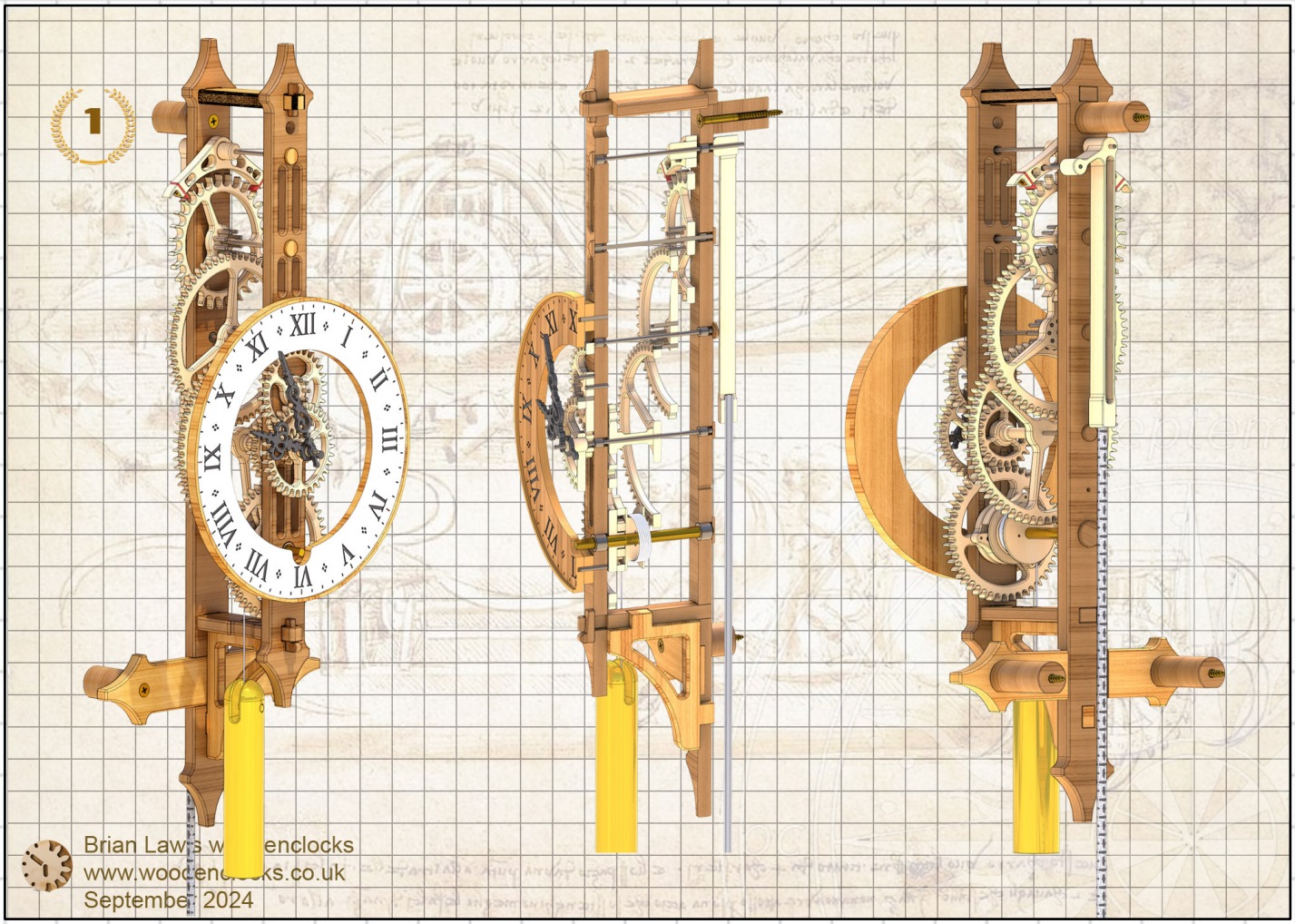
Clock 57 - 24 Hour Clock

Construction instructions for Clock 57



The inspiration for this clock originated from a review of designs I created nearly 40 years ago when Clock 1 was developed as a project to promote a new Bandsaw at the company I was employed by at the time.
The success of the Bandsaw sparked a lifelong interest in wooden clock design for me.Recently, I stumbled upon the original General Assembly drawing for this clock, prompting me to reflect on the advancements that could enhance the original design if I were to revisit it today. Thus, I embarked on creating this new clock design, incorporating Needle roller bearings on all drive shafts to enhance drive efficiency and reduce driving weight. I also utilised Lantern gears to facilitate the manufacturing of small gears. Additionally, I minimised friction by aligning the Escapement and Pendulum on the same axis and eliminated internal loading with a gravity clutch.

The geometry of the Escapement Arm has been significantly refined to make it more efficient and brought it closer to the original George Graham design.

This new clock has evolved from those revisions and I am pleased to report that it ran smoothly upon initial assembly and continues to function flawlessly several months later. The process of building this clock was truly enjoyable, and I trust that you will find it equally captivating.

Clock 57 - Pendulum Driven Clock

Construction instructions for Clock 57

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 57 - Pendulum Driven Clock

Construction instructions for Clock 57

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:-

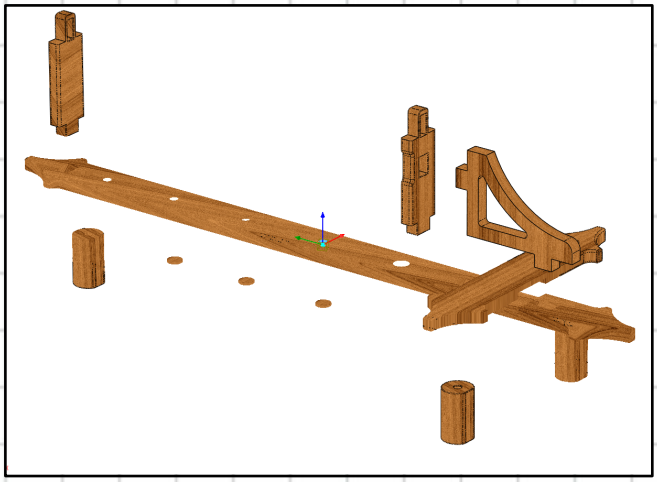
Ø3mm and Ø2mm Drill Rod or Silver Steel 250mm Long for all the shafts and numerous pins.
No 5 or 8 or 10 and wood screws 60 mm long for wall fixing 2 required
Ø25 mm Brass Rod 140 mm long for the weight.
Ø6 Plastic tube or wooden dowel for Pendulum Rod

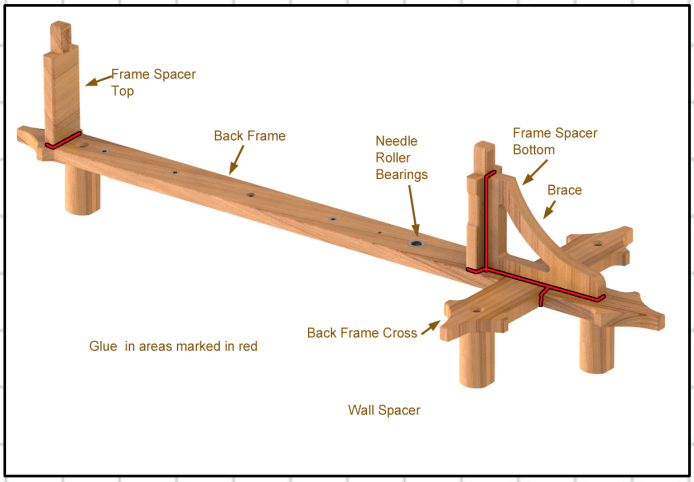
Note these are the minimum amount of material necessary to build the clock I used more in the prototype and you may well be advised to buy extra to cover those accidental losses that occur. If I have missed anything here, you will find them in the parts list for the clock anyway.

Clock 57 - 24 Hour Clock

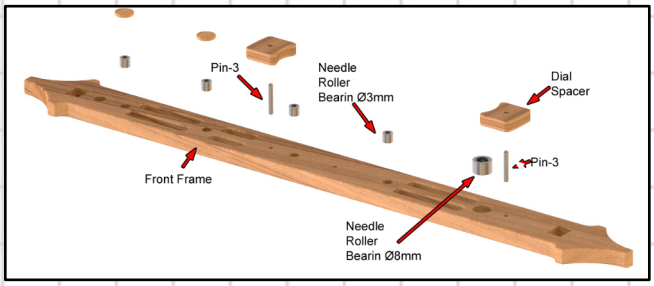
Construction instructions for Clock 57

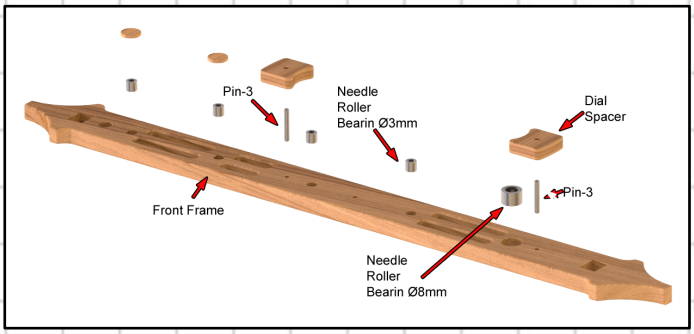
Step 1 Assembling the Frame Parts



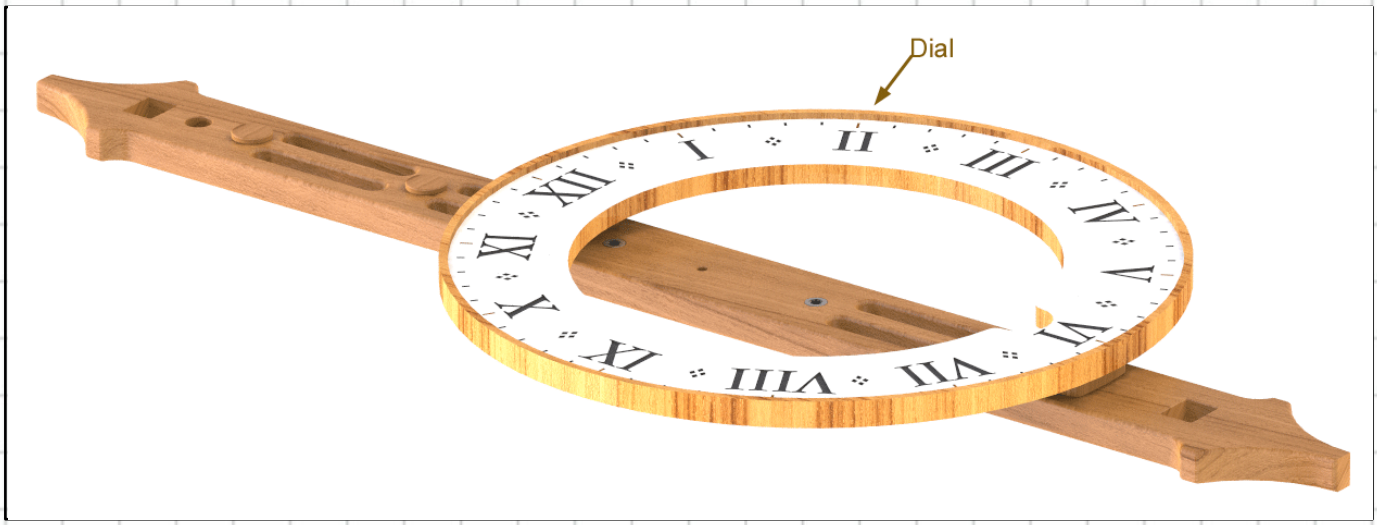


Start by Gluing all the parts shown to the Back Frame, Glue lines shown in Red.`Then Press fit all of the Needle Roller Bearings.





Glue the Spacers and the small Blank parts shown to the Front Frame, Glue lines shown in Red.`Then Press fit all of the Needle Roller Bearings.The Dial spacers are located by the pins before gluing.

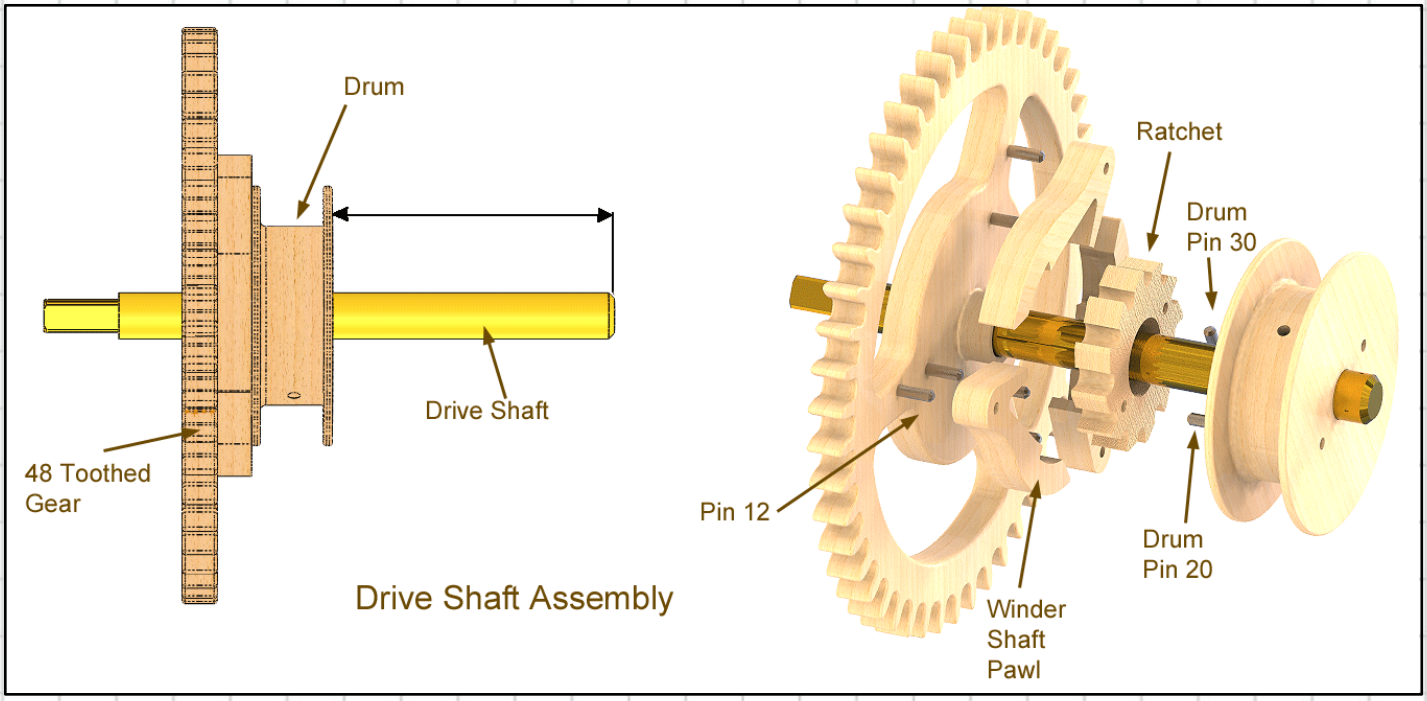


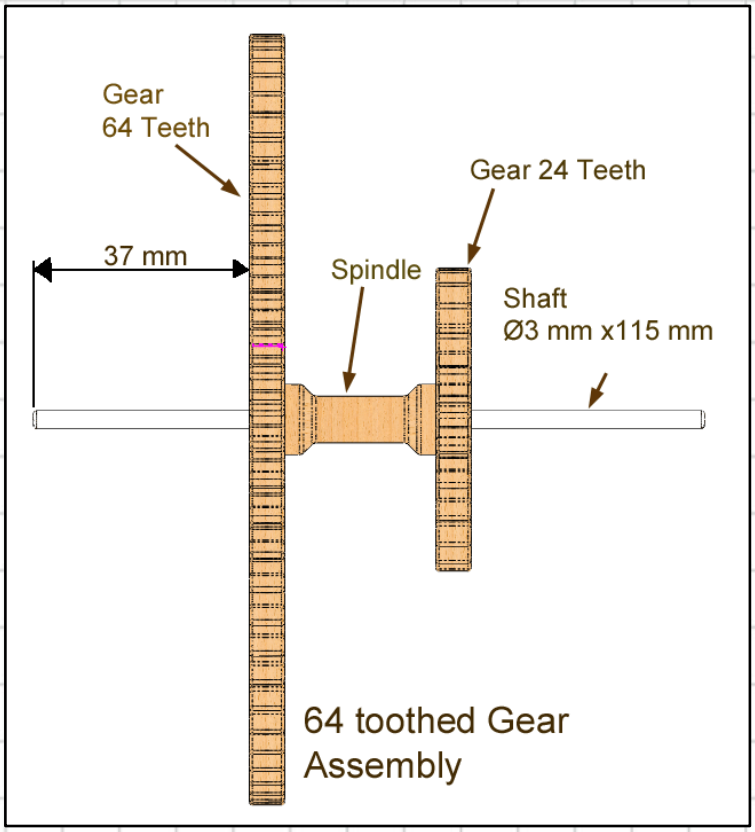
Fit the dial onto the two dial pins and glue if necessary

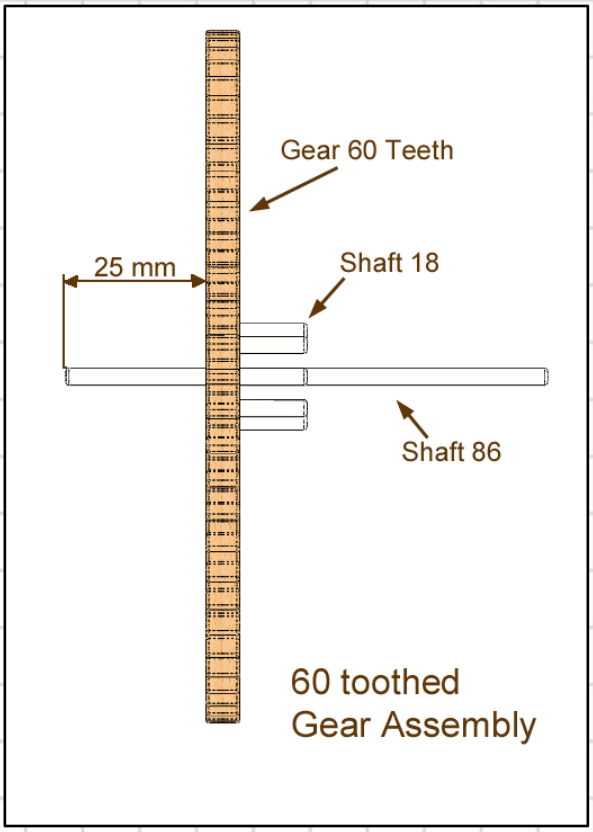
Clock 57 - Pendulum Driven Clock

Construction instructions for Clock 57

Step 2 Preparation of the Gear Sub assemblies



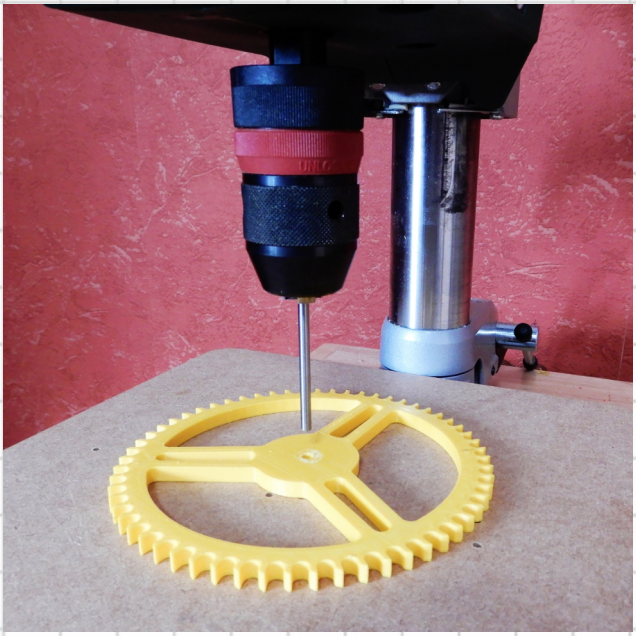


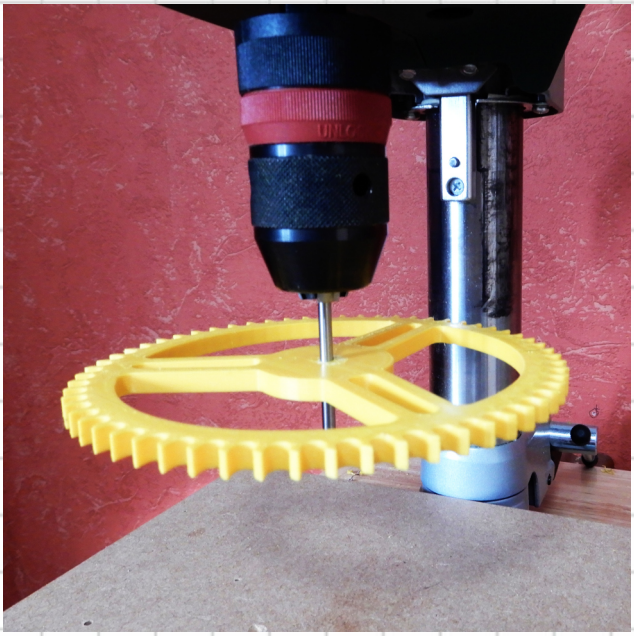


Clock 57 - Pendulum Driven Clock

Construction instructions for Clock 57

Step 2 Preparation of the Gear Sub assemblies



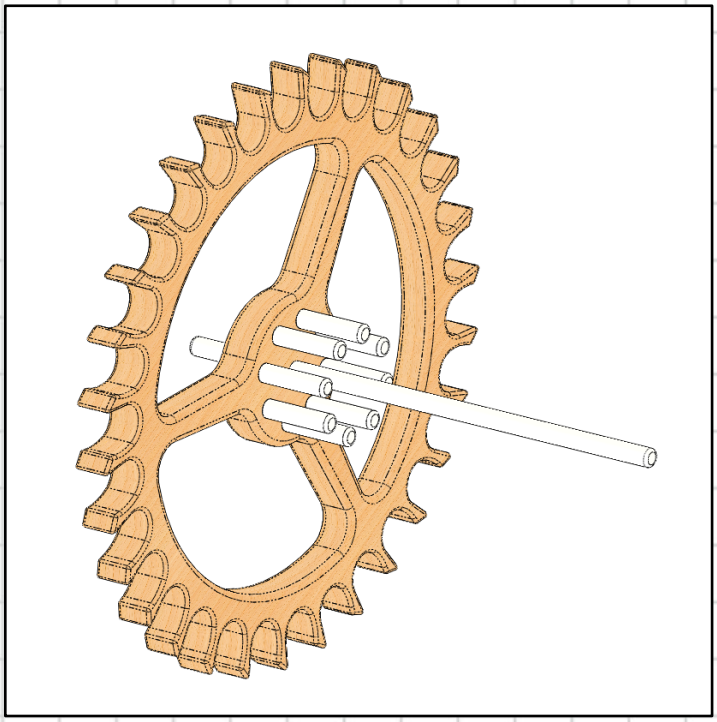


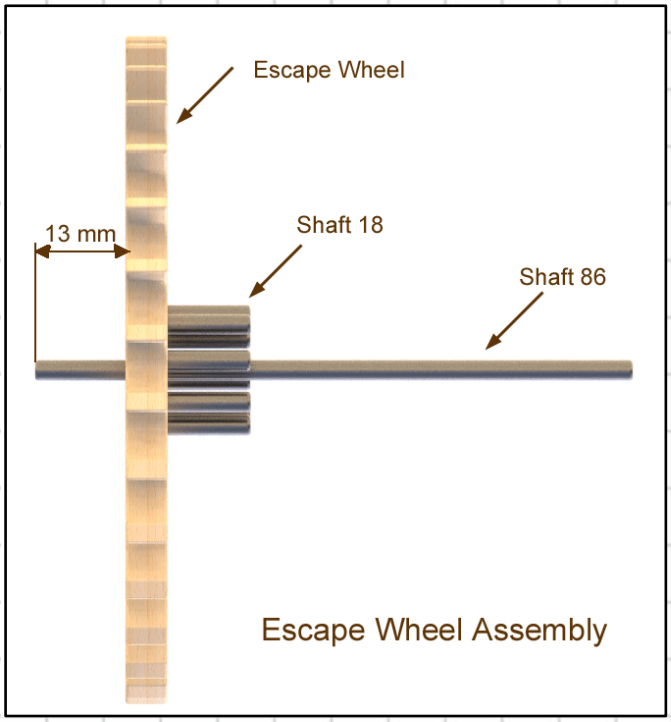
The Gear shown above is required to be assembled with care to ensure the shaft fits square to the gear. I recommend you use a drill press to do this as I have done, as it ensures that the gears are mounted square to the shaft.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

Step 2 Preparation of the Gear Sub assemblies

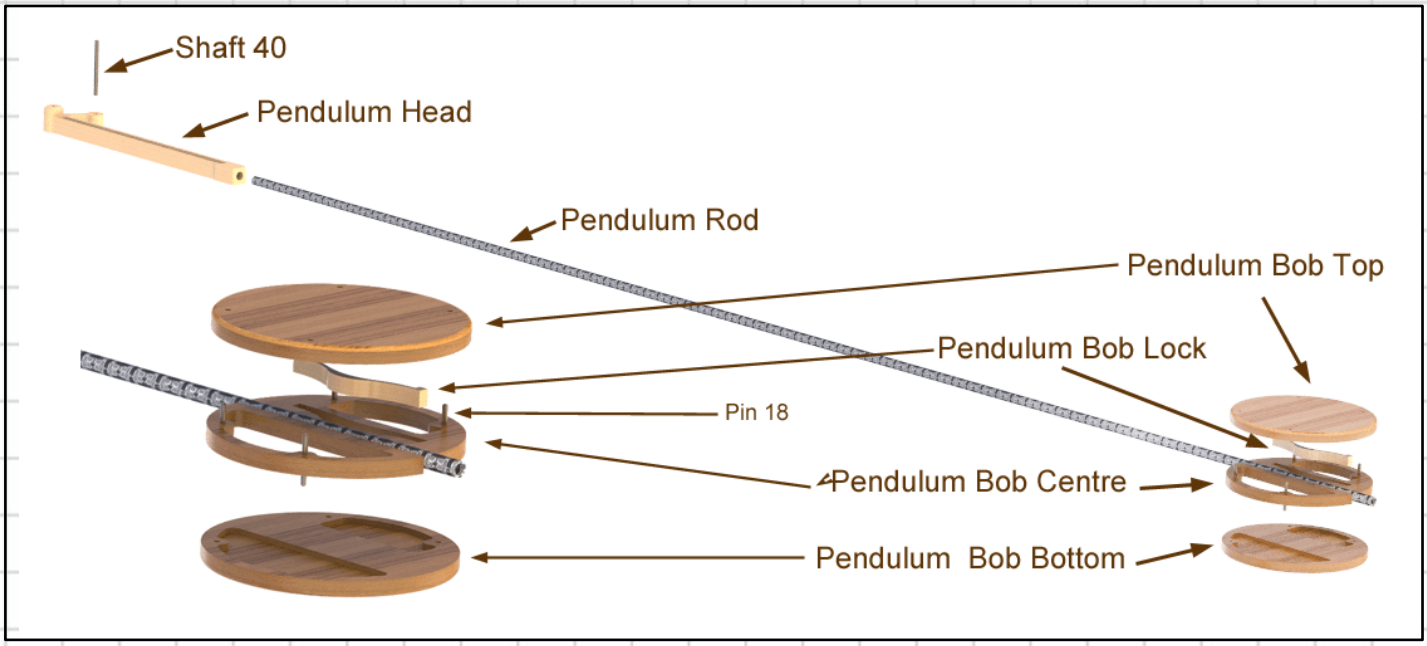




Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

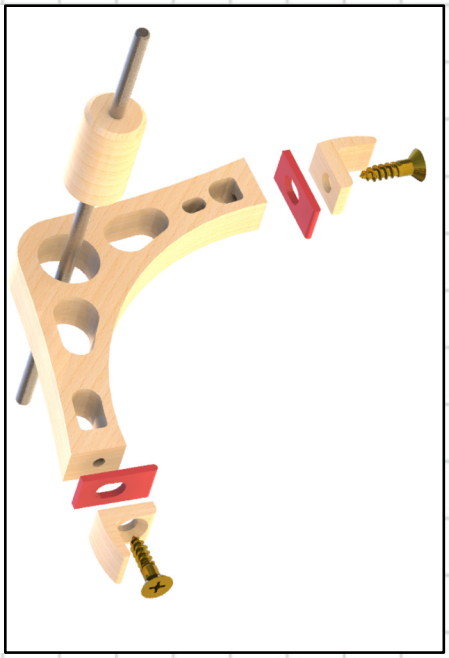
Step 3 Preparation of the Pendulum Assembly

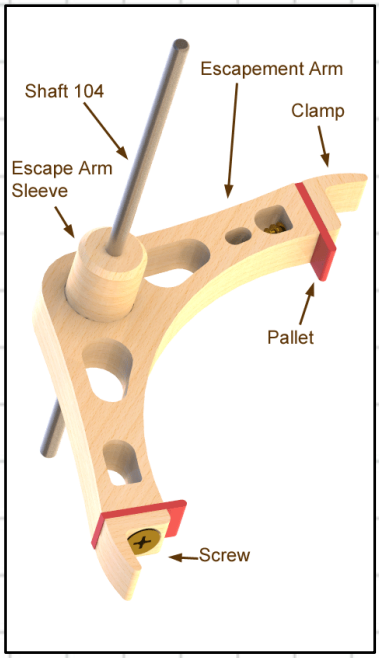


Fit and glue the pendulum Rod into the Pendulum Head and the Shaft 40 also a tight fit in the Pendulum head.

Assemble the 4 Pendulum Bob components around the Pendulum rod use 4 of the Pin 18 to secure them together. Not forgetting to add multiple Ø9 mm Ball bearings for extra weight before finally closing them all together. You can glue these together if necessary.

Note the lock should press tightly to the rod when assembled to stop it moving freely on the Rod but lose enough to be moved up and down to adjust the rate of the clock.





Now assemble the Escapement Arm, start by inserting the Sleeve into the Escape arm and gluing in position if it is not a tight fit.

Next fit the shaft into the sleeve and push it all the way through until it protrude 30 mm. It should be a Push fit in the sleeve.

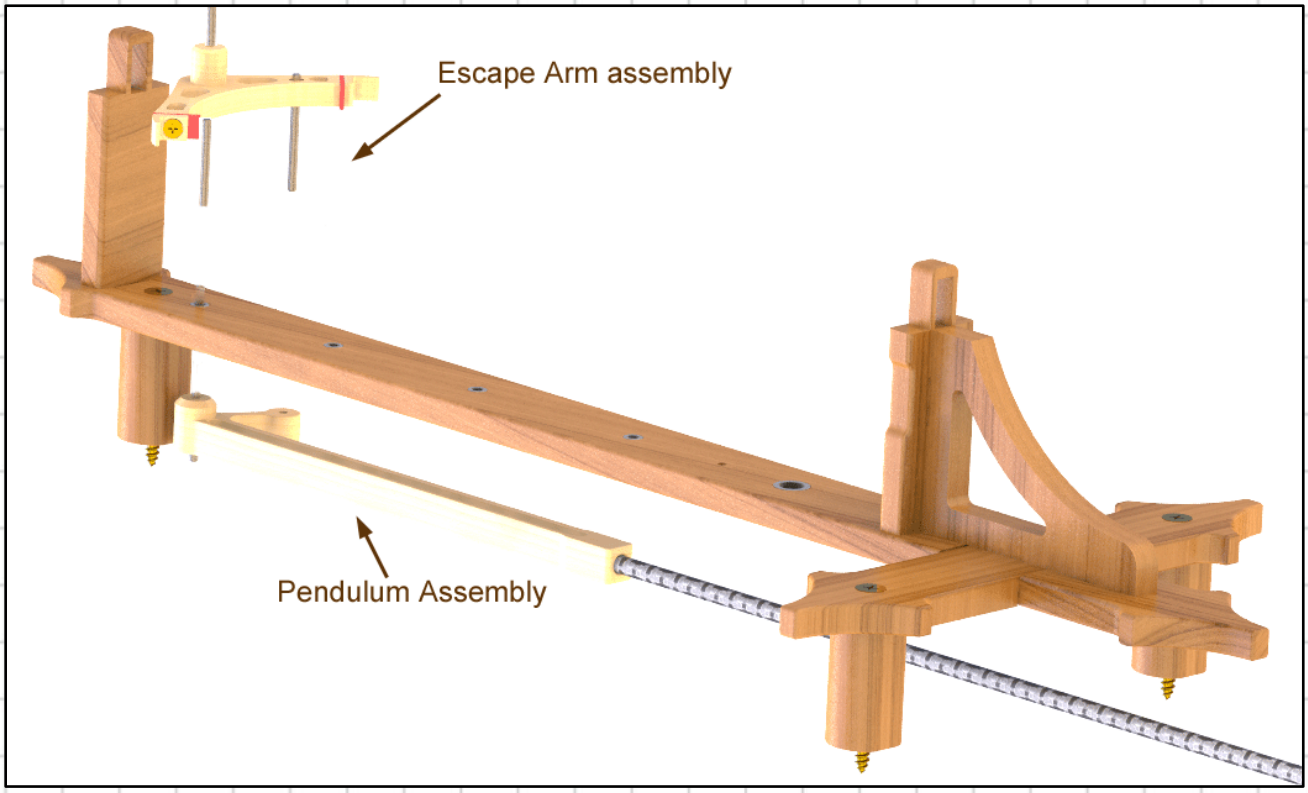
Now fit the Pallets to either end using the Clamps and the small wood-screw to secure in position.

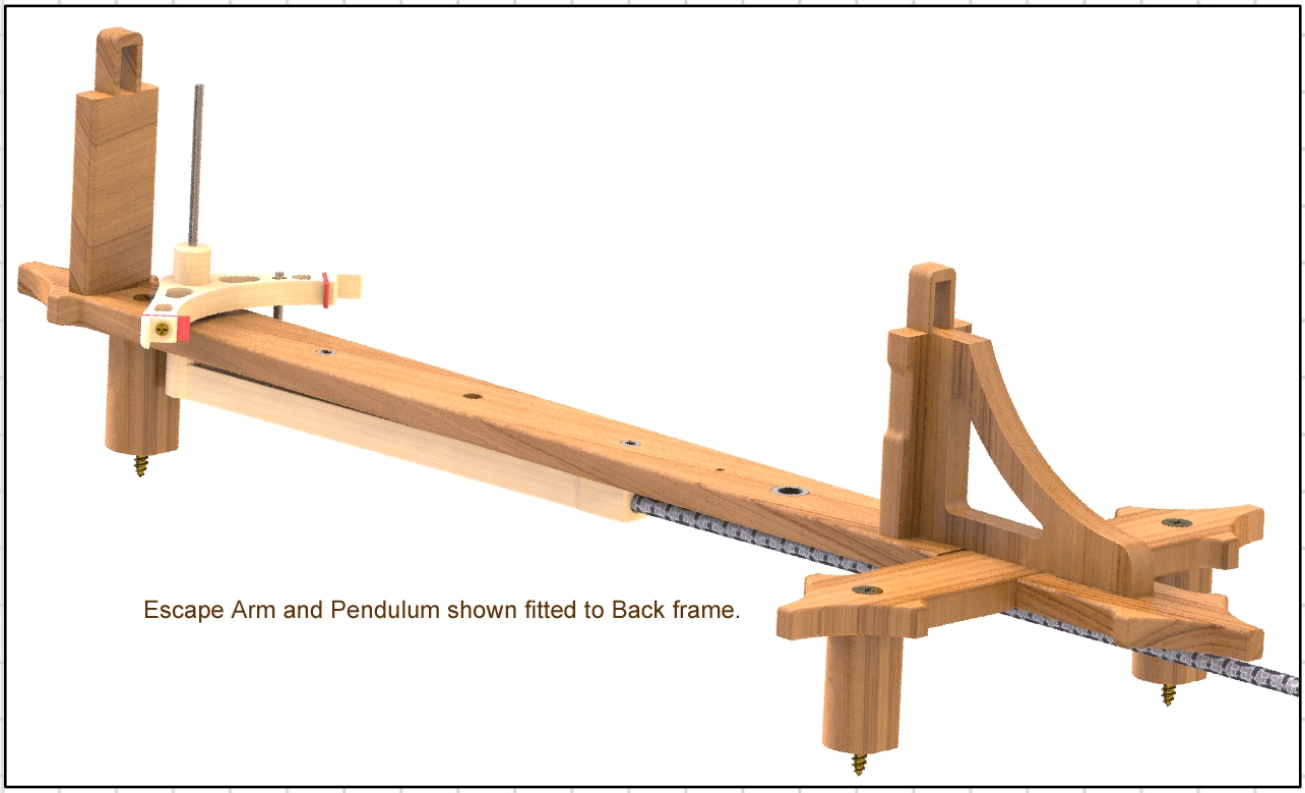
Start with the top edge of the pallet flush with the top face of the Arm as shown here. It may be necessary to adjust this later when setting up the clock.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

Step 4 Fit the Escapement and the Pendulum to the Back frame





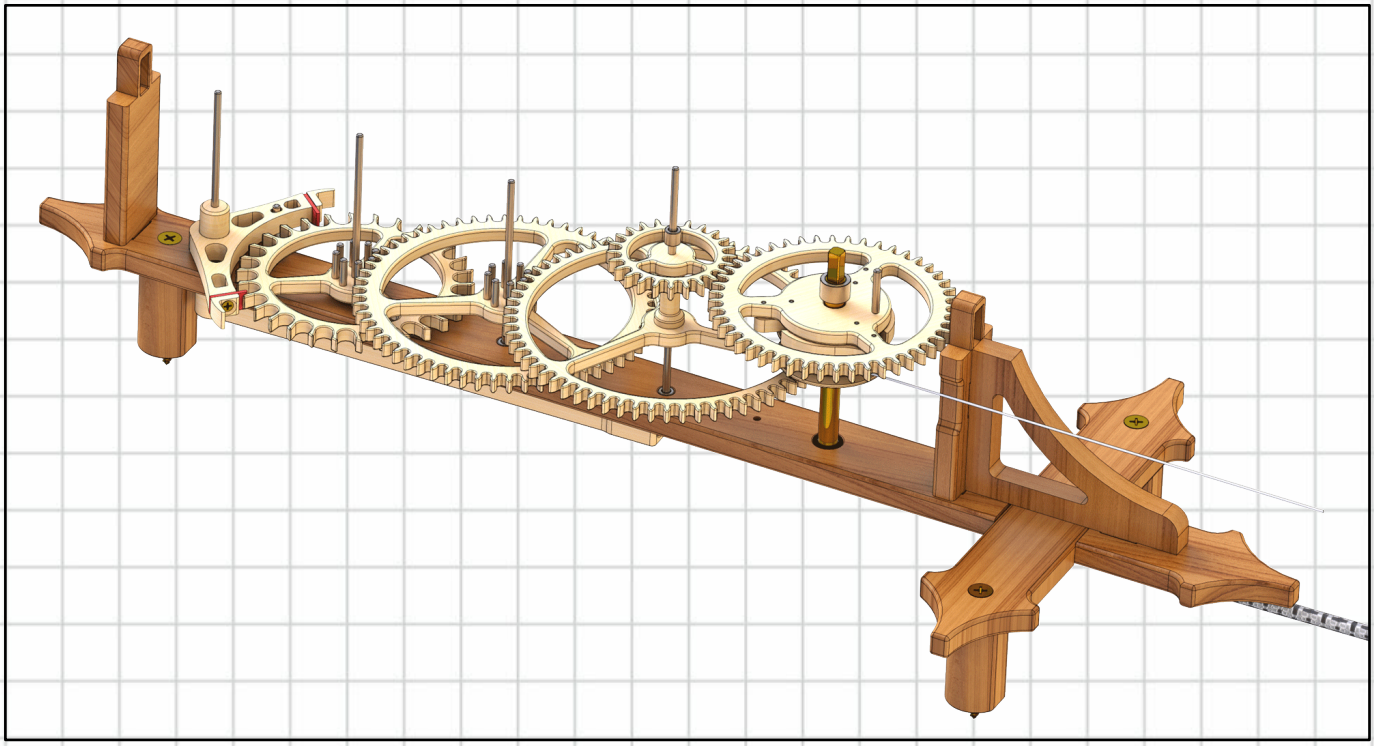
Escape Arm and Pendulum shown fitted to Back frame.

Slide the long shaft through the top bearing and push into the top hole in the Pendulum Head until it reaches the other side. The two assemblies are now be locked together but should turn freely in the Bearing.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

Step 5 Fit all the Gear assemblies to the Back frame as shown

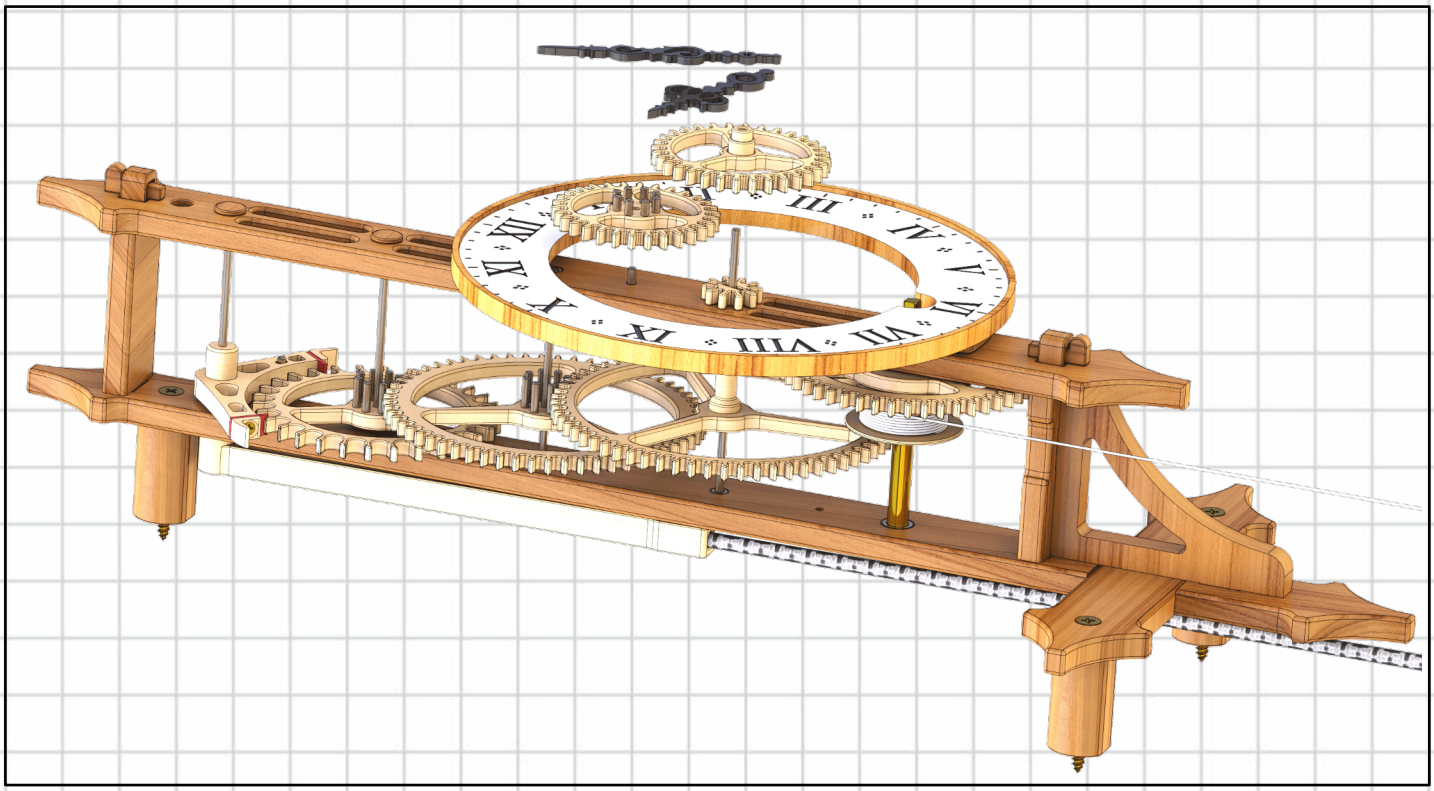


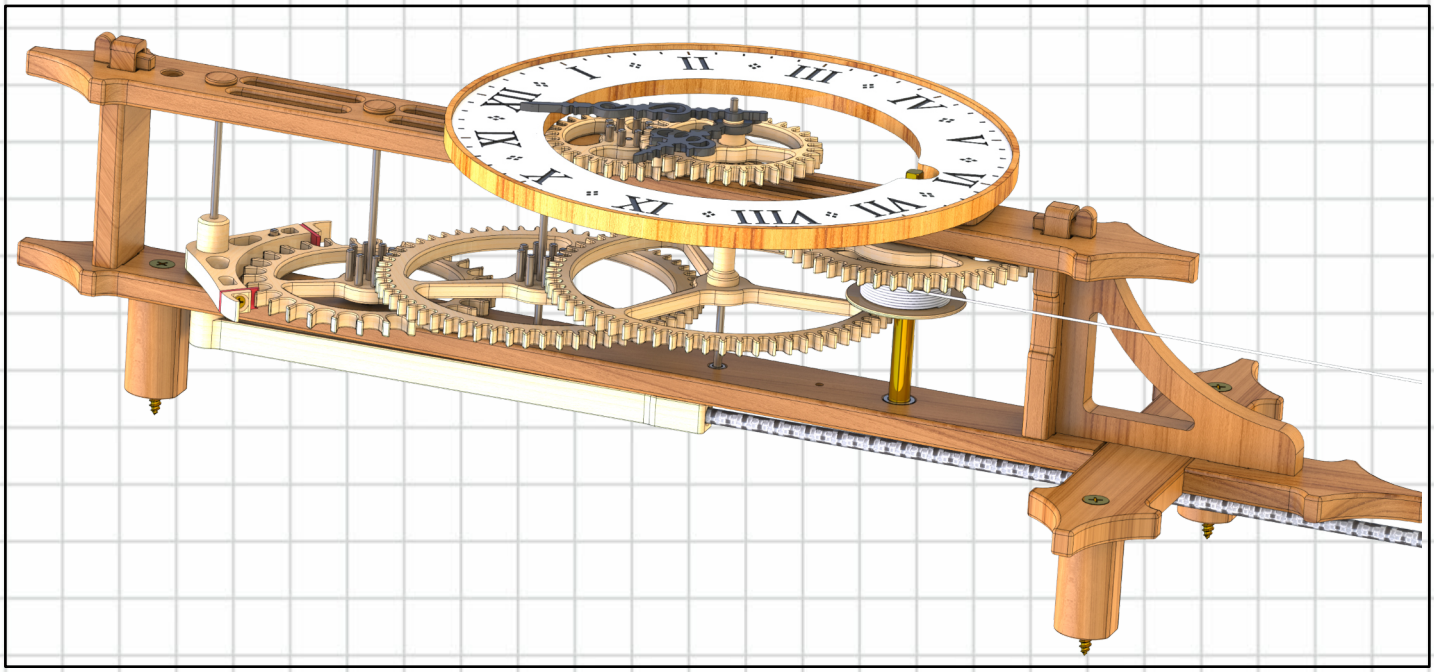
Load the gears questionably starting with the Escapement wheel assembly next to the Escapement arm. Make sure each gear engages its pinion correctly before moving on to fit the front Frame.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

Step6 Fitting the Front Frame



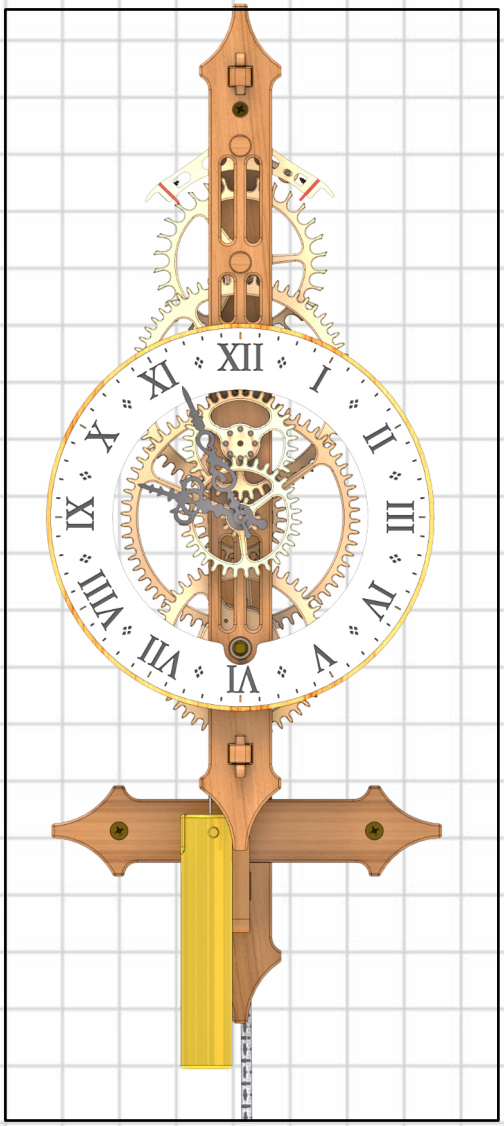


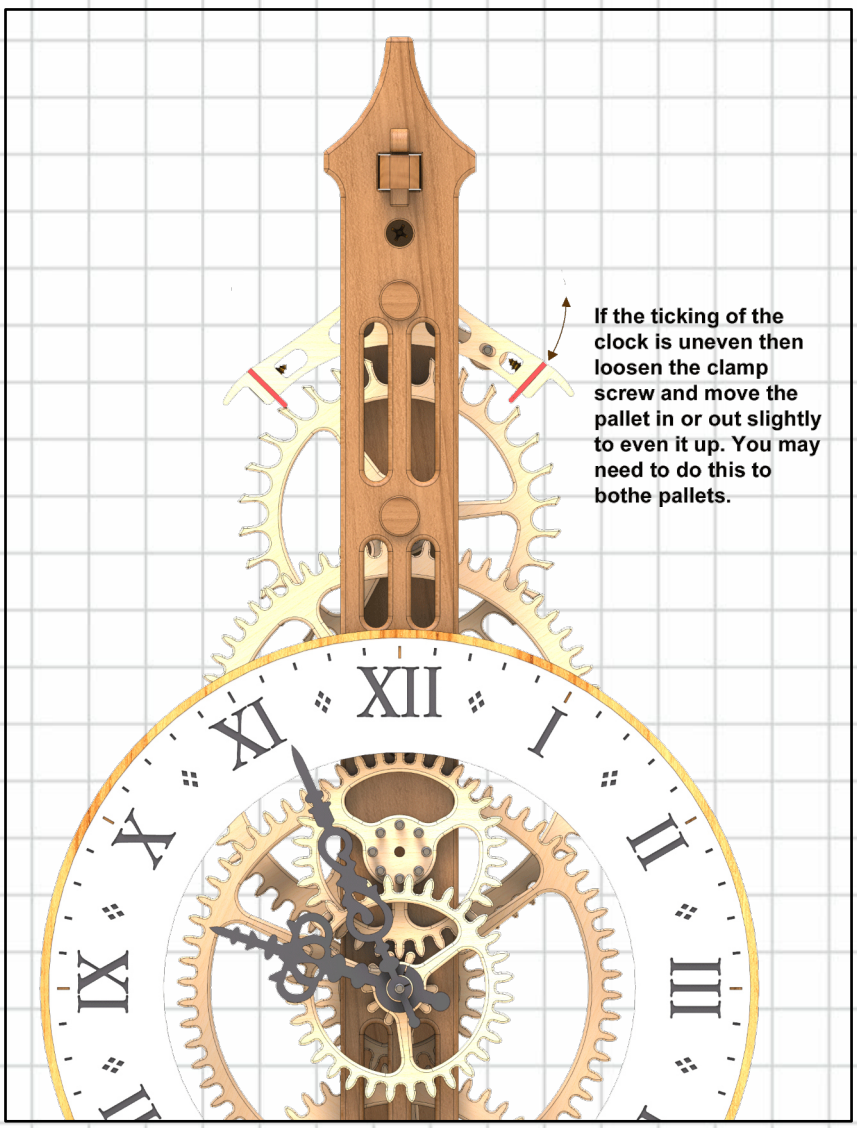
Front Frame is next to be fitted by sliding onto the tops of the Frame spacers and then carefully engaging each of the Protruding Shafts into their respective Bearings and finally pushing the frame down to its seat on the Frame spacers. Two wedges are then fitted to hold it in place.
The hour gears are fitted next the 10 toothed gear is first pushed onto the protruding Minute Shaft, its a tight fit. The 30 toothed gear is next by sliding it under the dial at the top edge whilst engaging the short protruding pin. Then finally the Hands.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

Step Mount the clock on the wall





Mount the clock on the wall using the three screws, making sure to make the frame completely vertical. If the pendulum Rod is not hanging vertical then the clock will tick irregularly, so then adjust the pallets as shown to correct this. When the clock is running continuously you can correct any error in the running rate by moving the pendulum Bob up slightly to speed it up and down to make it run slower.

Clock 57 - 24 Hour Clock

Construction instructions for Clock 57

HINTS AND TIPS - continued

- Main Weight between 600 grams total for the two weights
- Distance from pivot to centre of Pendulum Bob 110cms
- Run time 25 hrs when dial is set at 1600 mm above the floor.

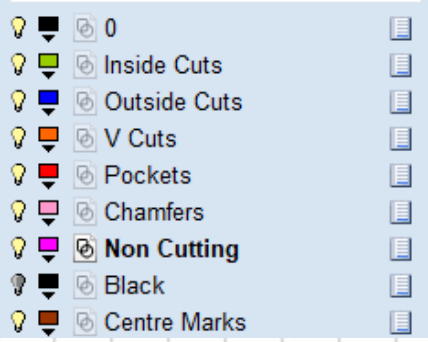
- When fitting the gear sub-assemblies into the frame make sure the mating gears engage and run smoothly. The faces of mating gears should be aligned so they fully engage with each other, i.e. the front faces of the gears are lined up. There is some clearance built into the design so that when the gears 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 57 - 24 Hour Clock

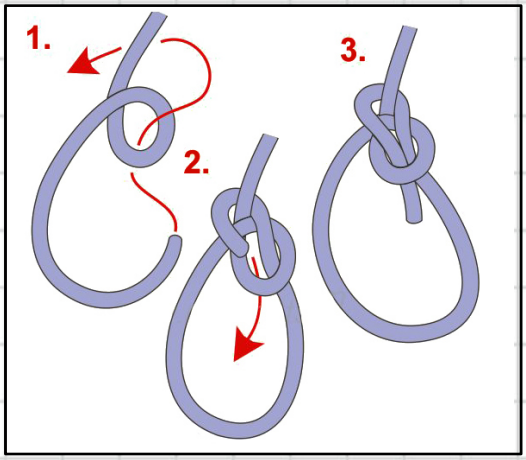
Construction instructions for Clock 57

- The Pendulum Bob needs to be fitted so that the centre of the Bob is about 110cm 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