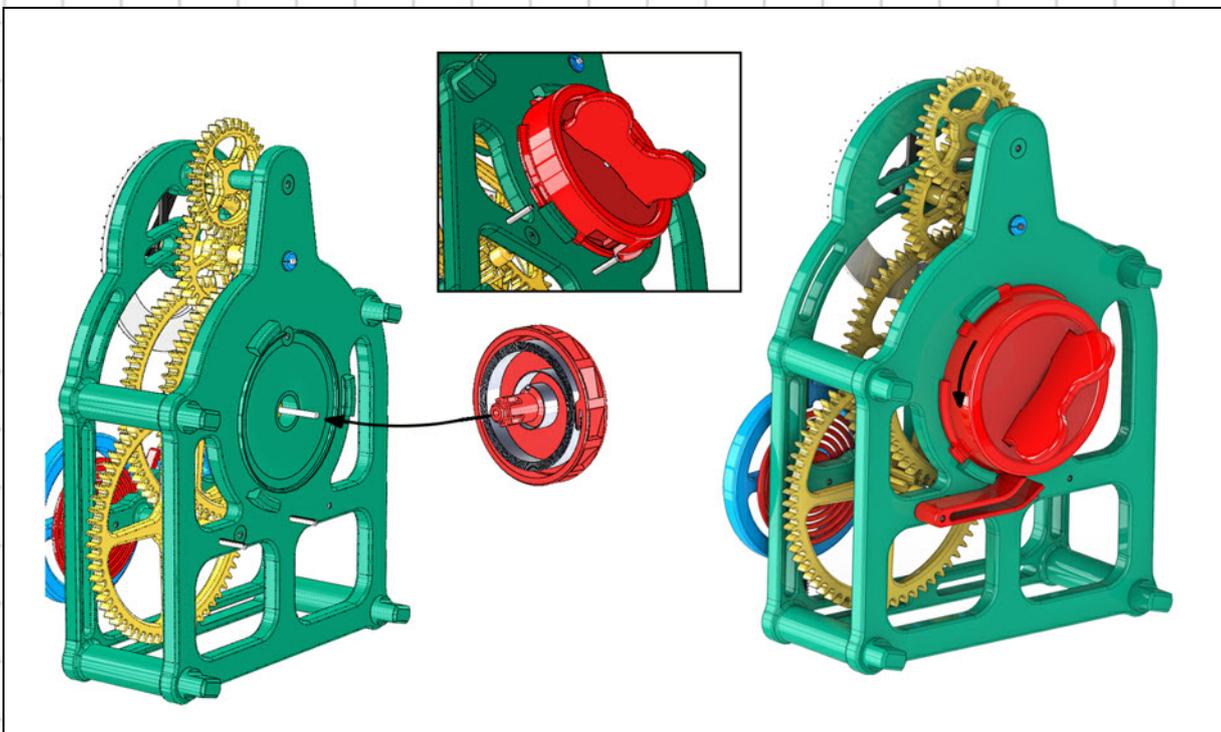
# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42

### Step 4 Fitting the Spring Drive



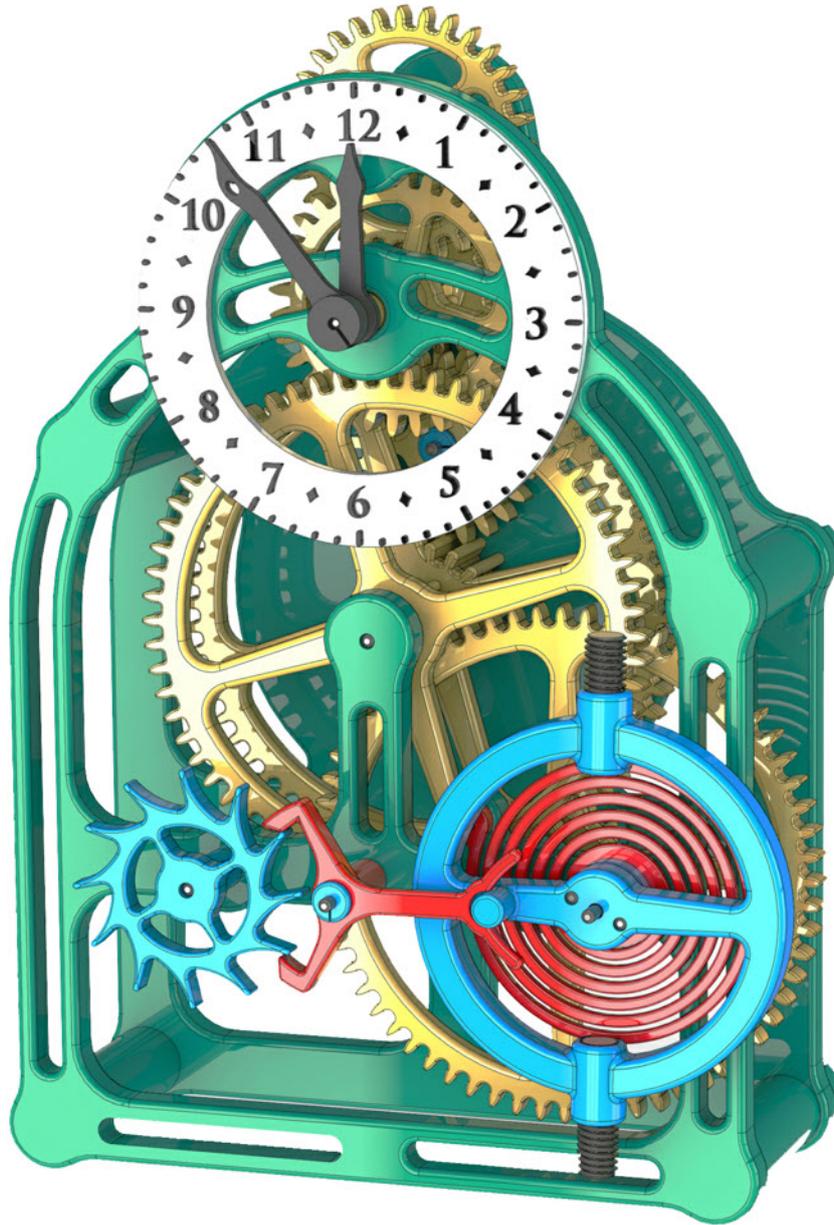
Firstly you will need to reshape the ends of the spring so that they form hooks that will engage inside the Spring case and around the Drive peg as shown in yellow above. Now wind the main spring into its case by engaging the outer hook as shown above and then carefully winding the rest of the spring inside, finishing by inserting the Drive Peg into the inner end of the Spring.



Now engage the hole in the drive peg over the protruding shaft and push the drive case firmly into place and then finally twist the retaining ring to hold the assembly to the back of the clock. Make sure that the window in the side of the Retaining ring is at the bottom so that the Pawl can engage with the ratchet when you fit it in position.

# Clock 42- with Swiss Lever Escapement

## Construction instructions for Clock 42



When the clock is first assembled, with the the hands fitted to the protruding shafts and the dial Super glued in position, screw the two threaded weights into the top and bottom positions of the balance wheel so that the screws are just level with the inside face of the wheel. This should give you a good position to start fine adjustment. Screw in to speed up and Visa Versa.