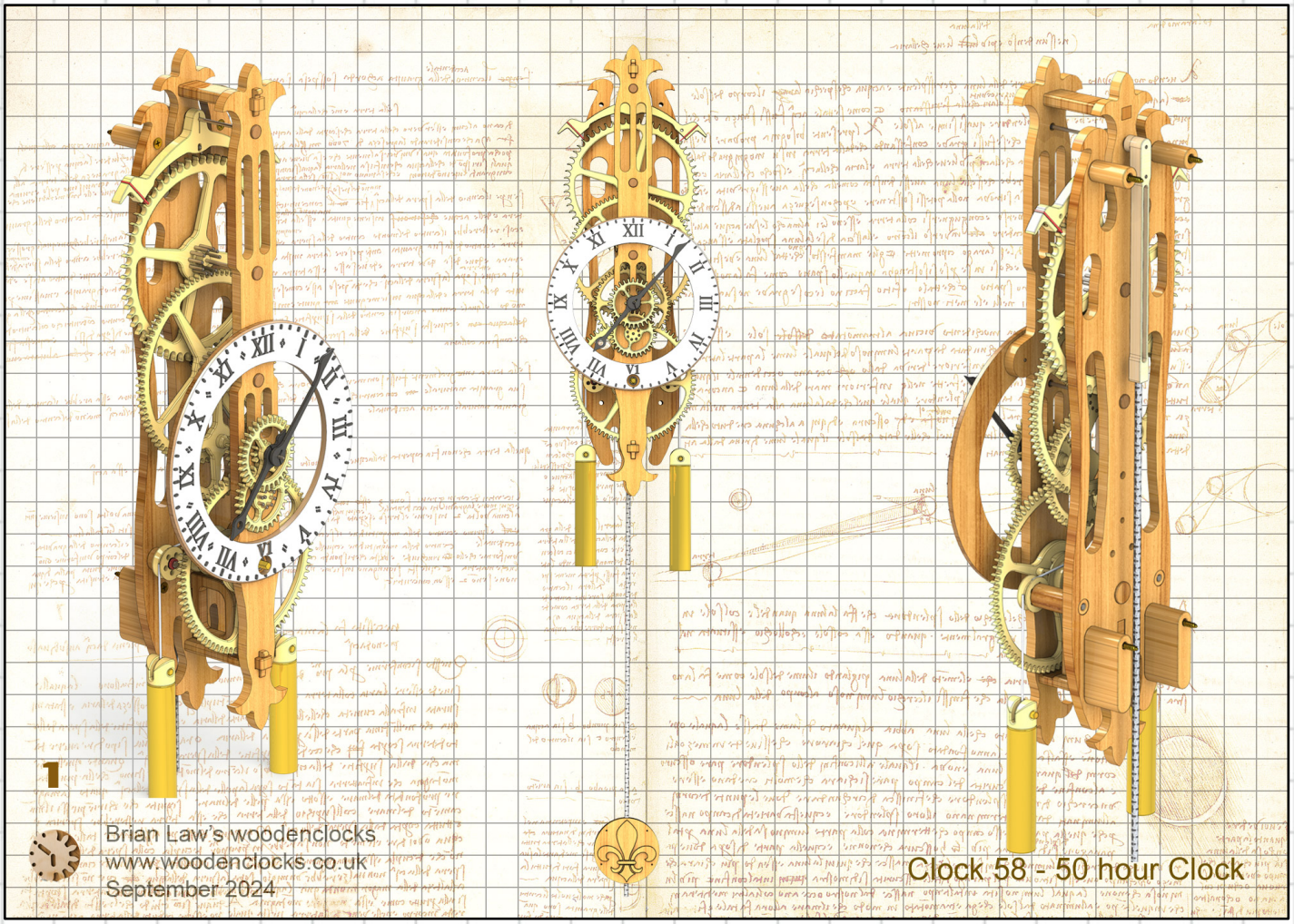
Clock 58 - 50 Hour Clock

Construction instructions for Clock 58



I aim to make each of my new designs unique in some way, but when I got to the 58th clock, this became increasingly challenging. However, I was able to create a design that would run for over fifty hours without using a weight of greater than a kilogram.

This utilizes two 375-gram weights, needle roller bearings, and brass pins for pinions, and it works pretty well. It's a big clock, just shy of 600mm tall, and it employs a Graham escapement, which is one of the better designs for these large wooden clocks.

The length of time for which it runs is mainly dependent on how far up the wall the clock is mounted and this prototype has the center of the Dial at 1600 mm above the floor and runs quietly and continuously for 52 hours with an accuracy within 20 seconds per day.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Equipment

The following equipment is desirable:

CNC Router to cut out all of the Parts

Or 3D Printer using the STL files supplied.

Pedestal Drill or simple drill stand with work holding vice. There is 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,Ø2, Ø2.1, Ø3 mm, Ø3.1 mm, Ø3.2, Ø6 mm

Hand tools; all the normal things that are used in the workshop, Files, screwdrivers, hammer, pliers etc.

Consumables

PLA Filament
Sandpaper in various grades from rough to fine
Super Glue

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Materials

I
The choice of material to build the clocks from is a very personal one and is down to you to decide. I normally build with Hard Maple for the gears and Cherry for the Frame parts.

If 3 D Printing then it would be either ABS or PLA

For all the other parts:-

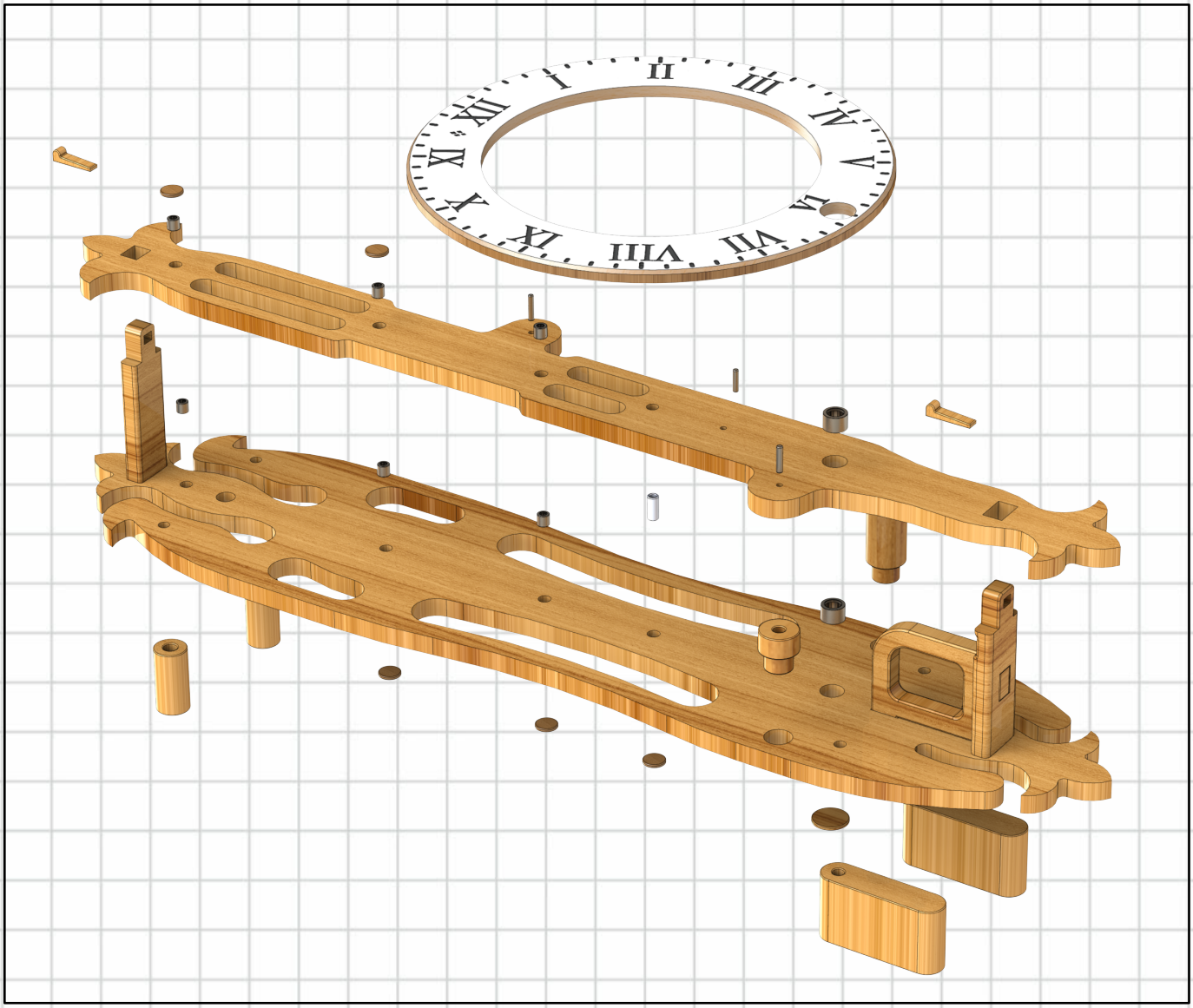
Ø3mm and Ø2mm Drill Rod or Silver Steel 250mm Long for all the shafts and numerous pins.
No 5 or 8 or 10 and wood screws 60 mm long for wall fixing 2 required
Ø25 mm Brass Rod 140 mm long for the weight.
Ø6 Plastic tube or wooden dowel for Pendulum Rod

Note these are the minimum amount 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 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 1 Assembling the Frame Parts



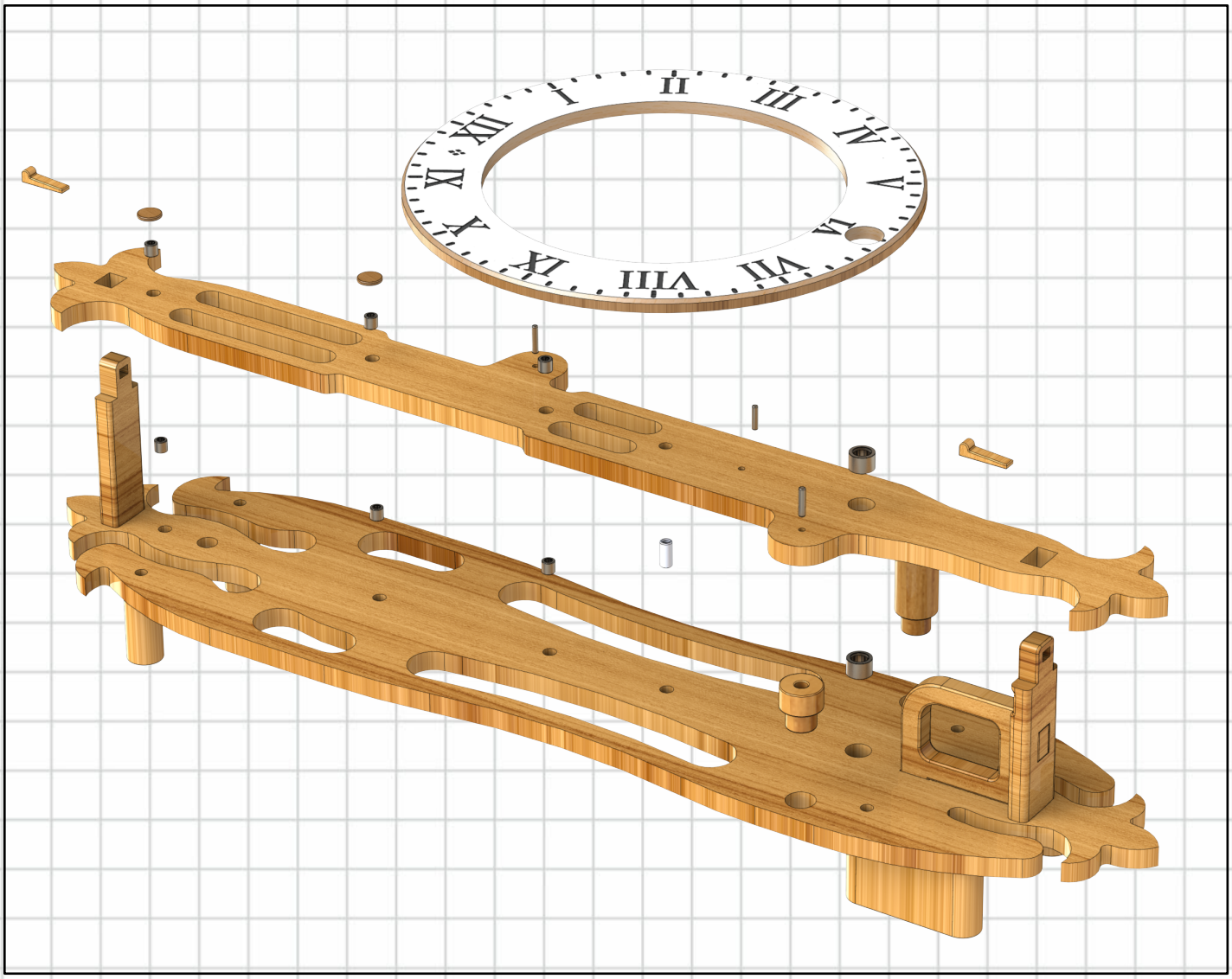
First task is to assemble all of the frame parts as shown in the picture above. This is to include all of the bearings Blanking caps being glued to the outside of the shaft holes in both frames. This includes the the short bearing sleeve in the centre of the front frame which is used instead of a bearing to give addition support to its shaft which is held on one side only.

Fit the dial onto the two dial pins and glue if necessary

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 1 Assembling the Frame Parts

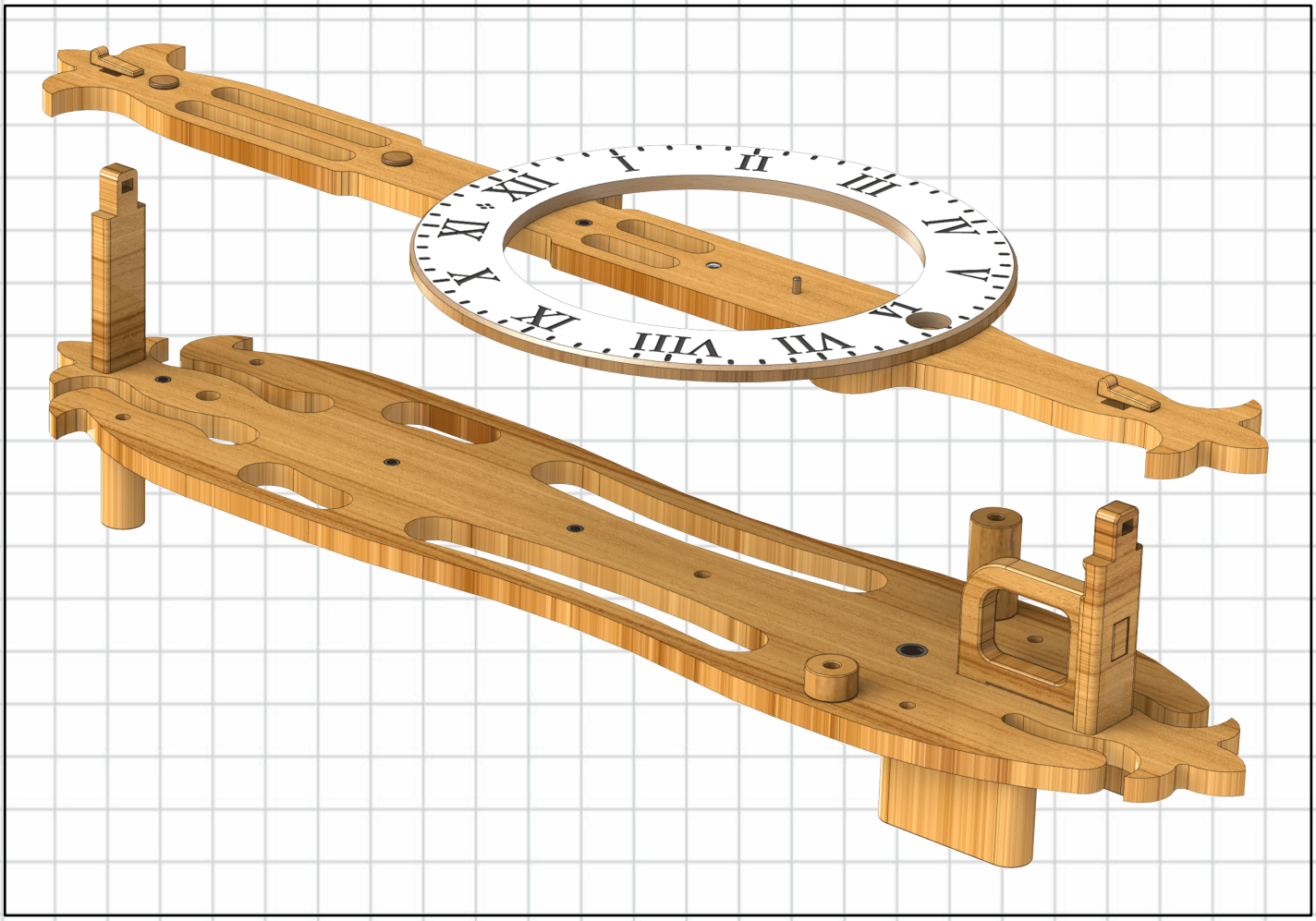


The two frame spacers and and the wall spacers on the underside are the first to be glued into place.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 1 Assembling the Frame Parts

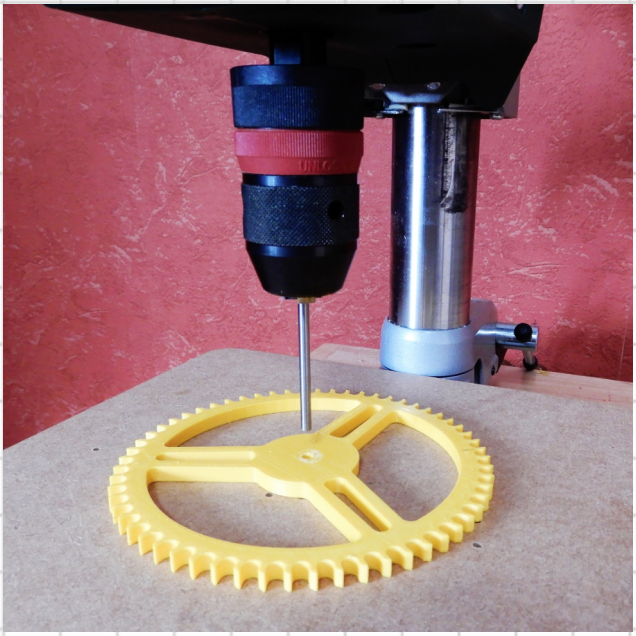


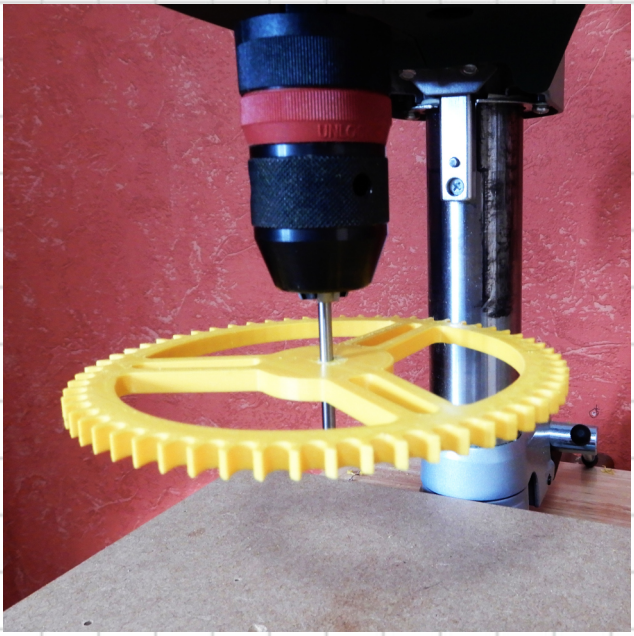
Next all the bearings are press fitted into the inside faces of the front and Back frames plus fitting the 3 short pins in the outside face of the Front Frame, two that hold the dial in place and one inside them for the Hour gear pivot. The Dial is then fitted to the pins and glued to the front face.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 2 Preparation of the Gear Sub assemblies



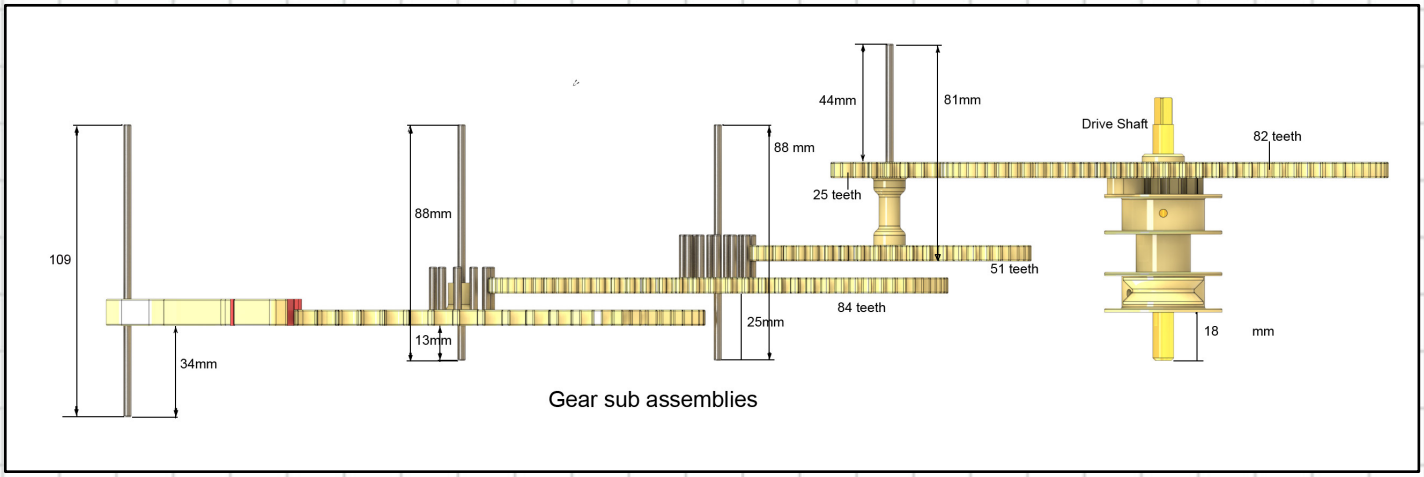


The Gear shown above is required to be assembled with care to ensure the shaft fits square to the gear. I recommend you use a drill press to do this as I have done, as it ensures that the gears are mounted square to the shaft.

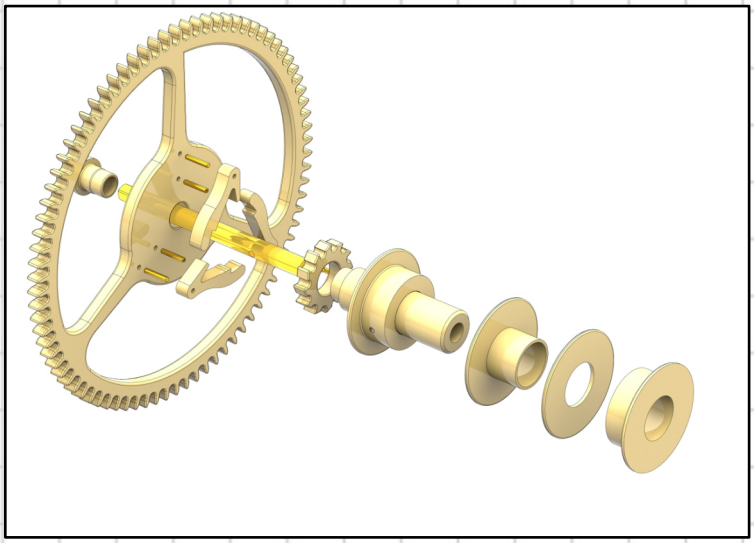
Clock 58 - 50 Hour Clock

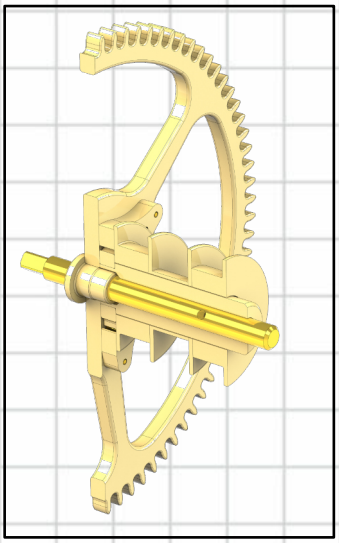
Construction instructions for Clock 58

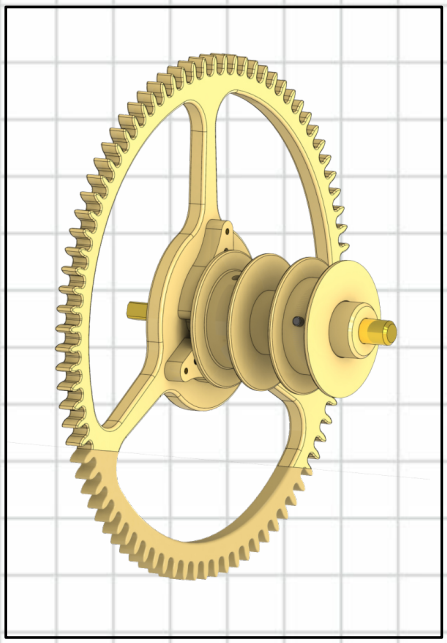
Step 2 Preparation of the Gear Sub assemblies



Gear sub assemblies







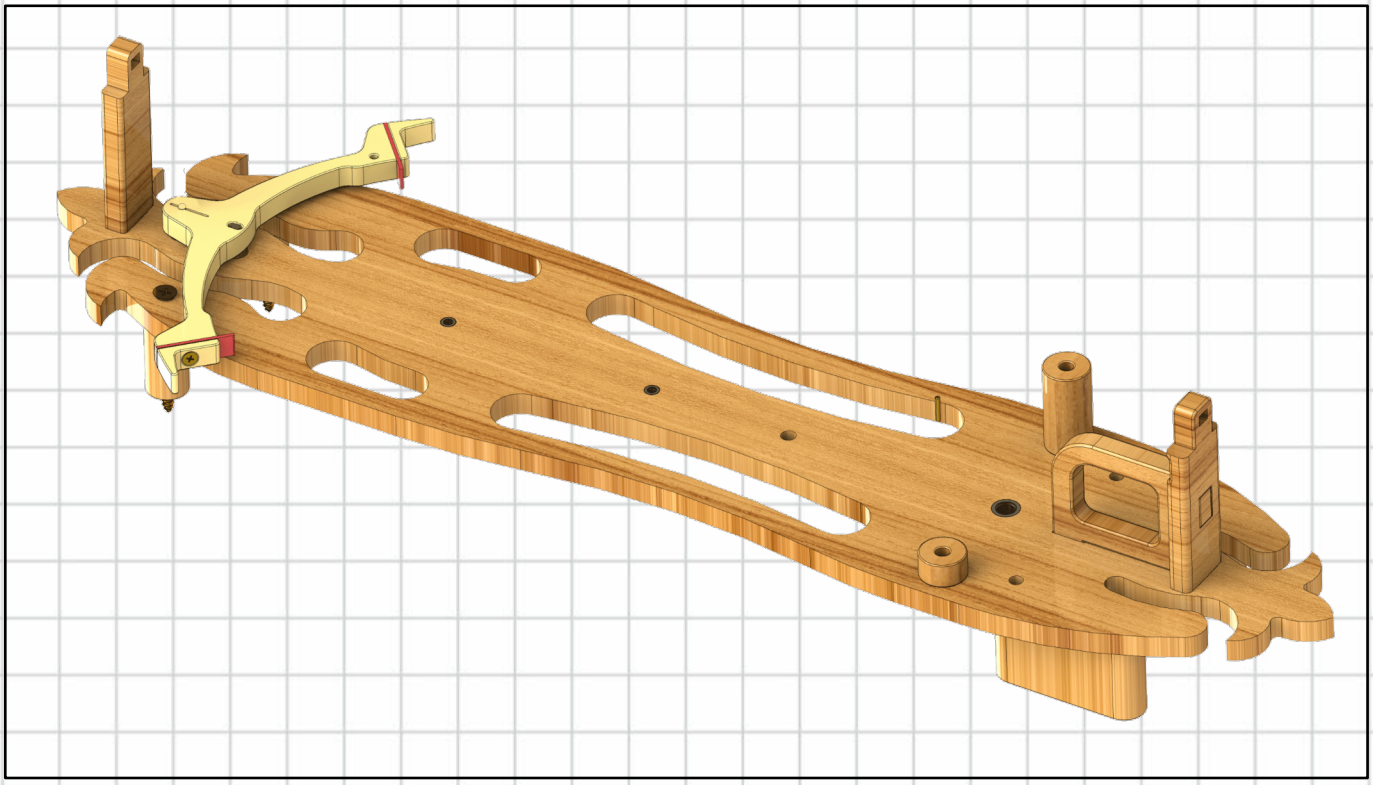
Next top panel shows the gear sub assemblies and the dimensions you need to assemble the parts. The middle left view shows the assembly sequence for mounting the parts on the drive shaft and the orientation of the ratchet gear to the rest of the parts as they are fitted and glued and pinned to the drive shaft.

The top right view shows a cross sectioned view of the assembled drive unit, and the view to the left shows the whole unit assembled. Although not shown here it may be easier to attach the two cords to the respective drums before the unit is fitted to the main assembly.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step3 Fitting the gear sub assemblies to the back frame.

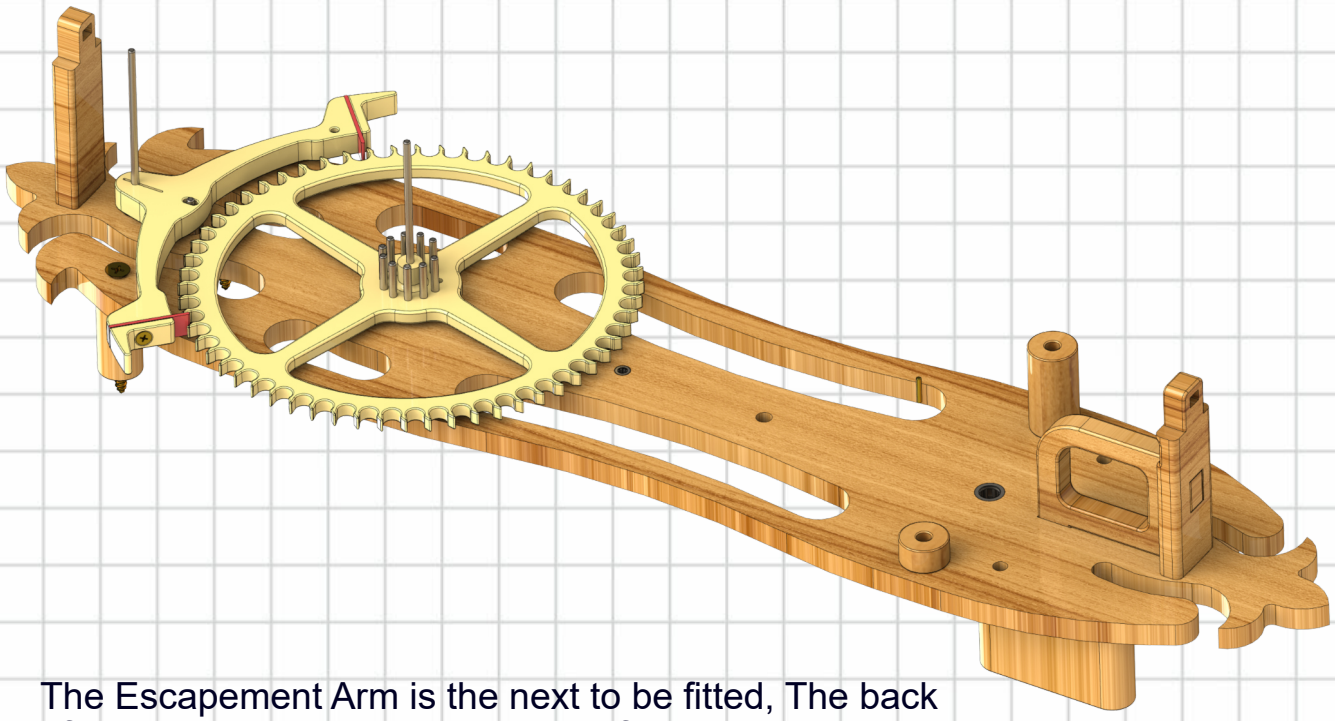


The Escapement Arm needs to be assembled and fitted with the Pallets and the Pallet clamps and laid in position at the top of the Back Frame . The shaft that this attaches to is on the Pendulum assembly and so will be fitted later.

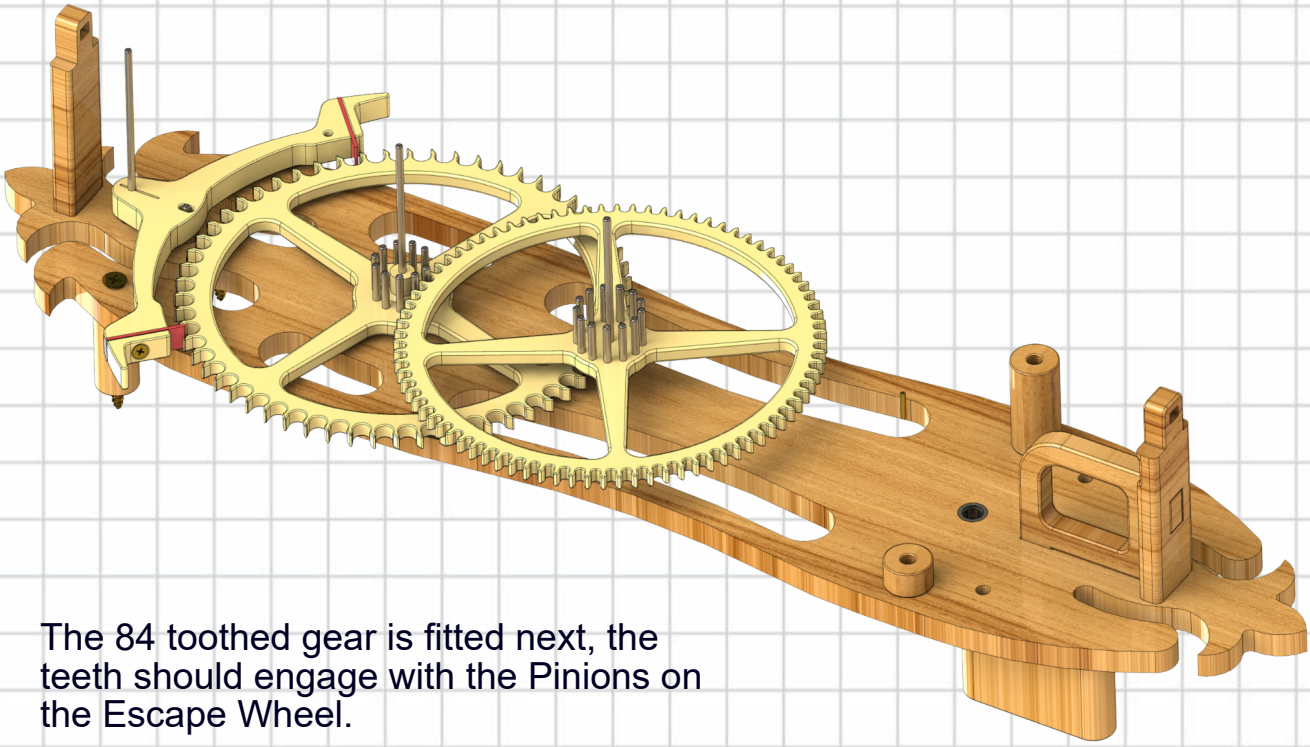
Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step3 Fitting the gear sub assemblies to the back frame.



The Escapement Arm is the next to be fitted, The back of the gear should be 3 mm clear of the back Frame.

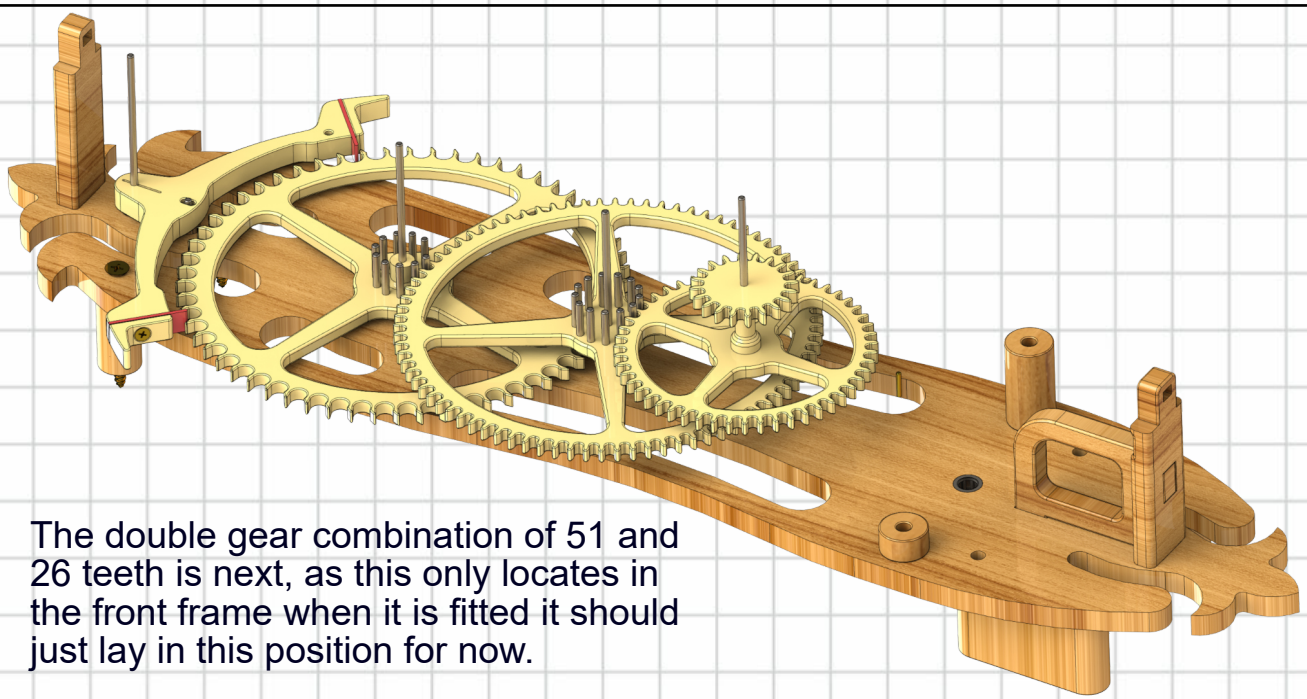


The 84 toothed gear is fitted next, the teeth should engage with the Pinions on the Escape Wheel.

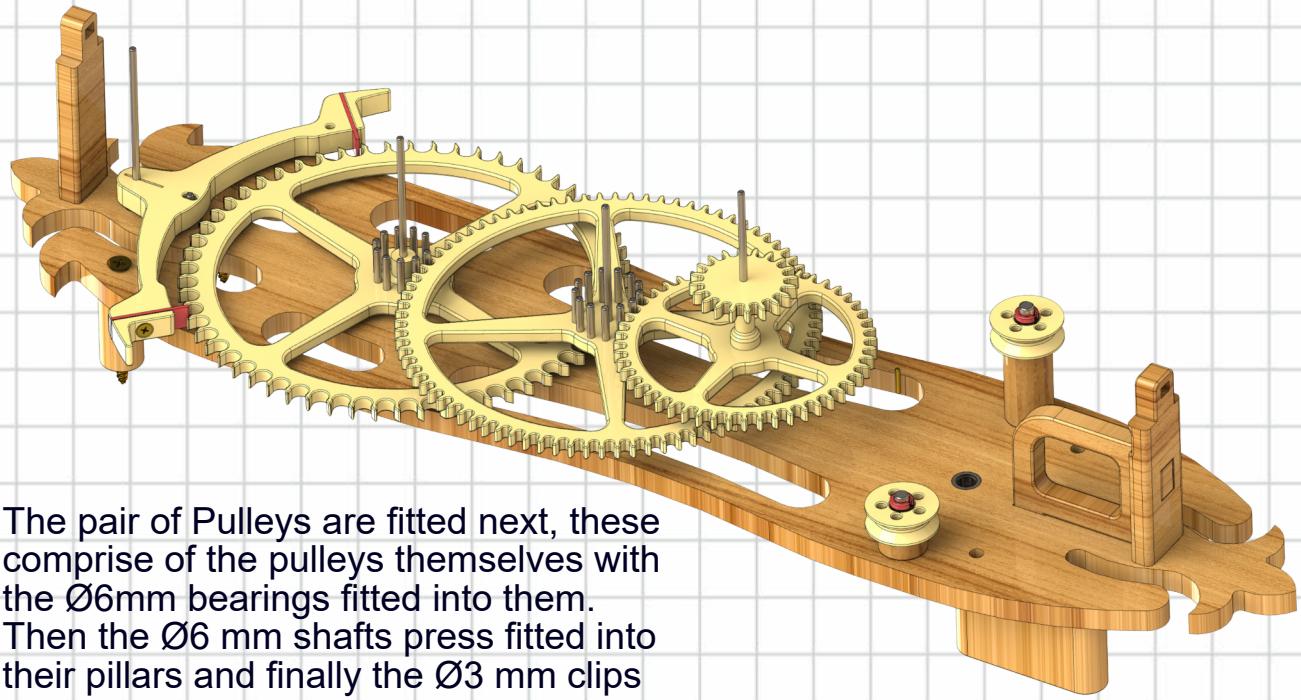
Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step3 Fitting the gear sub assemblies to the Back Frame.



The double gear combination of 51 and 26 teeth is next, as this only locates in the front frame when it is fitted it should just lay in this position for now.

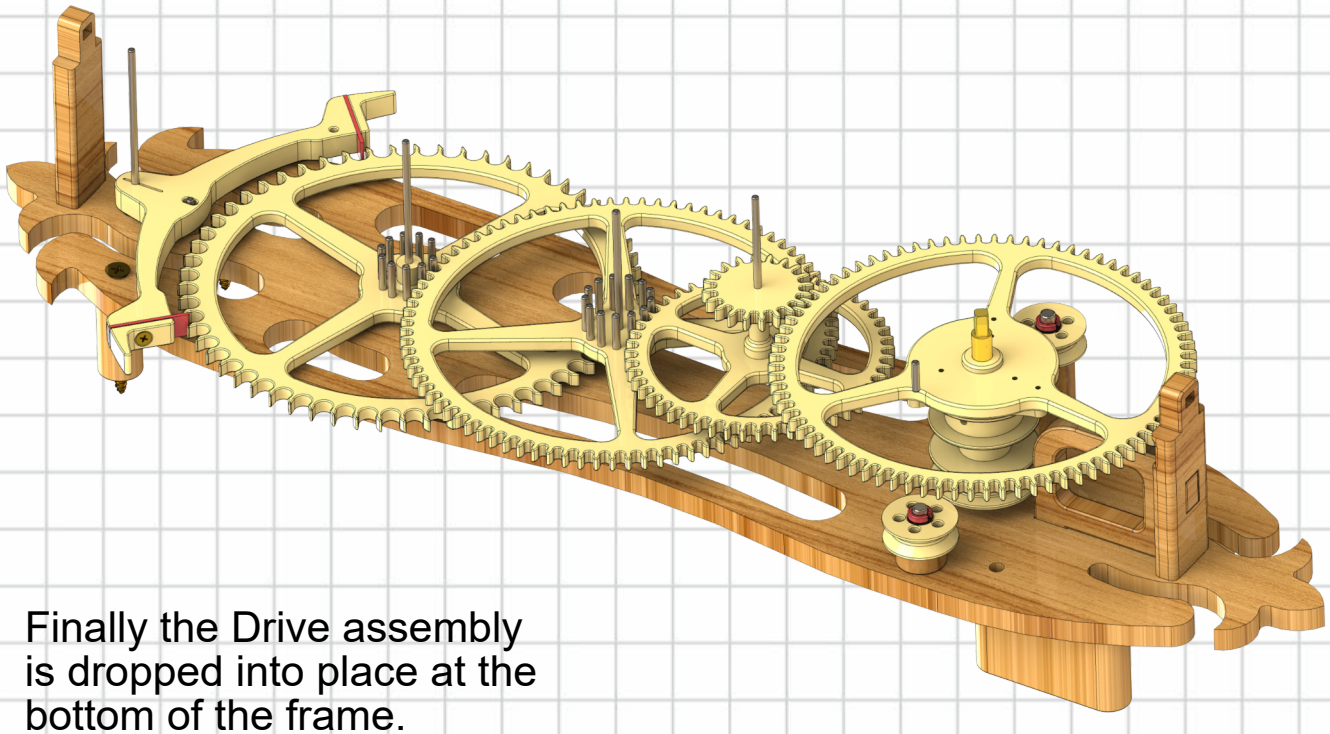


The pair of Pulleys are fitted next, these comprise of the pulleys themselves with the Ø6mm bearings fitted into them. Then the Ø6 mm shafts press fitted into their pillars and finally the Ø3 mm clips to hold them in place.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step3 Fitting the gear sub assemblies to the Back Frame.



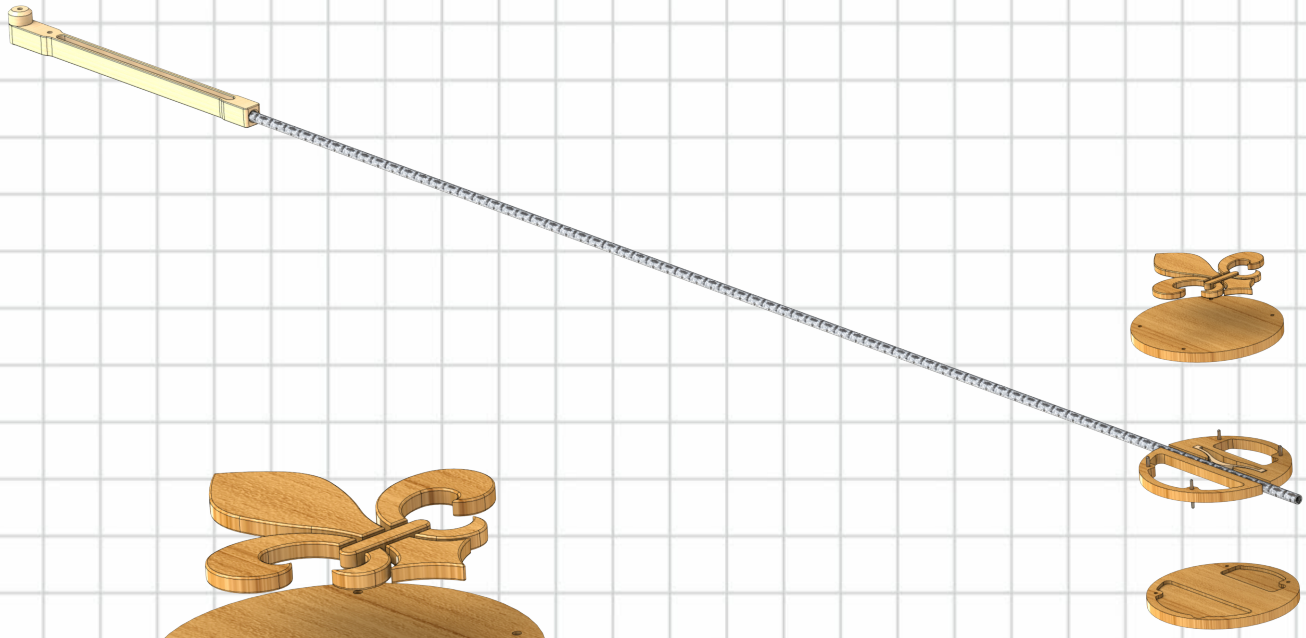
Finally the Drive assembly is dropped into place at the bottom of the frame.

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

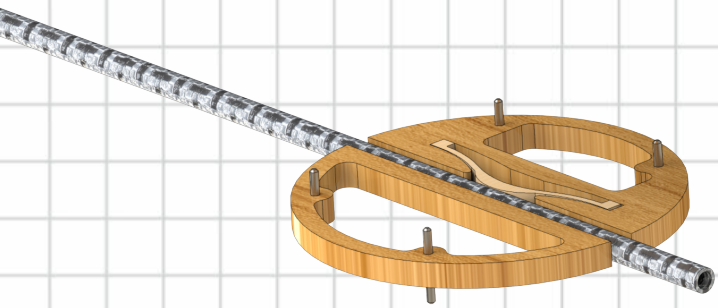
Step 4 - Assemble the Pendulum

The Pendulum Head is first fitted with the long Ø3 mm x 109 mm pivot shaft and the shorter Connector pin at the very top, these are both a press fit in the Pendulum Head. The pendulum rod is fitted next using a press fit or Glue into the Pendulum Head.



The Pendulum Bob is assembled next the 3 disks the Top Centre and Bottom are all pinned together with the 4 short pins. Before actually fitting the top disk you need to press the lock piece into its position and and fill the pockets with ball Ø8 or 9 mm Ball bearings.

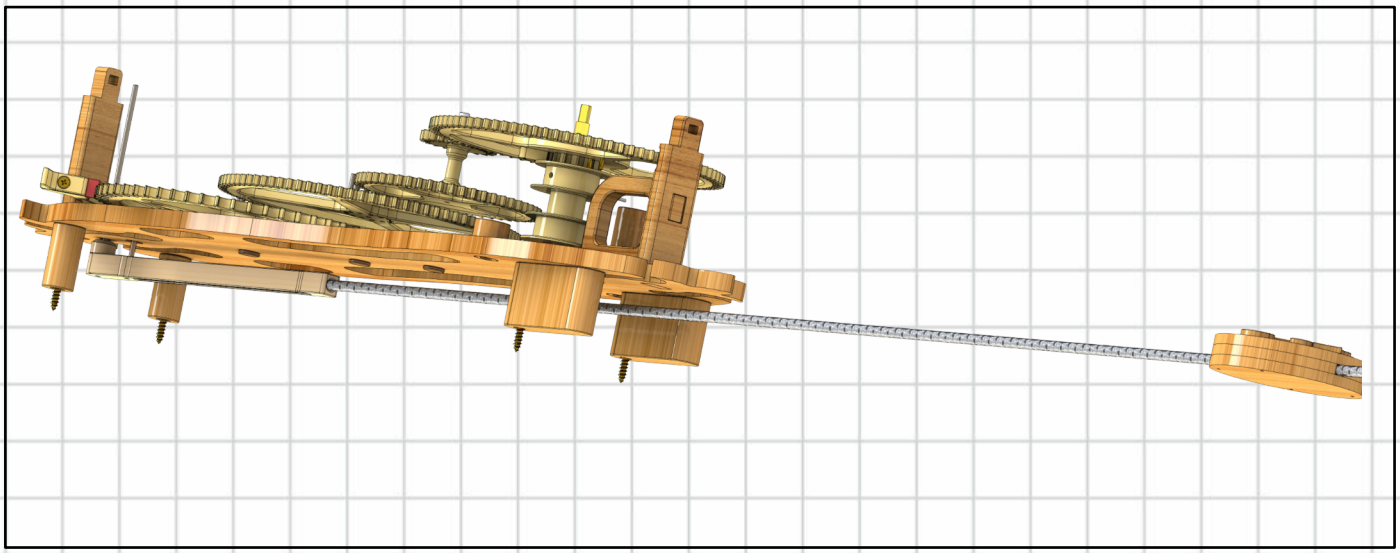
The lock simply apples pressure onto the pendulum Bob so that the Bob can be adjusted up or down on the rod and stay in position whilst the clock is running.



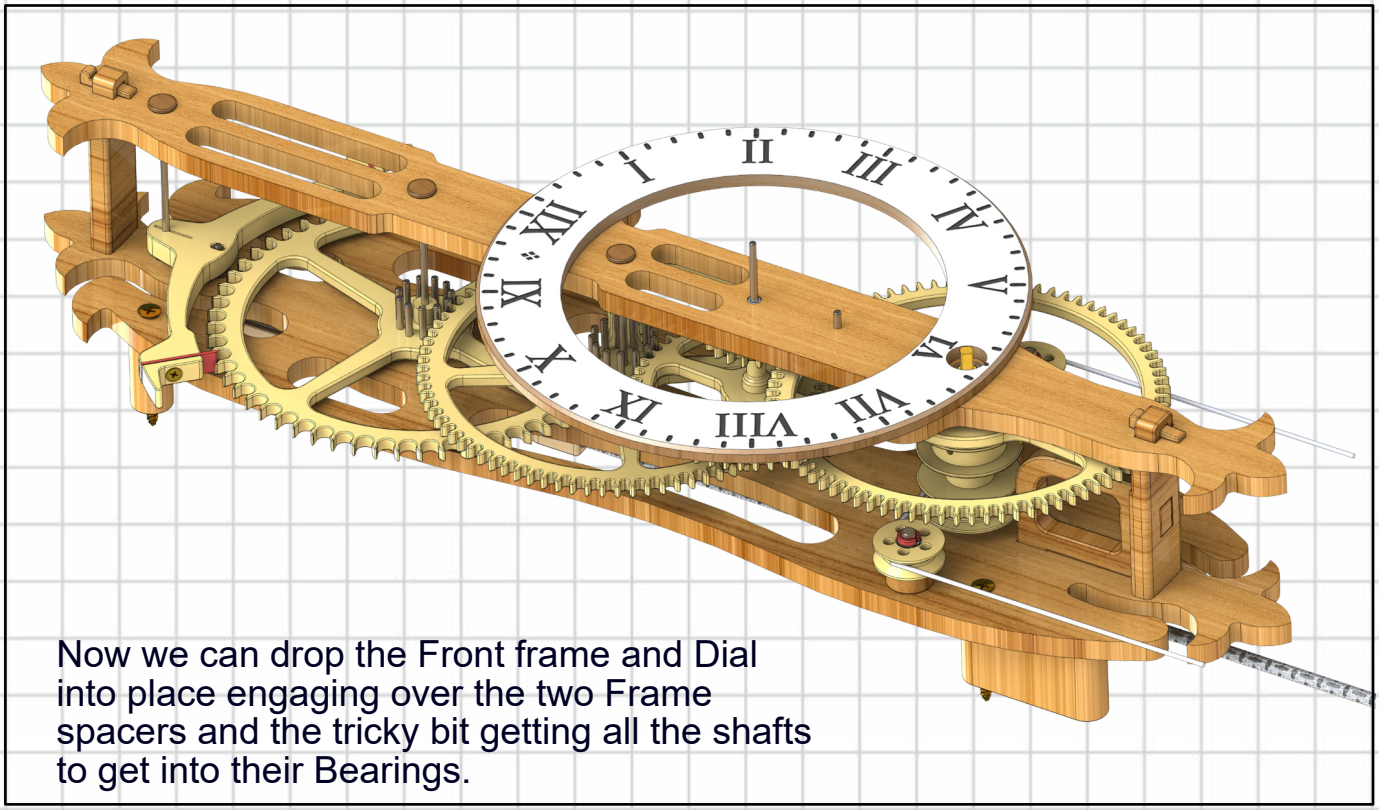
Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 5 - Fit pendulum into the back of the clock.



Fit the pendulum simply by pushing the two shafts at the top through the bearing at the top and into the two holes in the Escapement arm. The long Pivot shaft should be a Press fit in the Escapement arm. The shorter shaft is to make sure the Pendulum and the Escapement Arm move together.

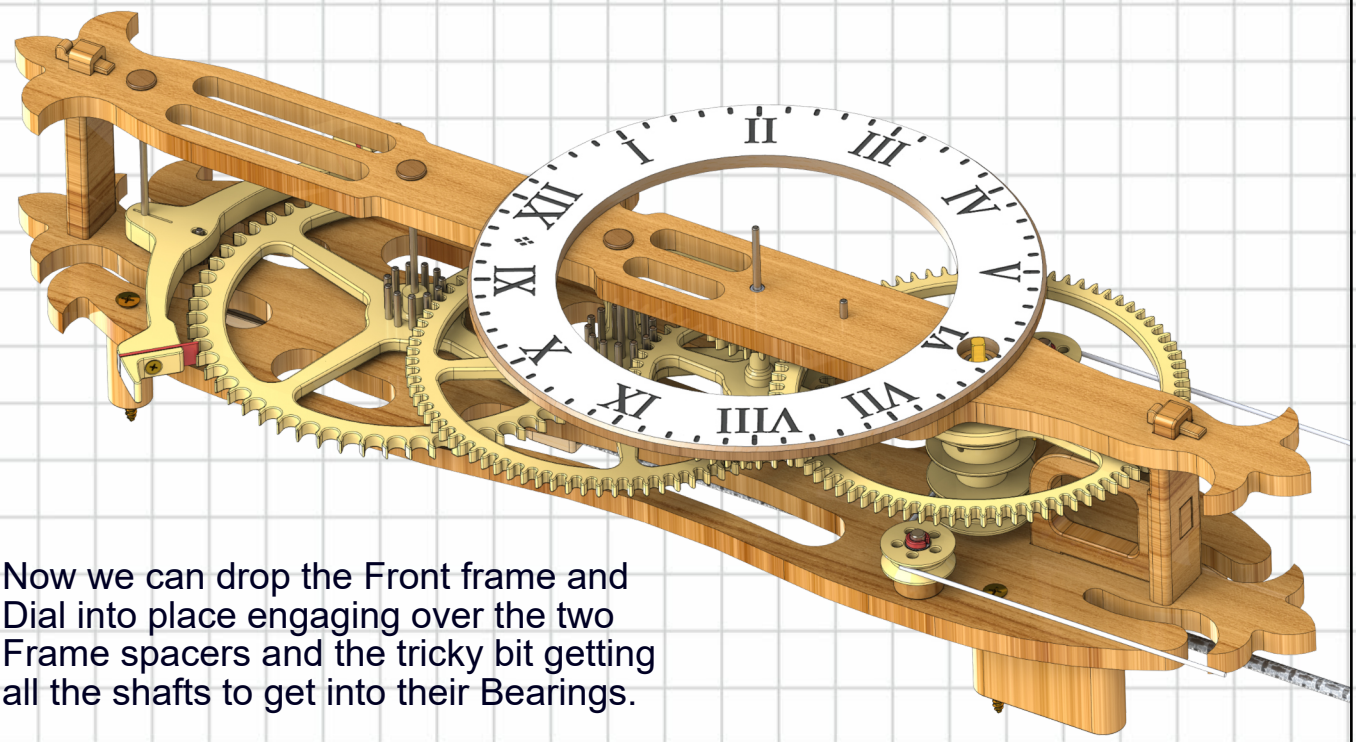


Now we can drop the Front frame and Dial into place engaging over the two Frame spacers and the tricky bit getting all the shafts to get into their Bearings.

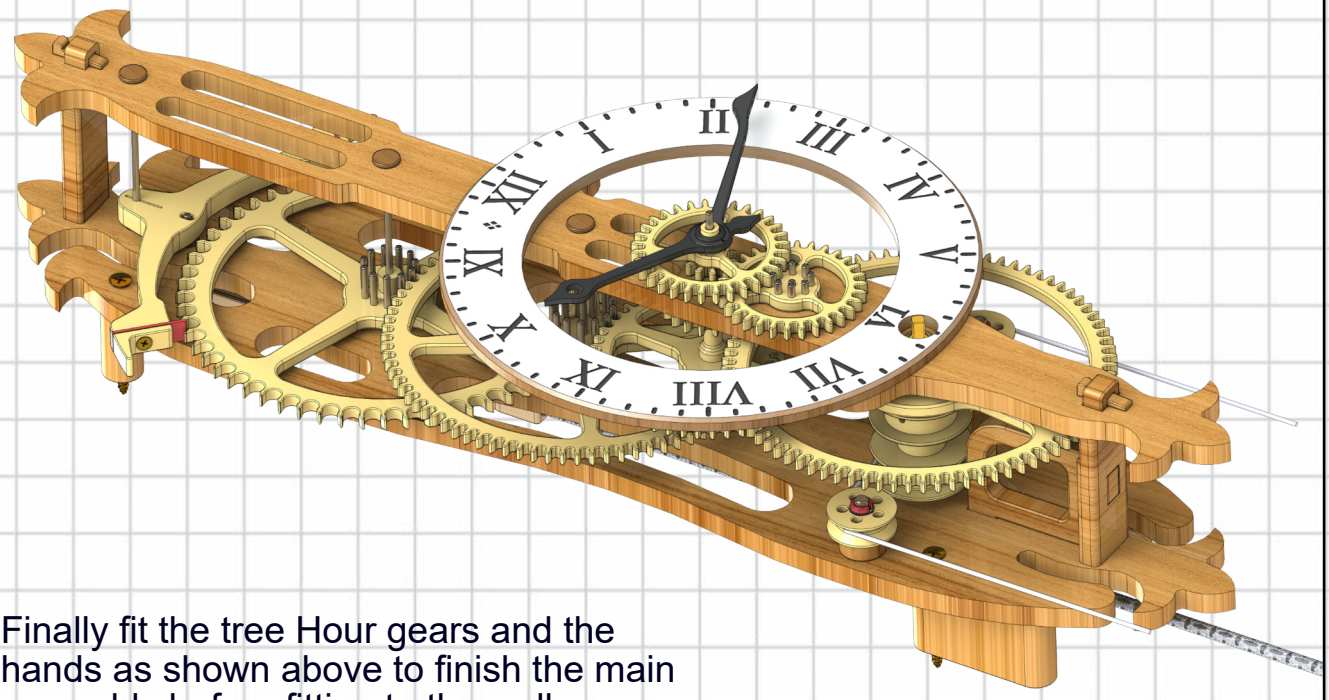
Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 6 - Fit Front Frame and Hour gears



Now we can drop the Front frame and Dial into place engaging over the two Frame spacers and the tricky bit getting all the shafts to get into their Bearings.

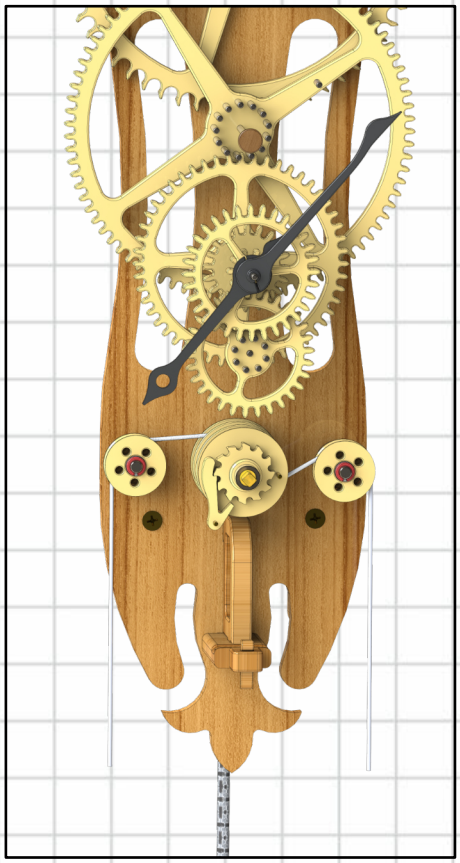


Finally fit the tree Hour gears and the hands as shown above to finish the main assembly before fitting to the wall.

Clock 58 - 50 Hour Clock

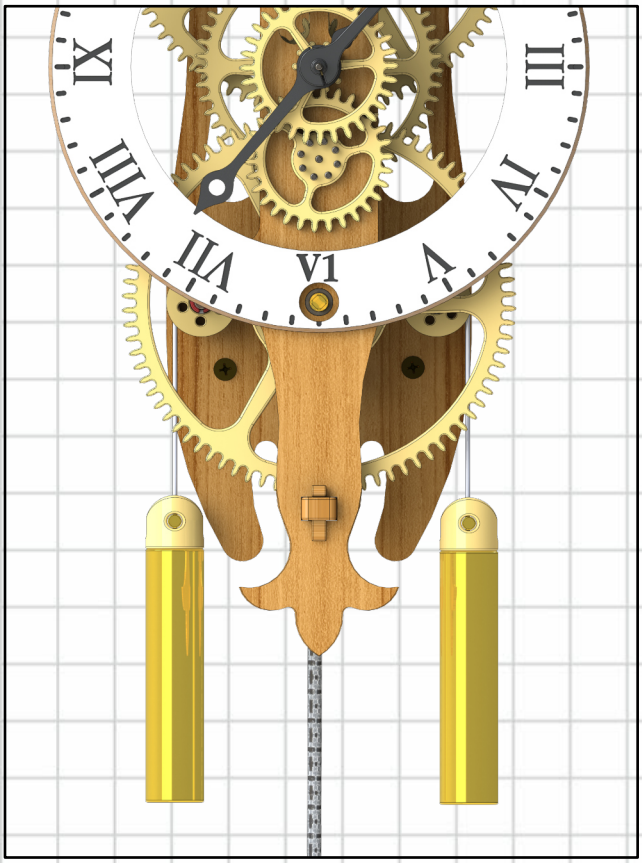
Construction instructions for Clock 58

Step 7- Fit Clock to the wall and set it running

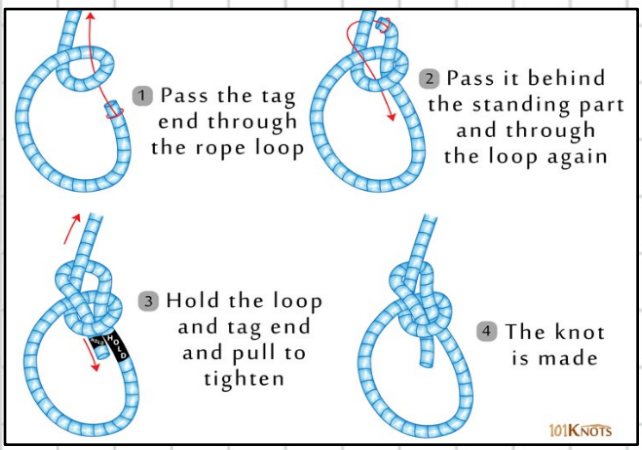


If you have not done it already then attach the two cords to their respective drums and then wrap them over their pulleys in the manner shown above. The weights need to turn the drum anti clockwise so they need to be pulling on opposite sides of the drum to ensure that is done, otherwise you will get no movement at all.

Screw the clock to the wall now using the four screws making sure the clock is fixed vertical using spirit level along the side.



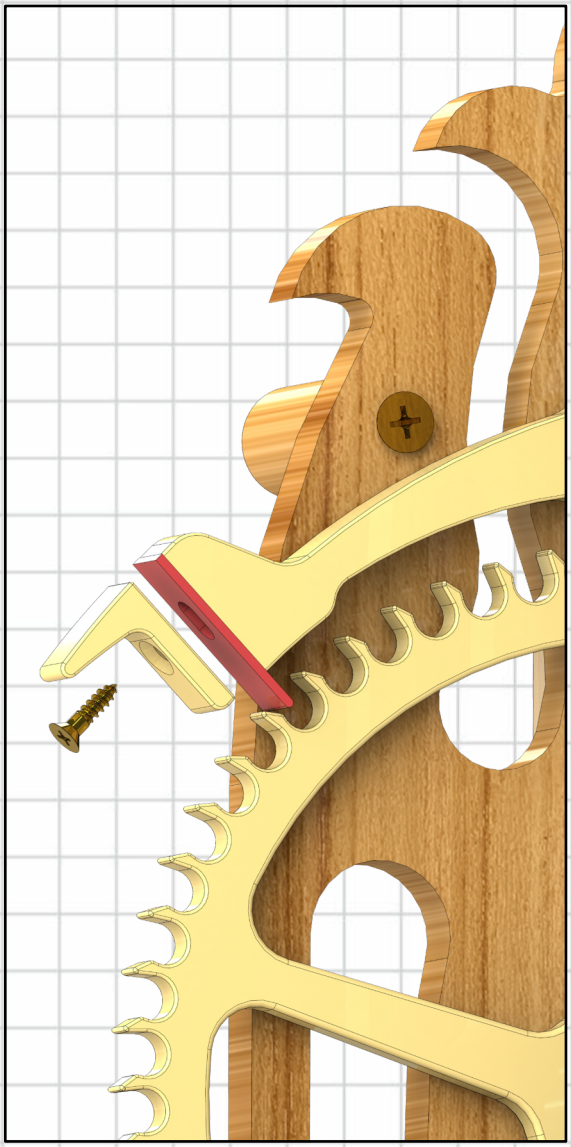
First glue the Weight Tops to the weight using superglue, now position the loop of the knot into the slot at the top of the weight and push the Pin through the cross hole and let go, the clock is ready to run

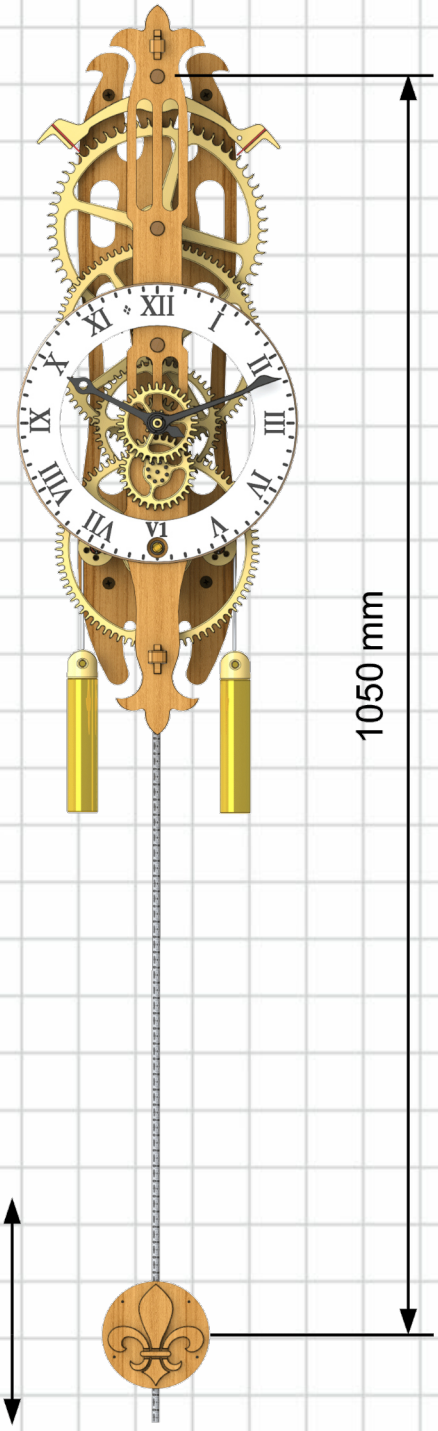


Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

Step 7- Fit Clock to the wall and set it running





For the clock to run correctly the Escapement should be set so that the swing of the pendulum moves the pallets in and out of engagement with the teeth evenly.

So if one of the pallets is moving in too far then loosen off the retaining screw that side and pull the Pallet back slightly then re-tighten. Conversely move the other side in slightly.

Initially set the Pendulum Bob so the distance to the pendulum pivot is 1050mm (41.5 inches) .

To get the clock to run quicker move the Bob up slightly and visa versa

Clock 58 - 50 Hour Clock

Construction instructions for Clock 58

HINTS AND TIPS - continued

- Main Weight between 750 grams total for the two weights
- Distance from pivot to centre of Pendulum Bob 1050 mm
- Run time 70 hrs when dial is set at 1600 mm above the floor.

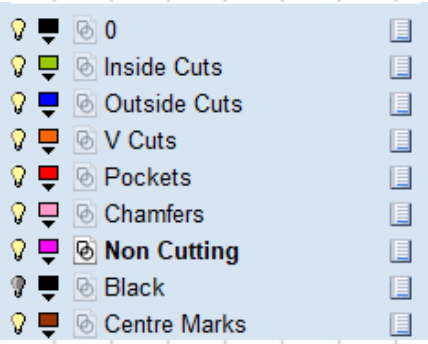
- When fitting the gear sub-assemblies into the frame make sure the mating gears engage and run smoothly. The faces of mating gears should be aligned so they fully engage with each other, i.e. the front faces of the gears are lined up. There is some clearance built into the design so that when the gears are enclosed between Front and Back frames they are free to move a little without rubbing on the frames.

- For the dial on this clock you could use a V bit cutter to cut out the numerals and minutes ring. I use Artcam Express which gives a good clean-cut edge and very fine detail without having to use extremely small diameter cutter. A free alternative to Artcam is a program called F-Engrave, There are many ways to construct the dial some can be found here in a two part article from my Blog https://brianlawswoodenclocks.blogspot.com/2014/11/clock-dials.html https://brianlawswoodenclocks.blogspot.com/2014/11/clock-dials-part-2.html

- If you have problems getting the clock running initially it could be that the problem is in the gear train itself, one or more of the gears may not be meshing correctly,
  You need to test each pair of gears in turn, by mounting each meshing pair in the frames on their own and turning them by hand very slowly with little pressure. if any pair sticks or interferes with the other you should mark the teeth that are affected and carry on until you have turned the large gear around completely, then strip down and dress the teeth you have marked until they work together smoothly. Repeat this process for all the meshing pairs of gears are running freely.
  It is not sufficient to test them when the gears are mounted in the clock and then left to run continuously unrestricted, as the free running gears will easily override any slight interference, whereas when the gears are running in the clock with the escapement in place they never run fast and so easily feel the effects of interference.
- Alternatively the Pendulum / Escapement may not be running freely on the 3 mm diameter shaft they are fitted to. The parts should be a running fit in the 3 mm diameter shaft.

- The DXF files supplied include all the parts that can be cut using the CNC router, they do not include any pins or nuts and bolts, information on these parts are included in the Detail drawings supplied in PDF format.

- The parts shown laid out in a single DXF files ready for you to extract and use in your CAM software. The profiles are shown on 6 separate layers , these being ‘Outside Cuts’ ‘Inside Cuts’ ‘Pockets ’ ‘Non Cutting Profiles’ and ‘V cuts’ and ‘Chambers’. The layers are colour coordinated as shown.



Clock 58 - 50 Hour Clock

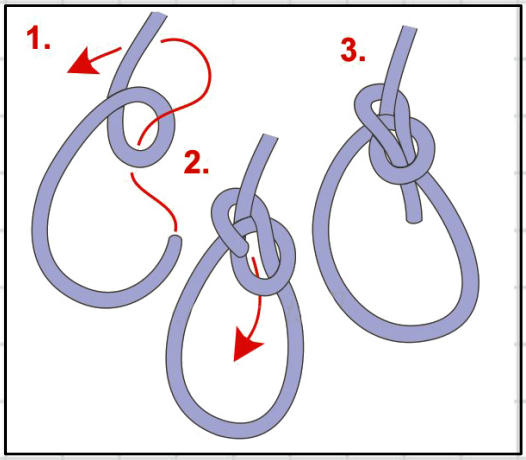
Construction instructions for Clock 58

- The Pendulum Bob needs to be fitted so that the centre of the Bob is about 105cm from the pivot point. This should allow the pendulum to swing a complete cycle every two seconds. The pendulum swing can be adjusted to make the clock run faster or slower by moving the Bob up to speed it up and down to make it run slower. I have found over the years that a slightly heavier Pendulum Bob is an advantage as it seems to overcome any momentary fluctuations caused by a sticking gear train, to achieve this on this clock I have added 9 mm diameter steel ball bearings to the pocket inside the Pendulum Bob, making the overall weight around 150 grams.

- Establishing the actual weight to use for the main clock weights, is done initially by trial and error. Each clock build is different and that has an effect on the size of weight to use. I normally use a large Coke bottle partly filled with water to start and add or remove water to get the clock running continuously.
  You would do this finally after assembling the clock and making sure everything is running freely and the escapement is set up correctly. Usually, a bit of back and forth here to adjust the escapement then adjust the weight.
  There are many styles of weight that can be used and I have shown several of these in a separate article that can be seen here
  https://brianlawswoodenclocks.blogspot.com/2021/05/the-woodenclocks-weight-drive.html

- If you intend to print out the clock profiles for use in conjunction with a Scrollsaw the this article from my Blog should help https://brianlawswoodenclocks.blogspot.com/2014/09/printing-clock-plans-using-pdf-and-dxf.html
  I would also recommend printing the parts using Foxit Reader as it seems to give a better solid black print out than Adobe Acrobat,

- Before assembling any gears onto their shafts cut all the shafts to length and then try them between the front and Back assembled frames, they should be free to rotate and slide forwards and backwards a small amount all quite freely.



I always use a Bow Line Knot on the end of the cord holding the driving weight of a clock, it is one of the most useful knots you can know. The Bowline forms a secure loop that will not jam and is easy to tie and untie. The Bowline is most commonly used for forming a fixed loop, large or small at the end of a line. Tried and tested over centuries, this knot is reliable, strong and stable. Even after severe tension is applied it is easy to untie.

There are of course many alternatives and you can find illustrations of them here,

https://www.animatedknots.com/end-loop-knots

For more Hints and tips you could have a look at my Blog here
https://brianlawswoodenclocks.blogspot.com/search?q=hints