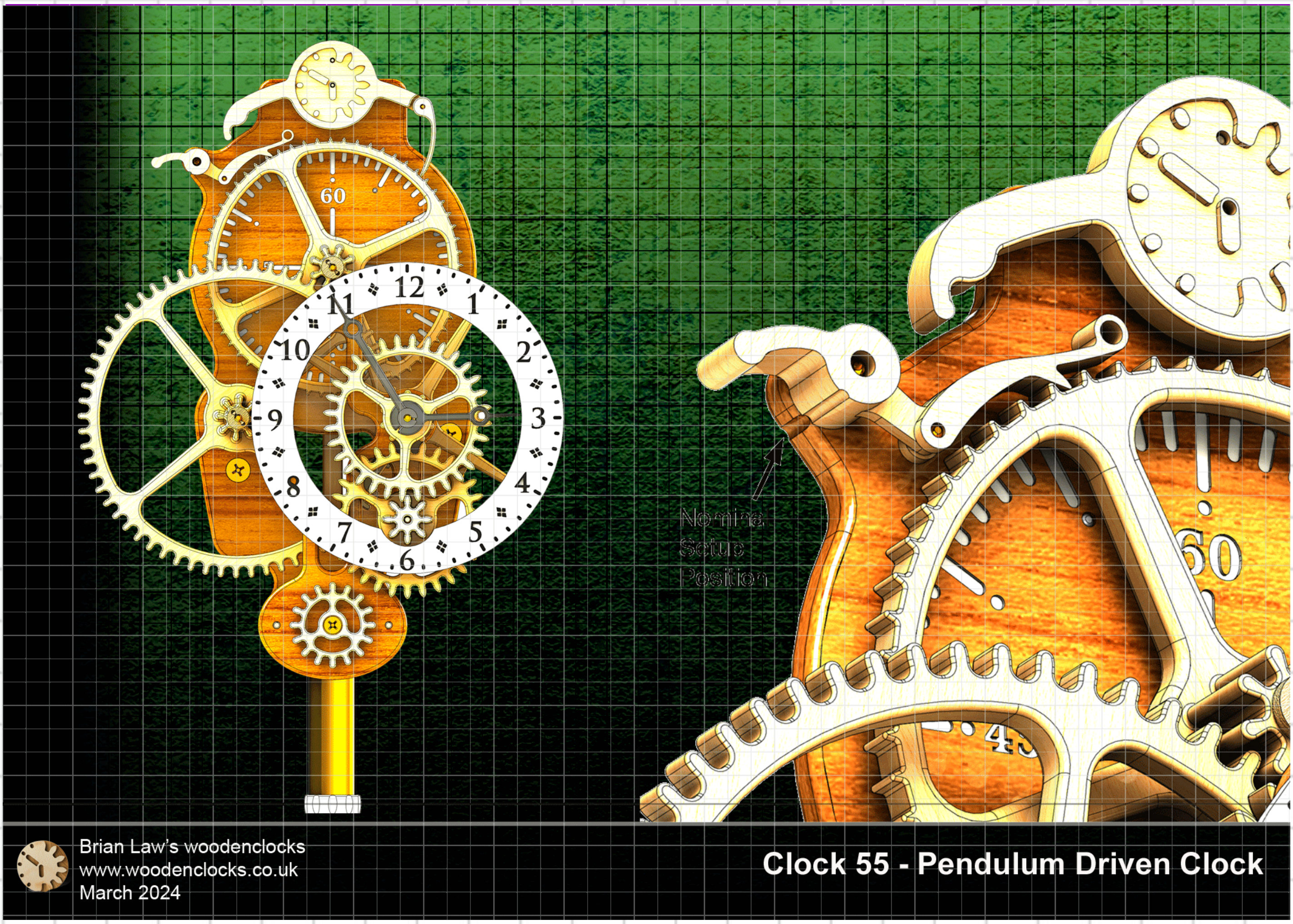
Clock 55 - Pendulum Driven Clock

Construction instructions for Clock 55



Clock 55 is a developed version of previous Pendulum driven clocks with a reconfigured Backstop to make it a little easier to set up the Pendulum drive unit.
It retains the minimal front frame making more of the gearing visible from the front.
The clock can be built from the Plans and files provided either by machining using a CNC machine or cutting out by hand with a scroll saw. It can also be built using 3D printing if you have that kit.
It still retains its main advantage over conventional drive units in that it will run for 2 months on a single AA battery

Equipment

The following equipment is desirable:

CNC Router or Laser or Waterjet and if not one of these then a Scroll-saw or a Bandsaw.

3D Printer is also an option for making the parts for this clock 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 mm Ø2.9mm, Ø3 mm, Ø3.1 mm, Ø3.2, Ø6 mm

Router Cutters Ø 2mm, Ø3 mm and possibly Ø6 mm for cutting out the larger frames.

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

If you want to save a lot of time, then look at a **Sanding disk** and a **Drum sander** but these are really just nice to have.

Consumables
Sandpaper in various grades from rough to fine
Danish oil for finishing.
Gorilla Glue
PVA wood glue
Dry Film Lubricant in a spray can for the gears after everything is finished.

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Materials

For all the wooden Parts

The choice of material to build the clocks from is a very personal one and is down to you to decide. I prefer to use actual timber, Cherry for the frames and Maple for the gears and other parts. I use timber machined to a standard size of 125mm x 6mm, and, and these are fabricated into blanks for the larger components by gluing two strips together.

You can, however, use a high-quality grade of plywood (Marine Ply) or MDF this route is a lot quicker as you can lay out multiple parts on a sheet and have the whole thing cut out in a day, still need to put in the time cleaning up the parts and making all the other bits, but generally speaking, the whole thing can be done a lot quicker. However, on this particular clock, I would advise against using Plywood for the Drive-wheel as the teeth on this part are very thin and can be fragile as they are used to drive the Gear-train and although this is not a high load it is constantly repeated every second.

You can also use Perspex with which you can create some colourful clocks

Whatever you use, the flat 2D parts are all laid out for you on the Profile cuts sheet, this comes as a DXF file, you can manipulate this in your own CAD program, which you will probably need to do, to be able to feed the files into your CAM program. For all the other parts:-

Ø3mm Drill Rod or Silver Steel 700mm Long for all the shafts and numerous pins.
Ø2 mm Drill Rod or Silver Steel 100mm for the small Pins and Pivots
No 8 or 10 wood screws 63 mm long for wall fixing 2 required
No 6 or 8 wood screws 16 mm long for Pivot support 1 required
No 6 or 8 wood screws 25 mm long for Pivot support 1
Ø19 mm Brass Rod 60 mm long for the weight
3 mm thick Plastic sheet for hands and Endstops, ABS or HIPS

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.

You will of course need a Pendulum Drive unit which can be readily found on the internet from Amazon or other, simply search using 'Pendulum Drive unit'

The same applies for finding the Needle roller Bearings HK0306.

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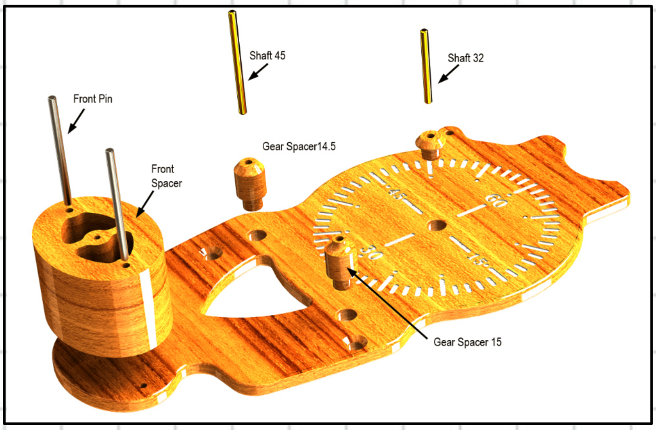
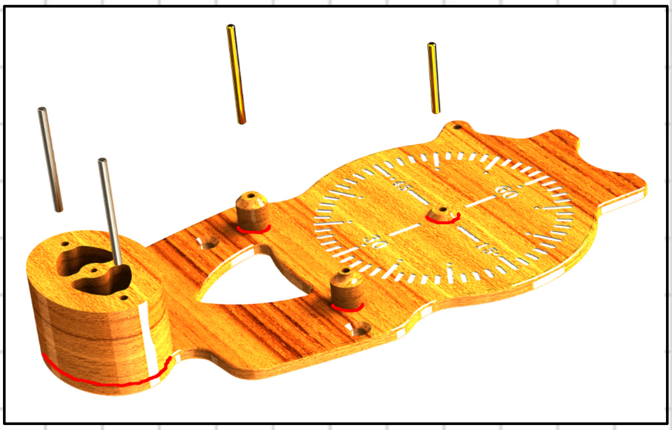
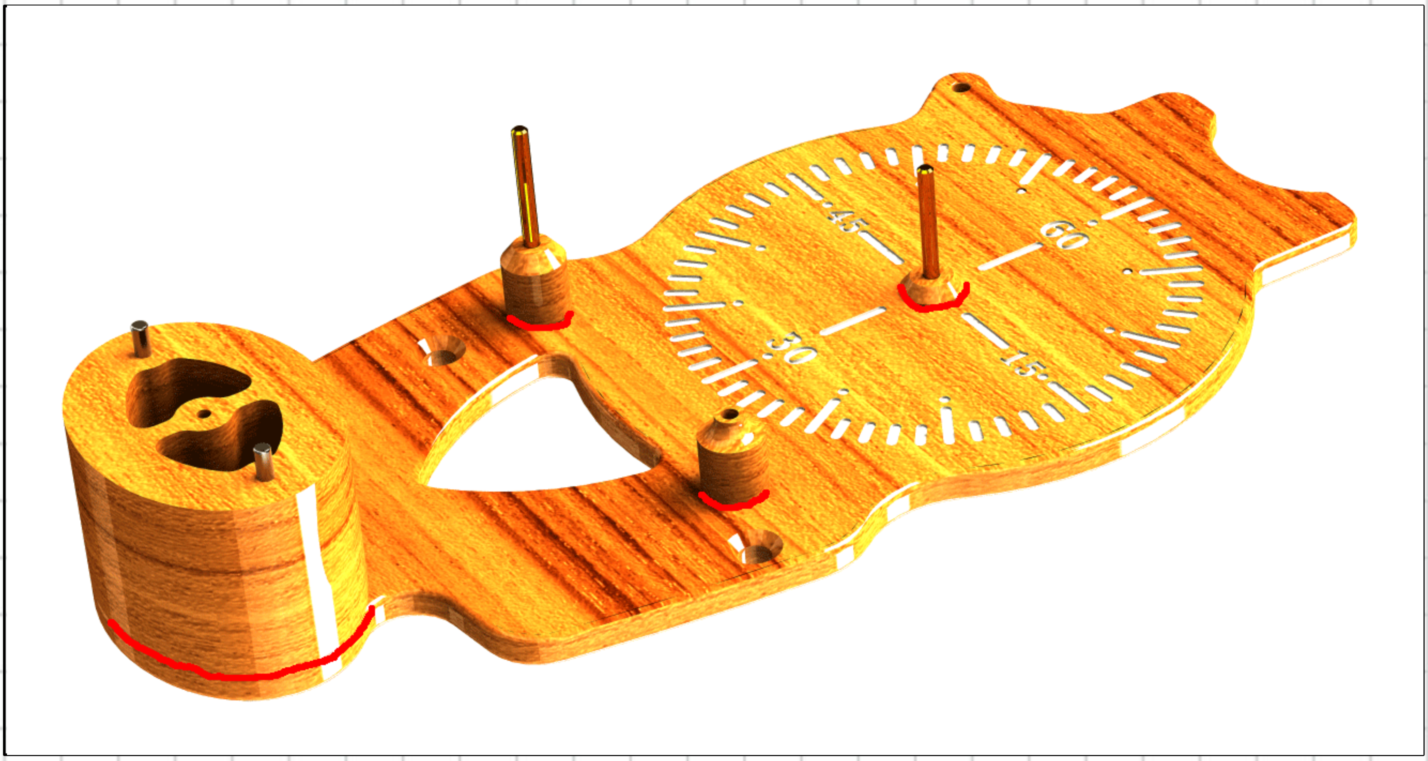
Step 1 Preparation of the Frames





We will start by assembling the Back Frame by installing the Gear Spacers and gluing them in position. The red marking shown above indicate the glue lines.



Next the the Shafts and the pins are fitted in place, note the two shafts are a press fit into the gear spacers, the the two long pins can be a slightly looser fit as the gluing should ensure the rigidity of the Front spacer.
The missing shaft will be fitted later as this is to be a lose fit on that shaft.

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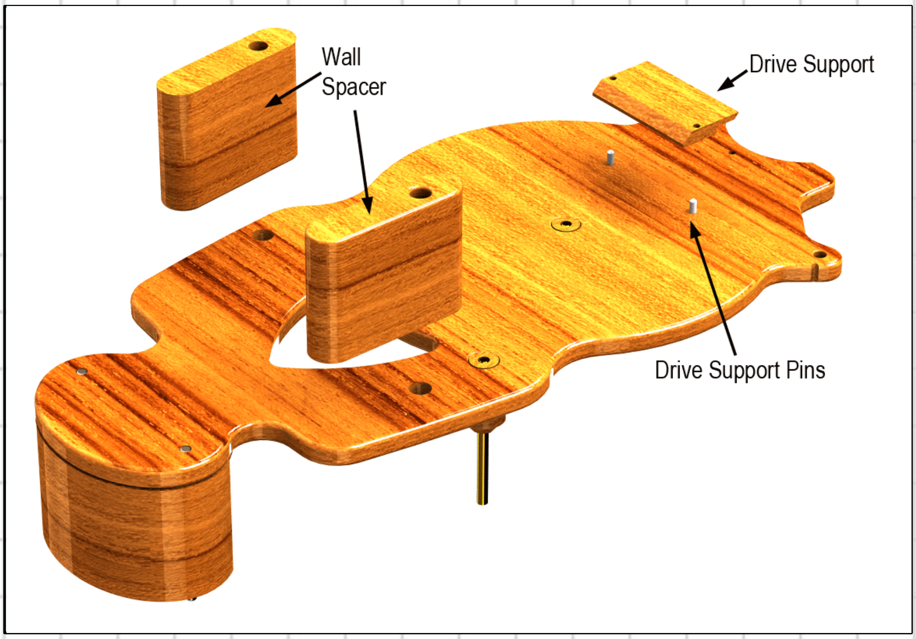
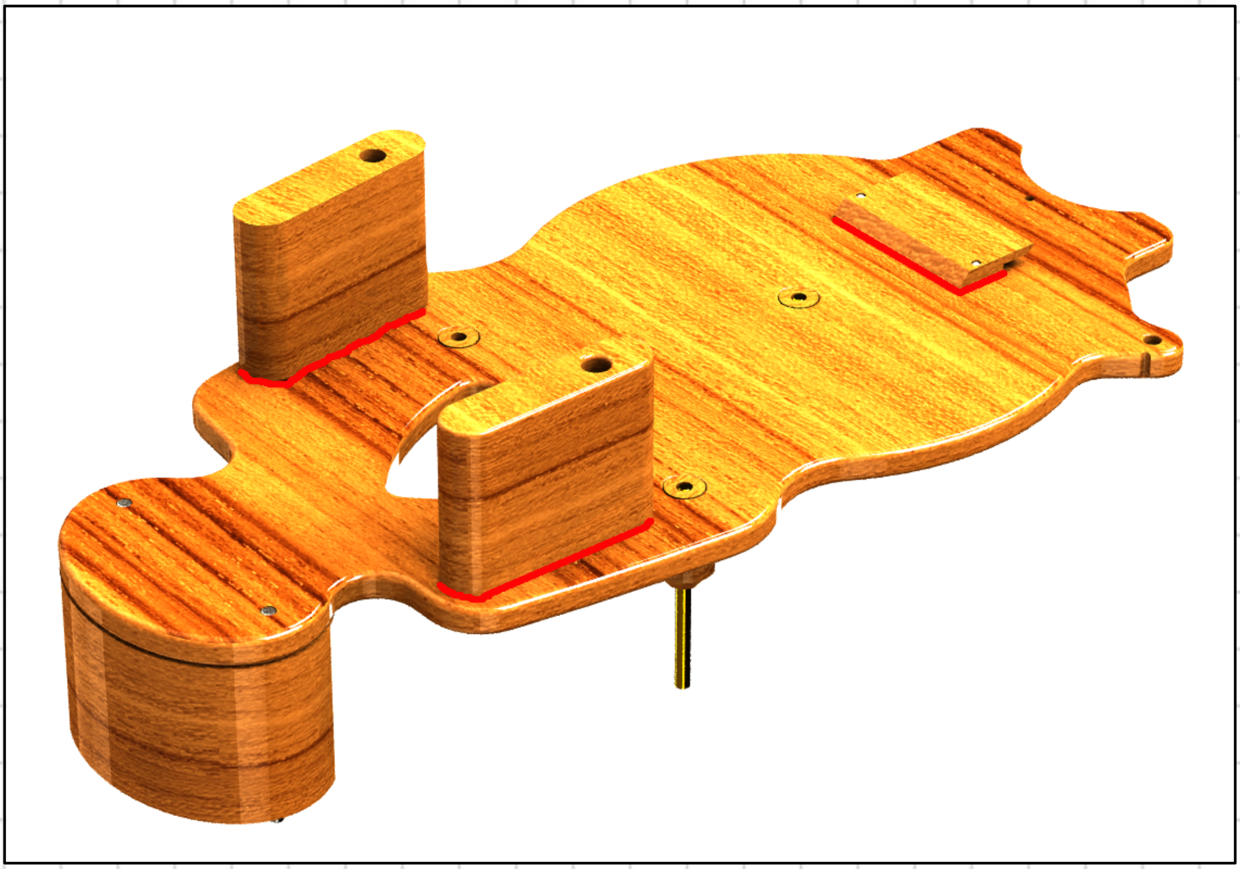
Step 1 Preparation of the Frames



On the back side of the Back frame the wall spacers are first glued to the frame, you may want to use the woodscrews at this stage to locate the spacers in position.
The two short Drive Support pins are fitted next, a press fit into the back Frame and the the Drive support is glued in position, the two pins locating it in place.



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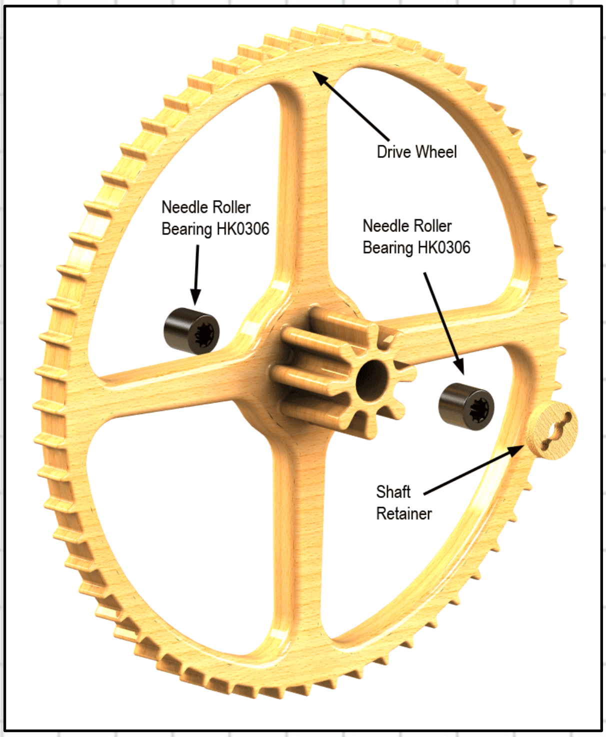
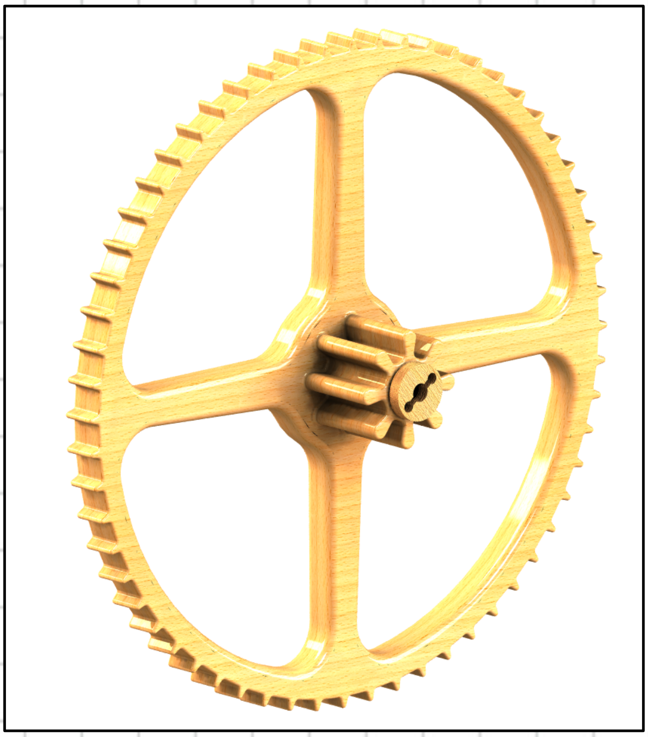
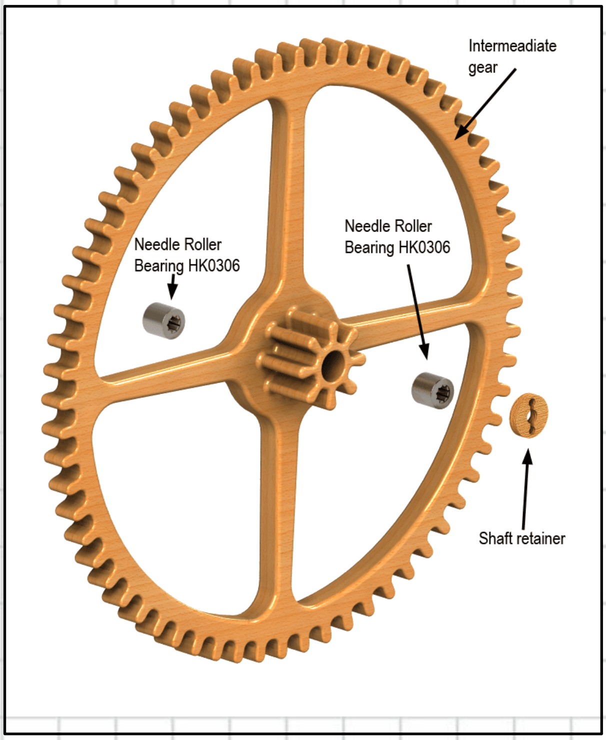
Construction instructions for Clock 55

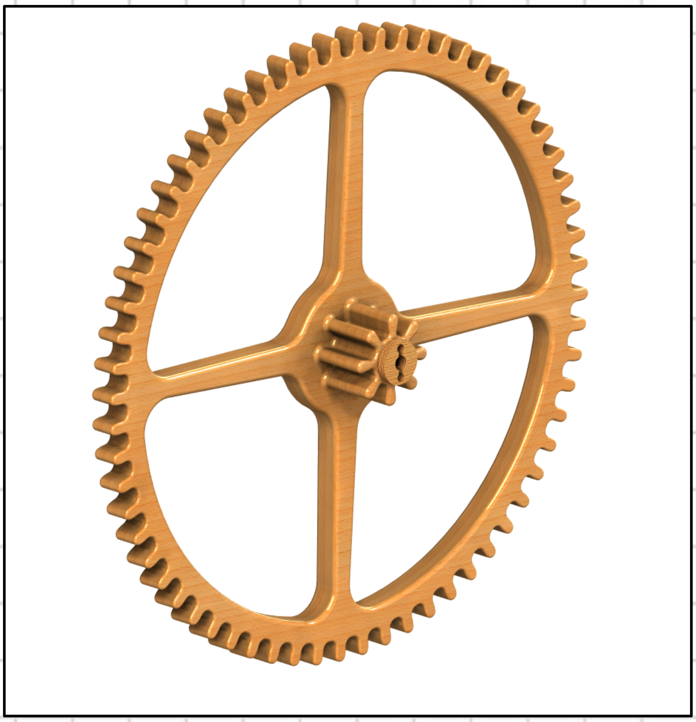
Step 2 Preparation of the Gear-train sub assembly's





Fit the Needle roller bearings into the centre of the gear, I suggest that you feed each bearing in from the same side as it seems to achieve better alignment between the two of them.





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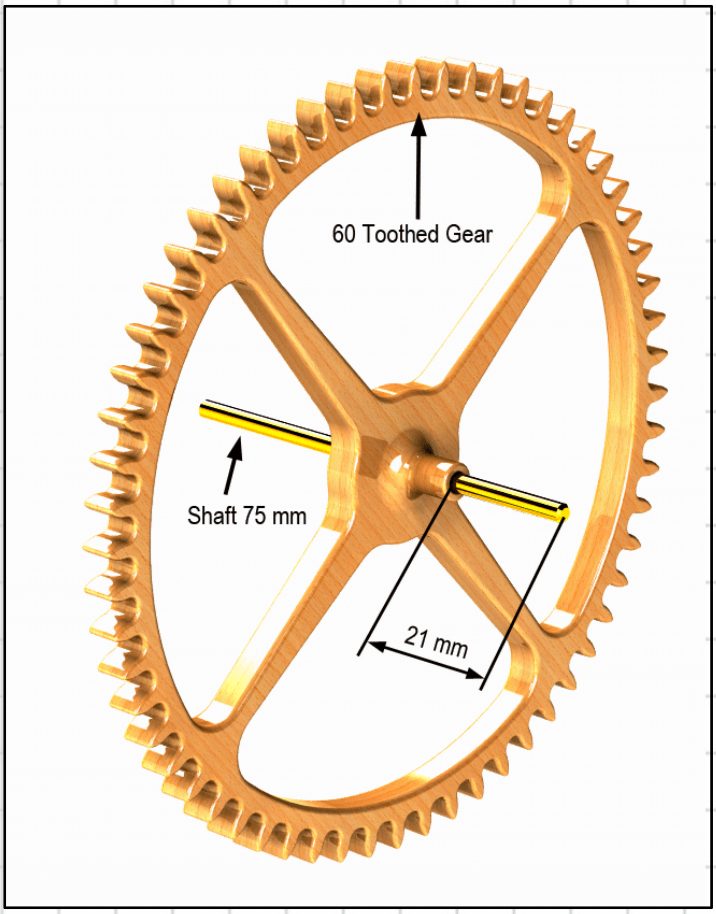
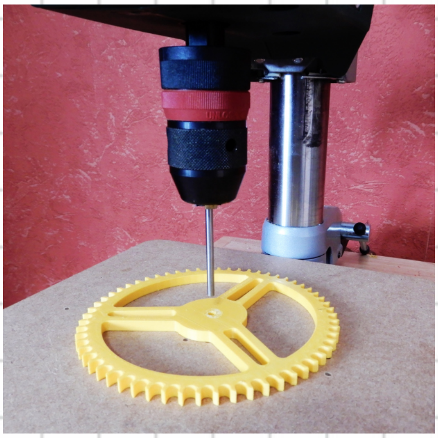
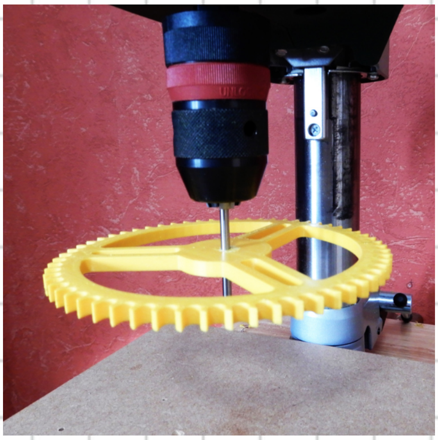
Step 3 Preparation of the Drive train sub assemblies



This Minute shaft sub assembly is the simplest of the three sub-assemblies as the shaft is a press fit into the gear, protruding through its back face by 21 mm. It is important to ensure the the shaft fits vertically through the gear itself.

To ensure this I recommend following the procedure shown below.





The Drive train sub assemblies shown above are all very similar and require to be assembled in the same manner. I recommend you use a drill press to do this as I have done, as it ensures that the gears are all mounted square to the shaft,.They should be a **Press fit** on the shaft.

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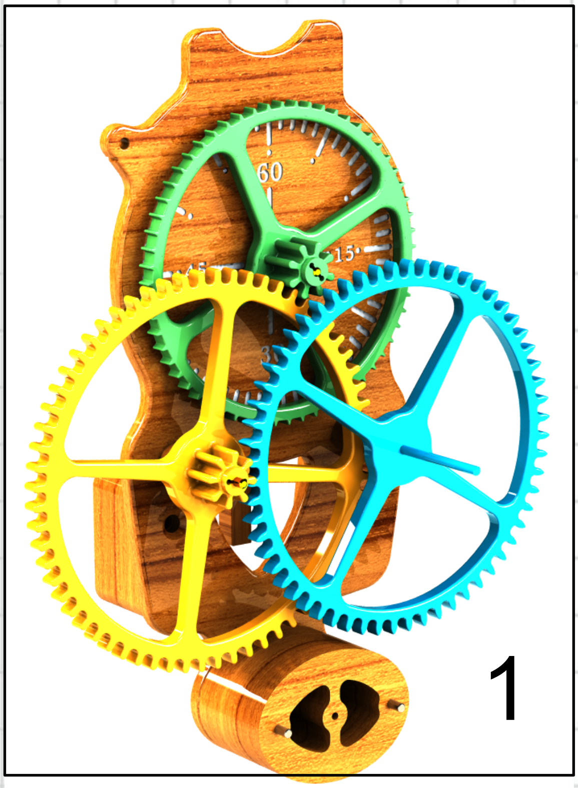
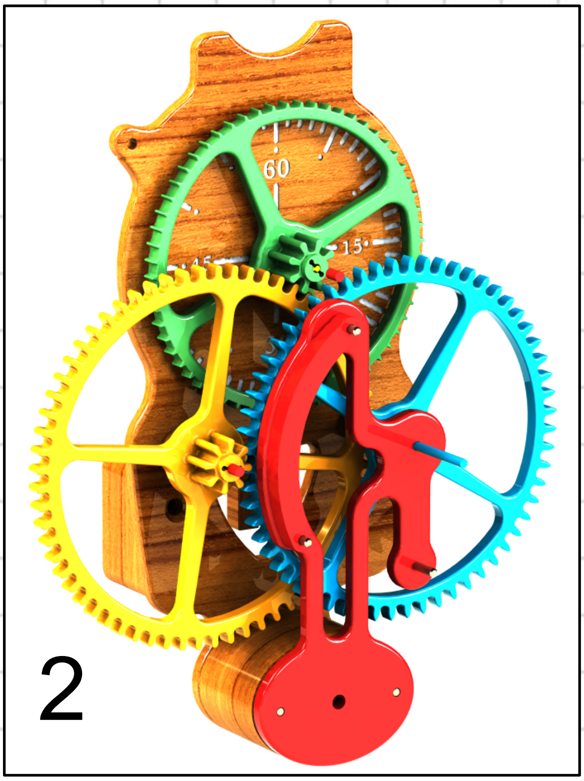
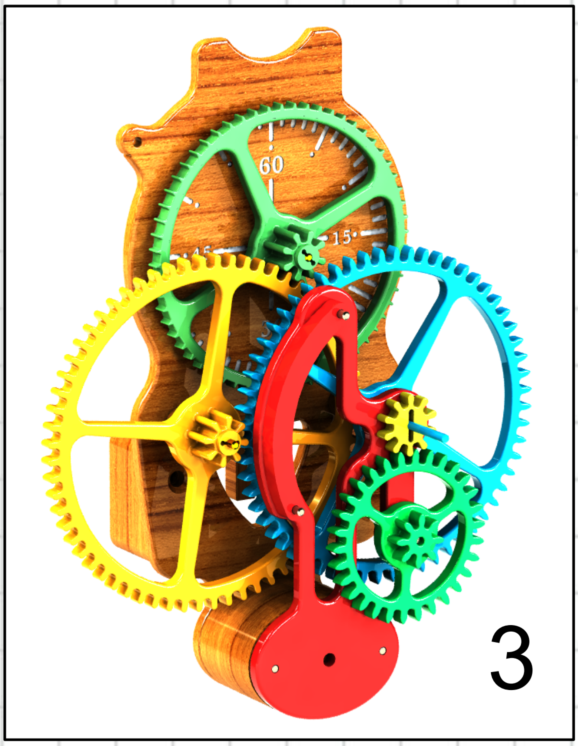
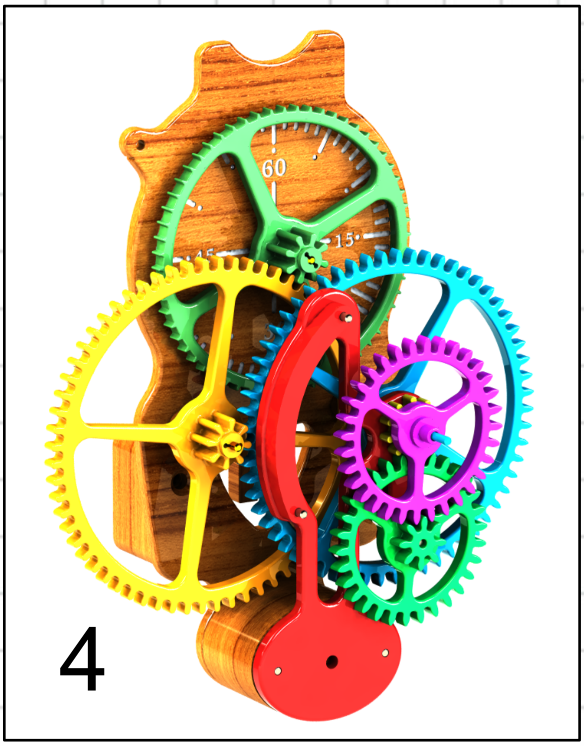
Step 4 Fitting the Gear trains









Load each of the Gear sub assemblies onto the Back frame in the sequence, it is best to do this with the clock laying down on its back. Fit the Drive wheel first, the the next two gears. The Front frame is next but first fit the 3 short pins into it. Now the Hour gears starting with the 10 tooth gear which is a press fit on the shaft and the the next 2 that are both lose fit on their shafts.

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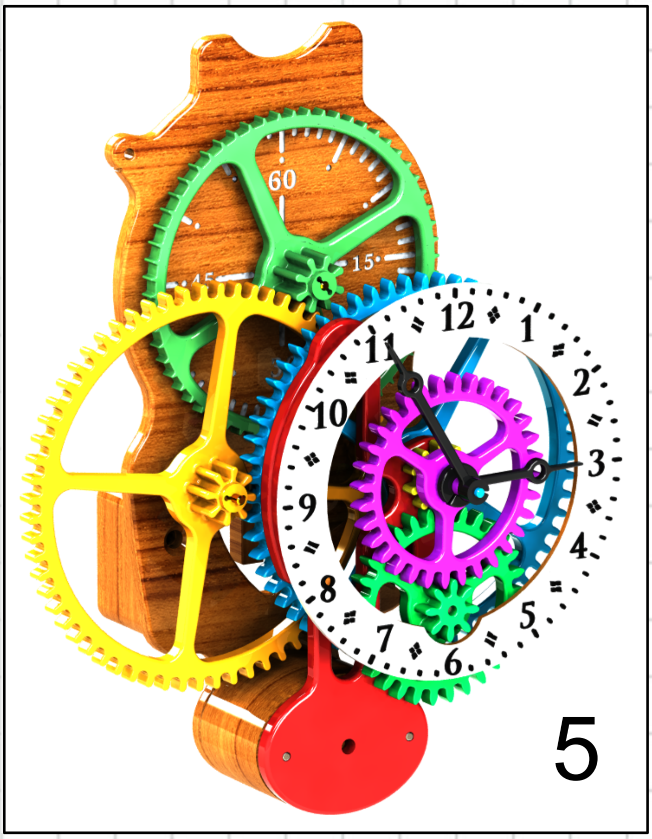
Step 4 Fitting the Gear trains



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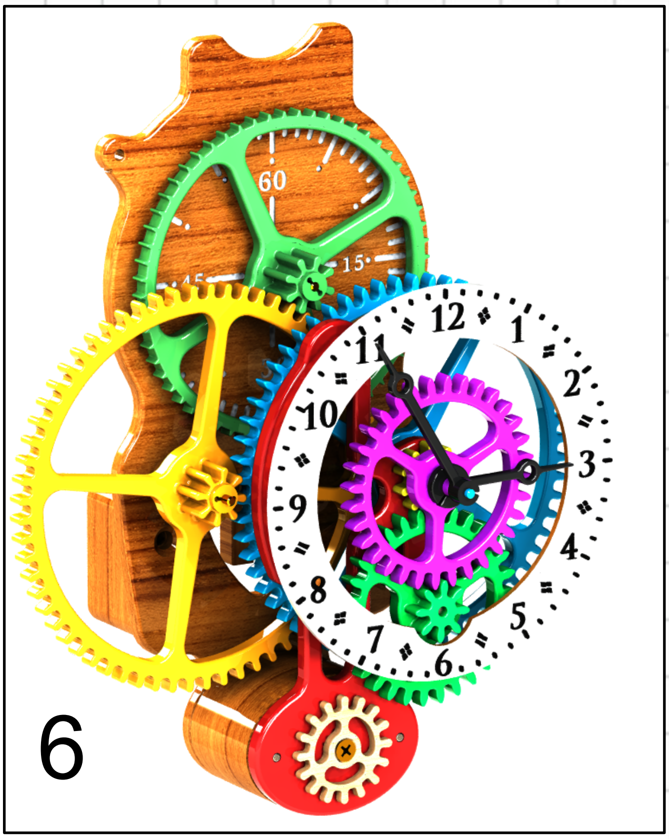

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The Dial can now be fitted to its 2 location pins, if this is not a tight fit then you will have to glue it on. Finally for this stage screw the Front gear in place. This is decoration only so you can something of your own choice here but remember the screw is holding the front frame in place as well.

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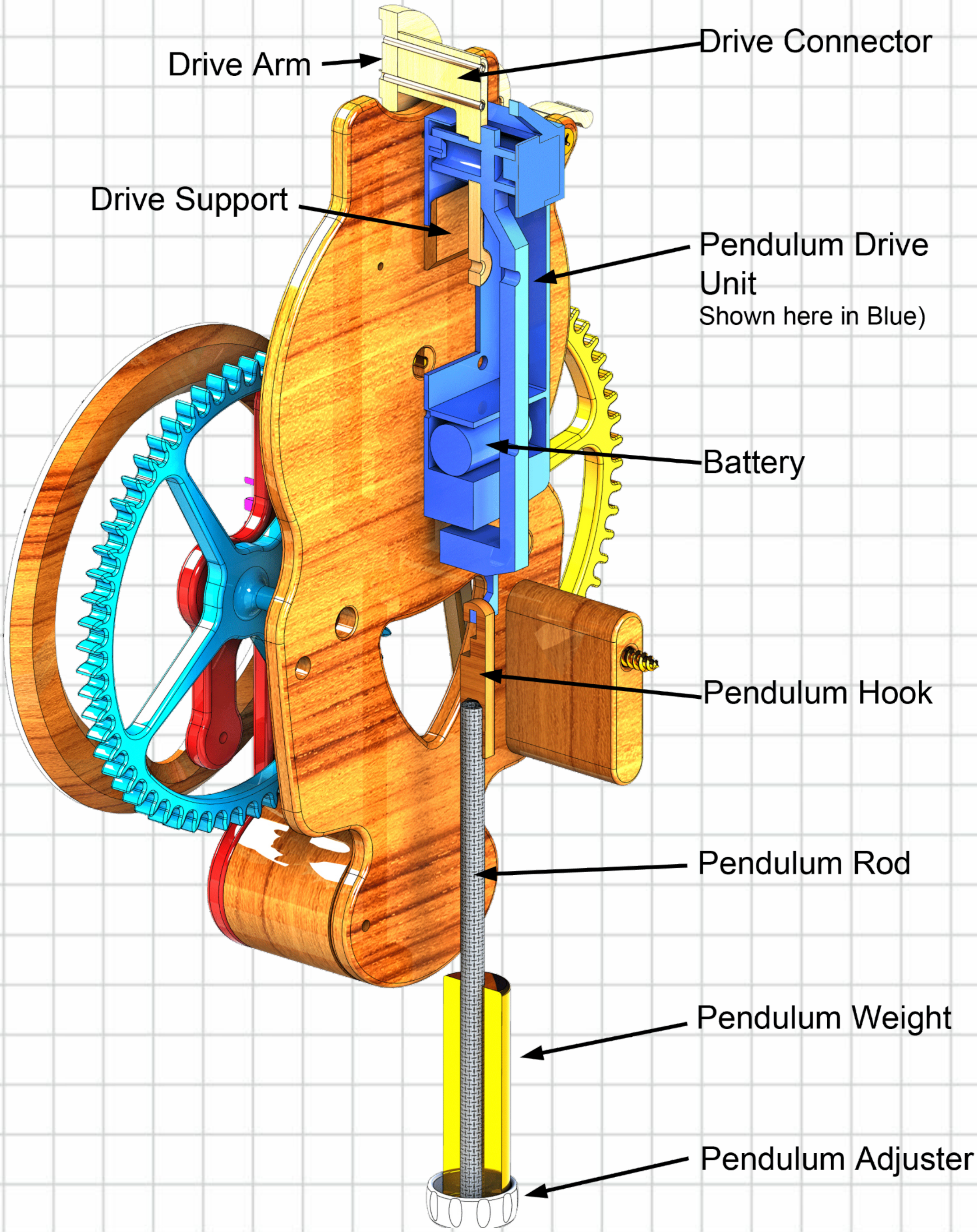
Step 5 Preparation of the Pendulum sub assembly



The pendulum assembly from the Drive Connector at the top the Pendulum Adjuster at the bottom all hang together when picked up by the Drive Connector. This assembly can now be hung onto the back of the clock by feeding the big square hole in the back of the Pendulum Drive Unit over the Drive Support glued to the back of the Base Frame as shown above. The Drive connector may need jiggling about a bit to get it to sit squarely on the pivots inside the Pendulum Drive Unit. This can be done either before or after mounting the clock itself to the wall.

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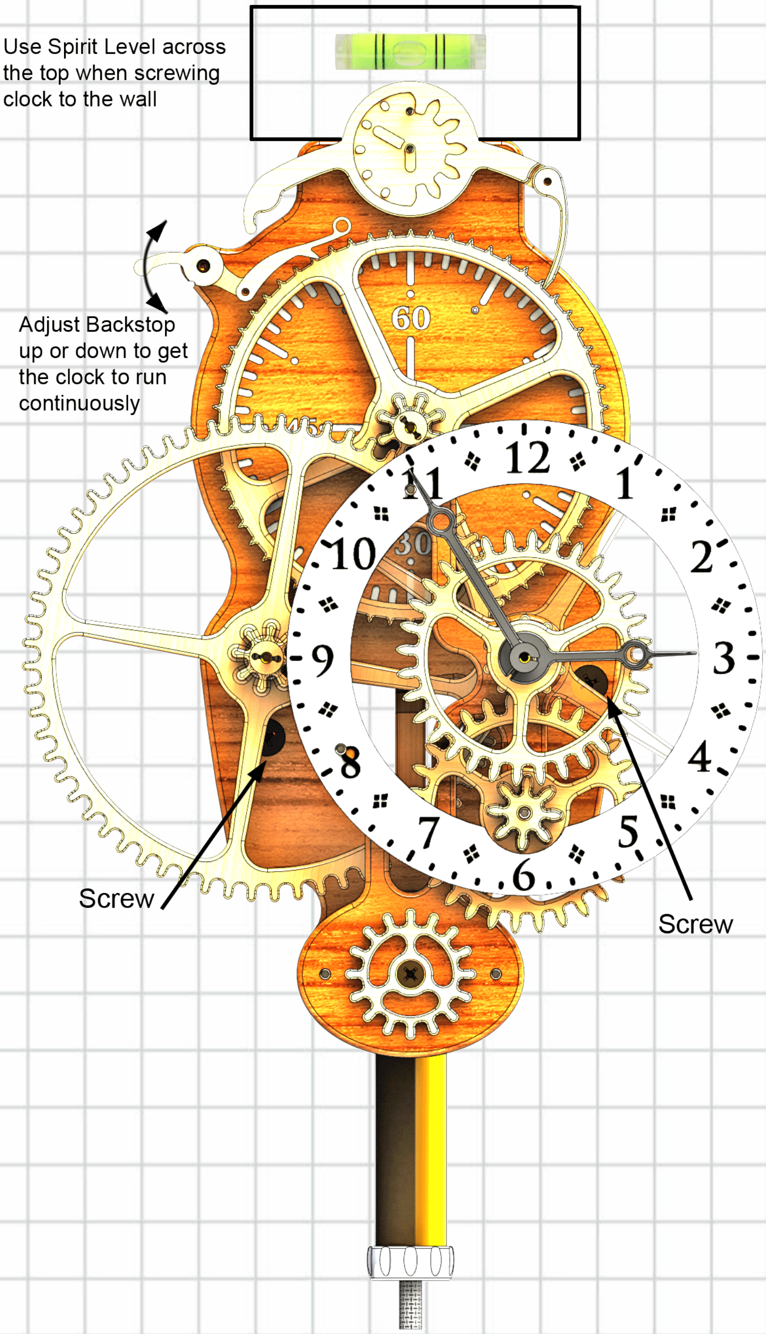
Step 6 Setting up the Weight and Cord and getting it running



After assembling, the clock can be mounted vertically onto the chosen wall with the centre of the Dial at a height of around 160cm .
First use the Screw hole on the Right Hand side behind the gear and secure the clock in that position. Make it tight enough to hold the clock in a Horizontal position using spirit level to ensure this. Fit the second screw at the left position in the centre of the slot and tighten until you can still move that side of the clock up and down slightly to ensure the top is horizontal and the tighten.

The Back stop should now be adjusted so that the notches line up. Now with an AA battery fitted start the pendulum swinging and move the Backstop adjuster up and down slightly to keep the clock running continuously moving one notch at a time.

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Construction instructions for Clock 55

HINTS AND TIPS

- I need to use headed pins for some of the shafts in this clock design but small diameter Clevis pins are hard to find and so I have looked for alternatives. Round nails might work although the finish on those can be quite rough, An alternative I have used on this clock is a plain steel dowel for the shaft and a small plastic split washer that is slightly undersized, I couldn't find a source for these either but they are fairly easy to make. Another alternative is to use carbon steel ground pins for the shafts, and then fit a larger diameter Rod type magnet to cap the end and prevent any parts falling off. Best not to use these close to any ball bearings as it can apply a drag to the rotating balls

- 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 120 grams.

- Establishing the actual weight to use for the main clock weight, 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.

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HINTS AND TIPS - continued

- Main Weight between 750-1000 grams
- Distance from pivot to centre of Pendulum Bob 110cms
- Run time 24 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 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 ‘Chamfers’. The layers are colour coordinated as shown.