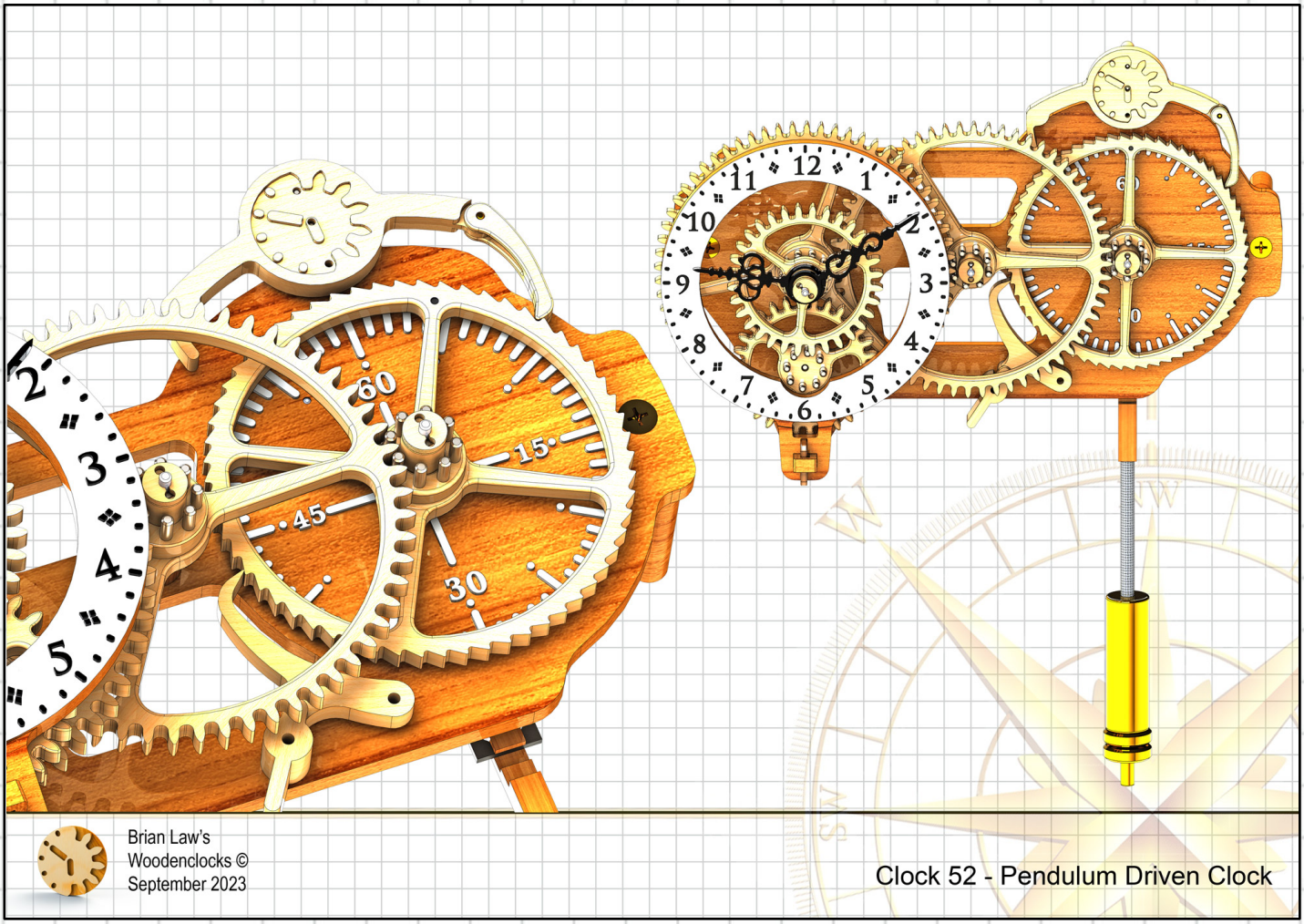
Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52



This clock incorporates a Pendulum Drive unit, a gadget developed originally to add a decorative pendulum to a Quartz drive used in any number of battery powered wall clocks.

The Pendulum drive unit is an inexpensive plastic cased attachment purchased from the internet for around $5 needing only the addition of a clip on connector to attach it to your clock.

The unit works by firing a short pulse to a magnet mounted on the Pendulum section of the unit and it does this at each pass of the swinging pendulum. These units have been used before to drive wooden clocks by separating the Pulse and battery sections and re-positioning them in the base of the clock and at the end of the pendulum. I have done this differently by using the unit whole and simply adding a connector piece to the top of the pendulum that drives a finger, that pushes around what would normally be the Escape wheel. This effectively reverses the action of a normal clock which is driven from the other end of the geartrain. By doing this you need 60 times less power to drive the clocks, so no large weights needed to drive it for weeks on end. Instead the clock runs continuously using a single AA battery and should run for around 10 to 12 weeks based on my prototypes. It also means that you can use this technique to drive a wall mounted clock which you can not do easily with the other method.

This all goes to mean that you can simplify the design by removing the power section of the gearing and the associated stiffening of the structure need to support the larger driving weight.

That being said it can be tricky to set it up and keep it running, there being two adjustments that need to be made to let the clock run smoothly , the lever at the bottom that controls the Backstop and the angle of the Driving Arm relative to the pendulum. Both of these can be manually adjusted incrementally to get the clock running smoothly. I have supplied detail settings that I used on the prototype to get you started.

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.

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, Ø2.1 mm, Ø2.9mm, Ø3 mm, Ø3.1 mm, Ø3.2, Ø6 mm

Router Cutters Ø 1.5mm, 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.

Materials

For all the wooden Parts

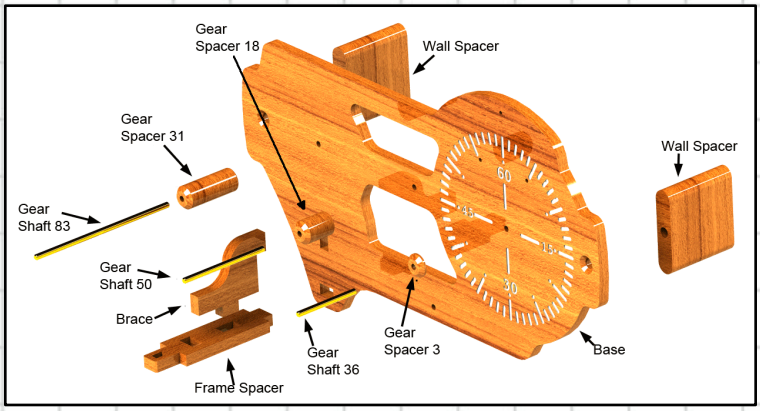
The choice of material to build the clocks from is a very personal one and is down to you to decide. I prefer to use actual timber, Cherry for the frames and Maple for the gears and other parts. I use timber machined to a standard size of 125mm x 6mm, and 125mm X 10mm, and these are fabricated into blanks 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 anything other than the frame parts as greater accuracy is needed for the gears and the Escapement parts.
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 that is 48” square, 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 450mm Long for all the shafts and numerous pins.
Ø2mm Drill Rod or Silver Steel 450mm Long for the pins
No 6 and 10 wood screws 63 mm long for wall fixing 2 required
Ø19 mm Brass Rod 60 mm long for the weight .
3 mm and 2 mm thick Plastic sheet for hands and Shaft retainers, 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.

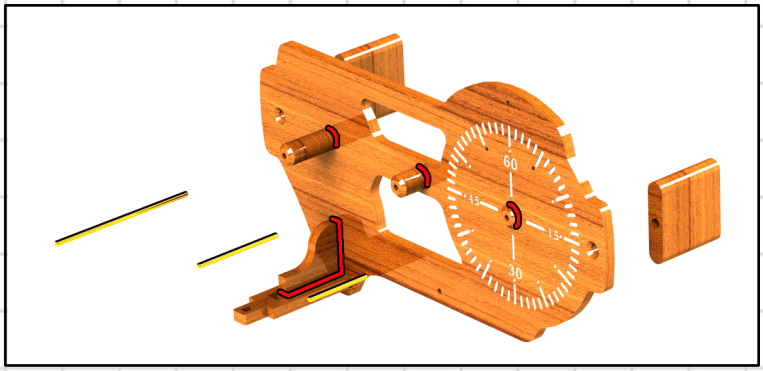
Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

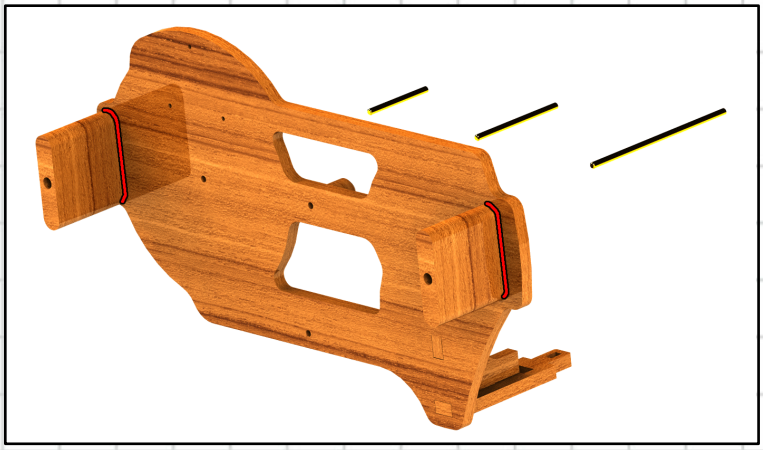
Step 1 Preparation of the Frames



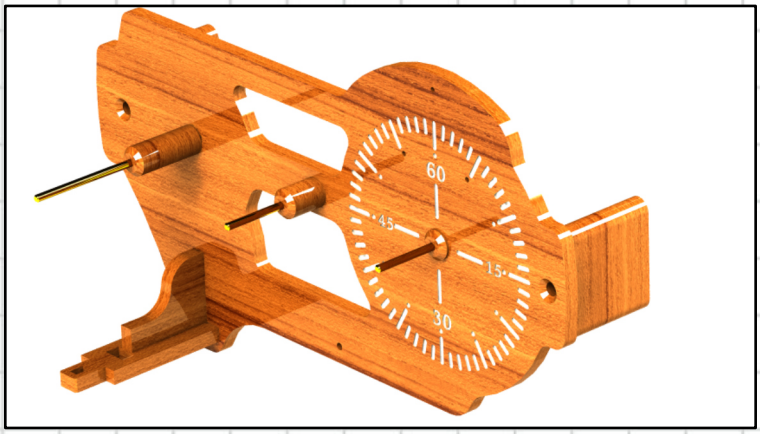
Collect all the Frame components together in preparation to gluing



Fit and glue all parts together, use a pin from the rear to guide the shaft into place whilst gluing



Glue the wall spacers to the back side of the Base

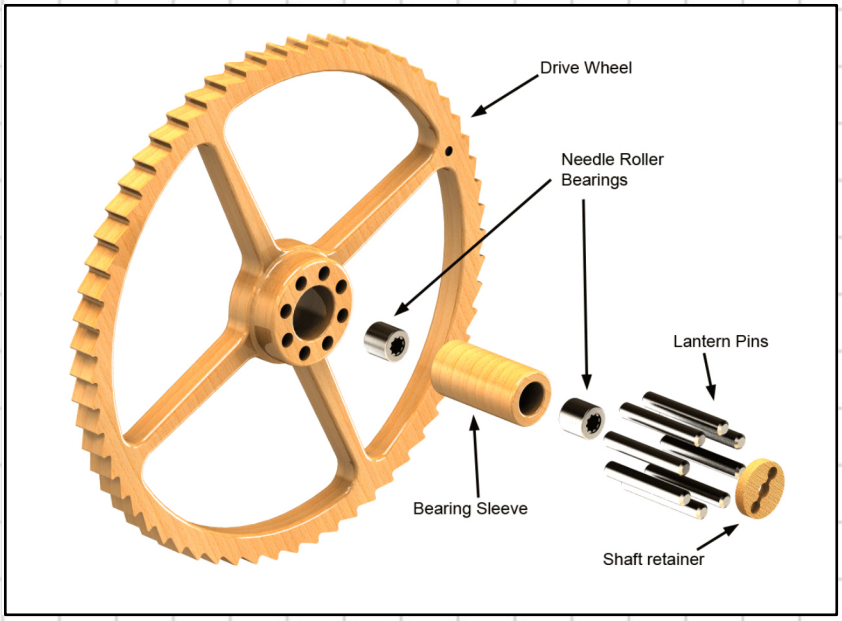


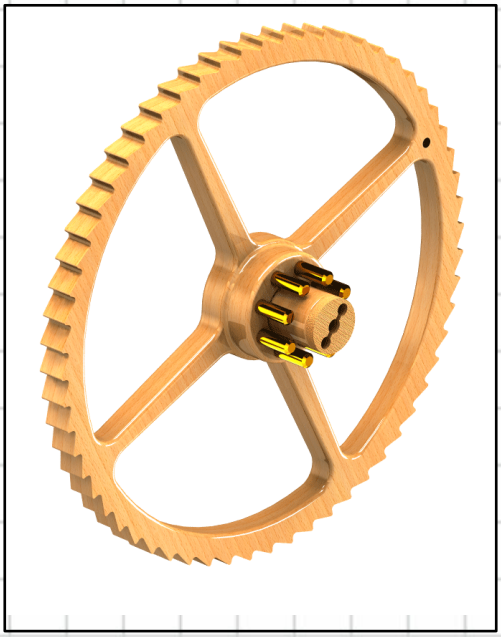
Finally insert the gear shafts into the base , the longest going into the end hole as shown

Clock 52 - Pendulum Driven clock

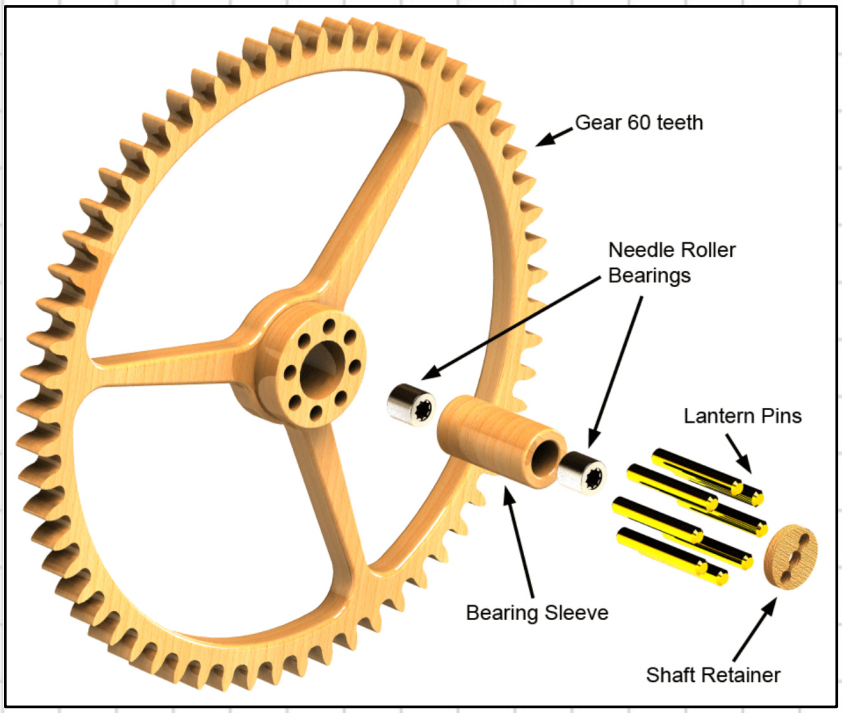
Construction instructions for Clock 52

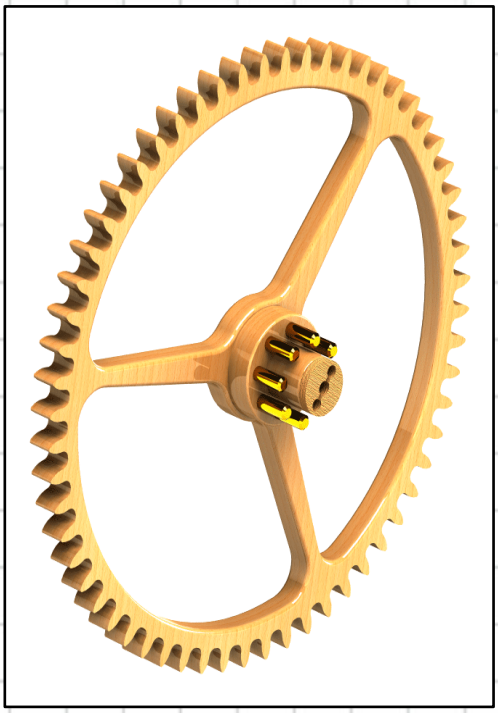
Step 2 Preparation of the Gear trains





To start, fit the Lantern Pins into the Drive Wheel and then fit the Bearing sleeve into the Drive Wheel and the Needle Roller Bearings into each end of the Bearing sleeve. They should all be a tight fit.



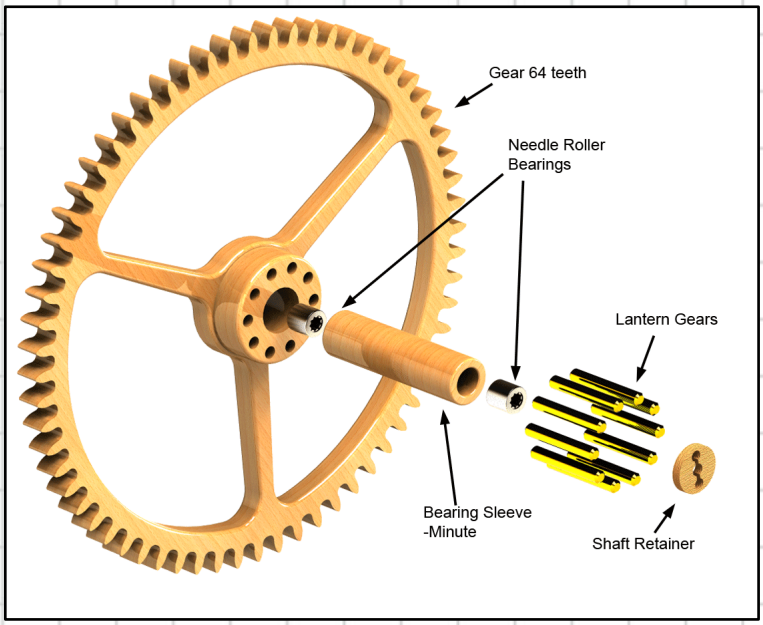


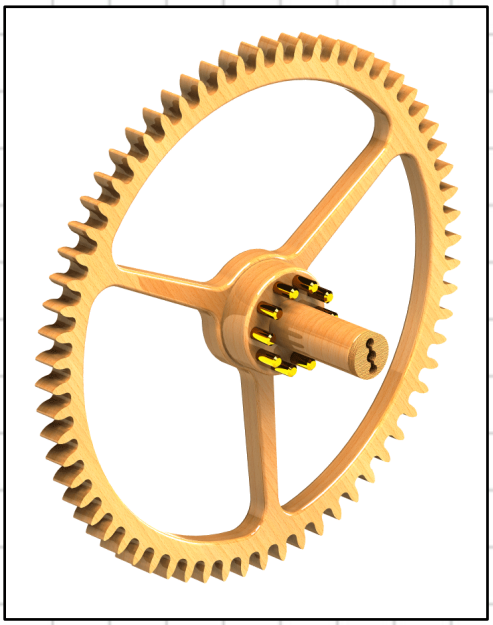
The same procedure is followed to assemble the 60 toothed gear assembly

Clock 52 - Pendulum Driven clock

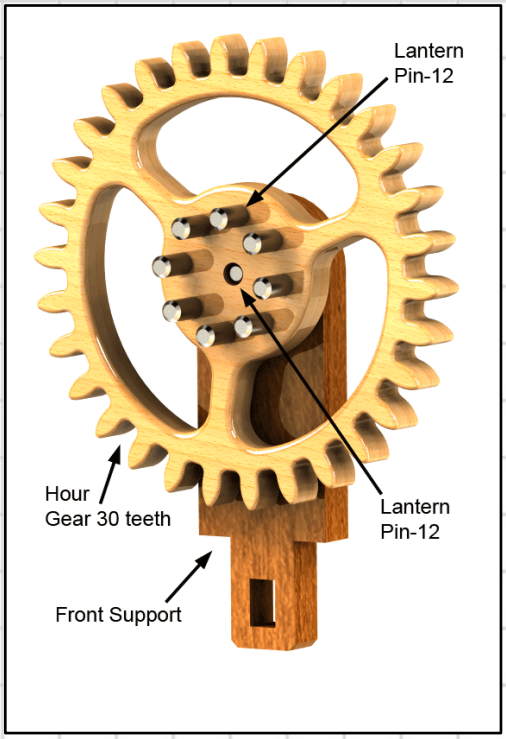
Construction instructions for Clock 52

Step 2 Preparation of the Gear trains





Again the same procedure is followed to assemble the 64 toothed gear assembly

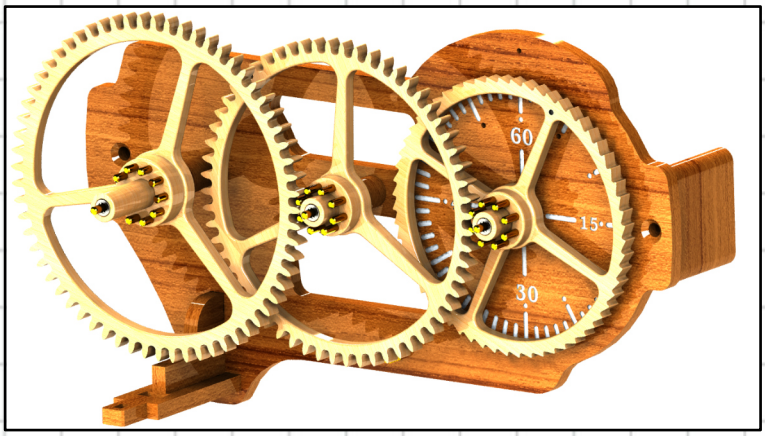


The 32 toothed Hour gear is mounted on a separate component, the Front Support shown here. All the pins are a tight fit into their mounts but the gear itself is a loose fit on the Hour Gears Pivot

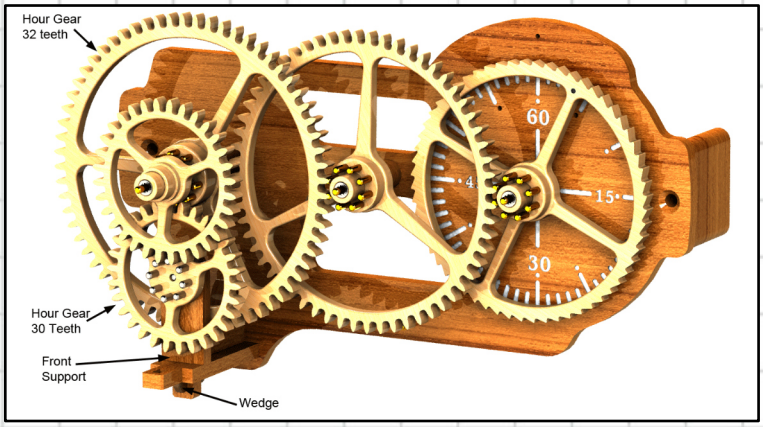
Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

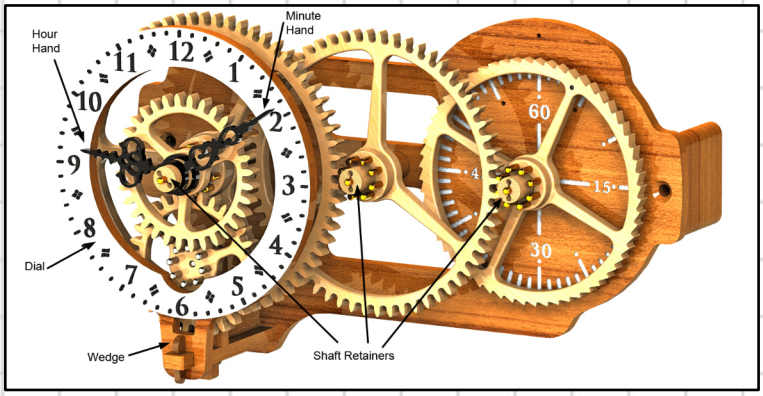
Step 3 Loading all gear sub assemblies



The 3 gear sub assemblies are pushed onto their respective shafts and held onto the shaft using the Shaft retainers fitted lose enough so that the gears can rotate freely Check for smooth running of the complete geartrain by rotating the Drive wheel slowly and check for any catching of the gears.

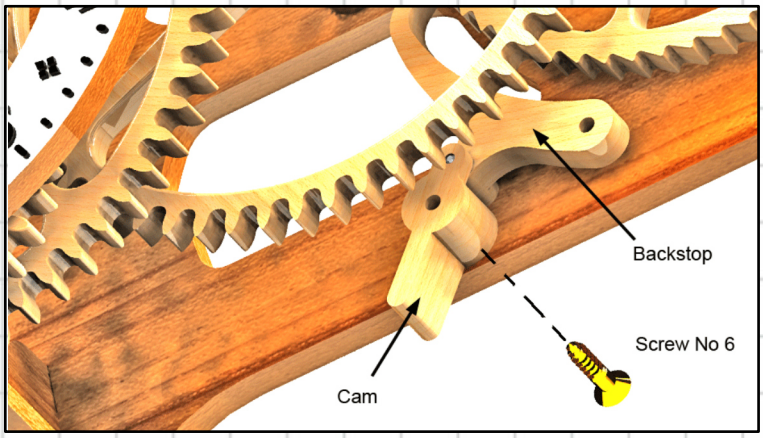


Next fit the Front Support with its attached gear into the slot in the base and secure with a Wedge.



Slide the dial into position and secure with a wedge.

Now fit the hands to the hands to the protruding shafts.



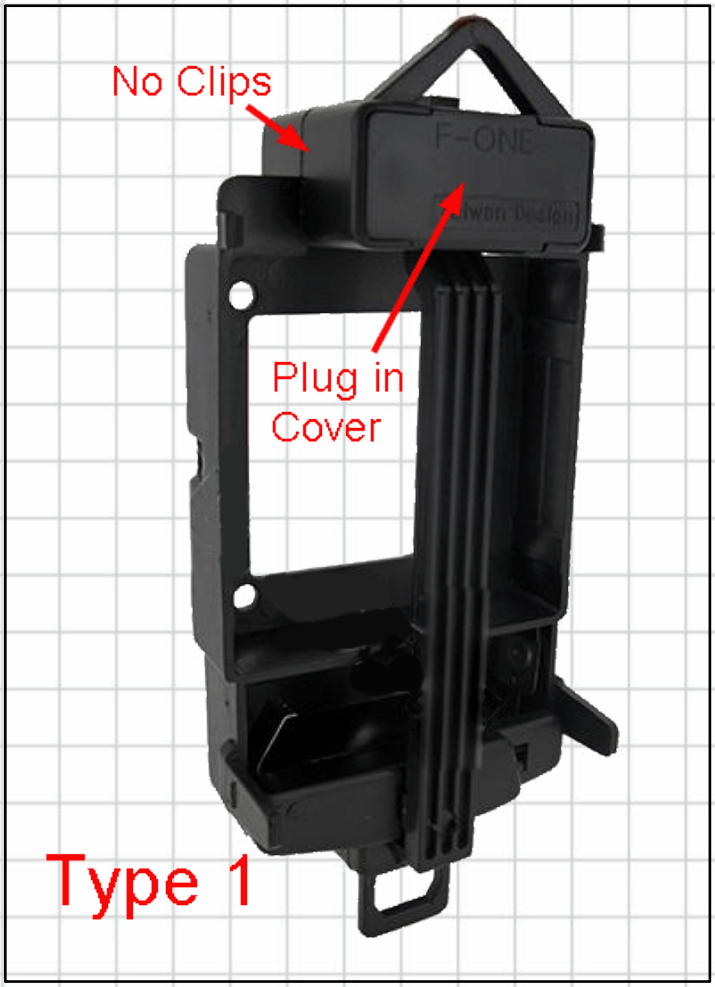
The Backstop and Cam can be fitted next securing it with a screw from the back side. The short pin is a tight fit in the Cam and a lose fit in the Backstop.

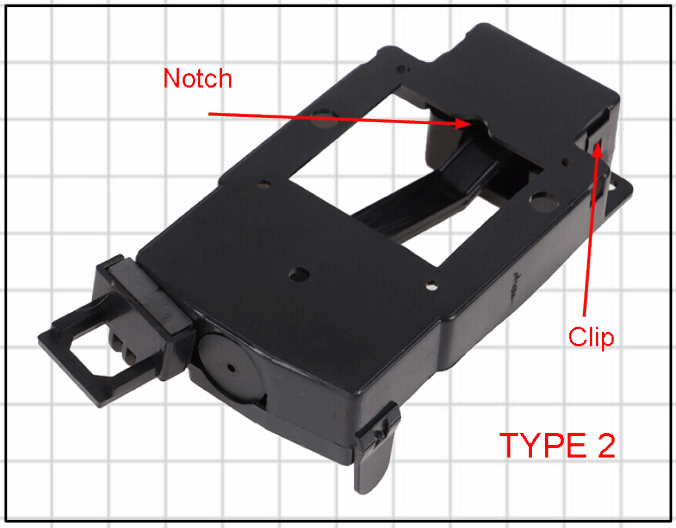
The screw needs to allow the Cam to be adjustable so don't tighten it too much.

Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

Step 5 The Pendulum Drive Unit





These are the two types of Pendulum Drive Units that I have used on this project. They are basically the same with a couple of slight differences that you need to know about before making all the components. The first difference is in the diameter of the tube at the top of the pendulum itself, Type 1 is slightly bigger so I have drawn up two versions of the Connector component to suit both. The second difference is in the width of the square cut out in the back of the box is slightly different, again two versions are provided of the Drive Support that connects in this hole.

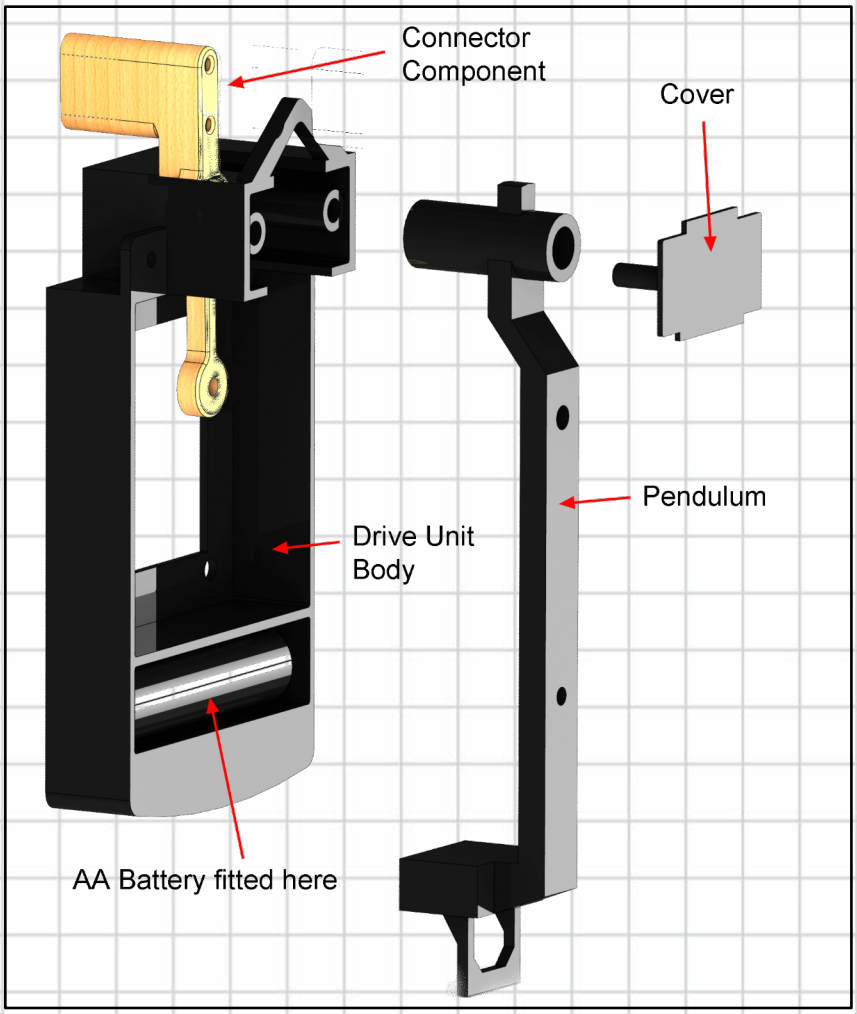
To fit the Connector component you need to remove the Plug in cover on Type 1 by gently prising it off with a small screwdriver or thin blade, it won't come off easily as there are two plugs holding it in and the may break off if your not careful. Once the cover is removed the pendulum can be withdrawn and then the Connector component dropped in and fitted over the Tube at the top of the pendulum and pushed right up to its stop. Now push the Pendulum back in place and refit the cover. If you broke off the Plugs then use tape to hold it in place.

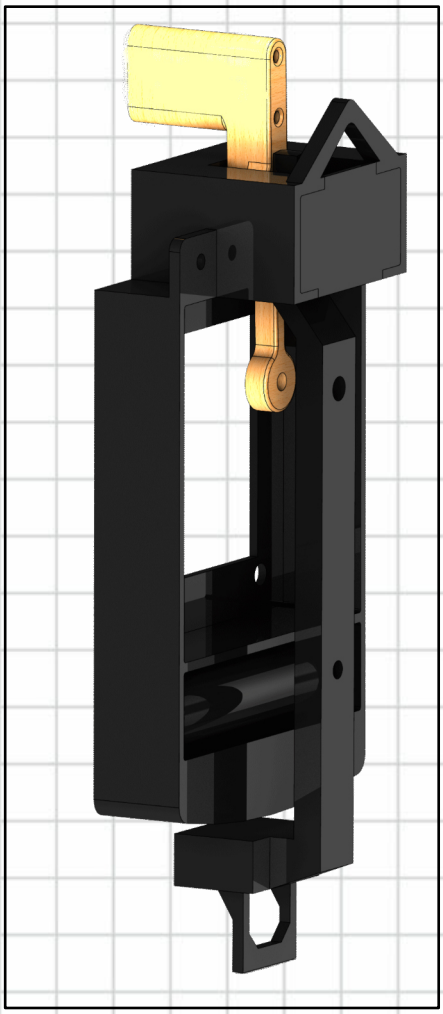
For the Type 2 unit the procedure is the same but the cover is removed by pulling open the clips and sliding the cover off, much easier this one.

Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

Step 6 Fitting the Connector to the Pendulum Drive unit





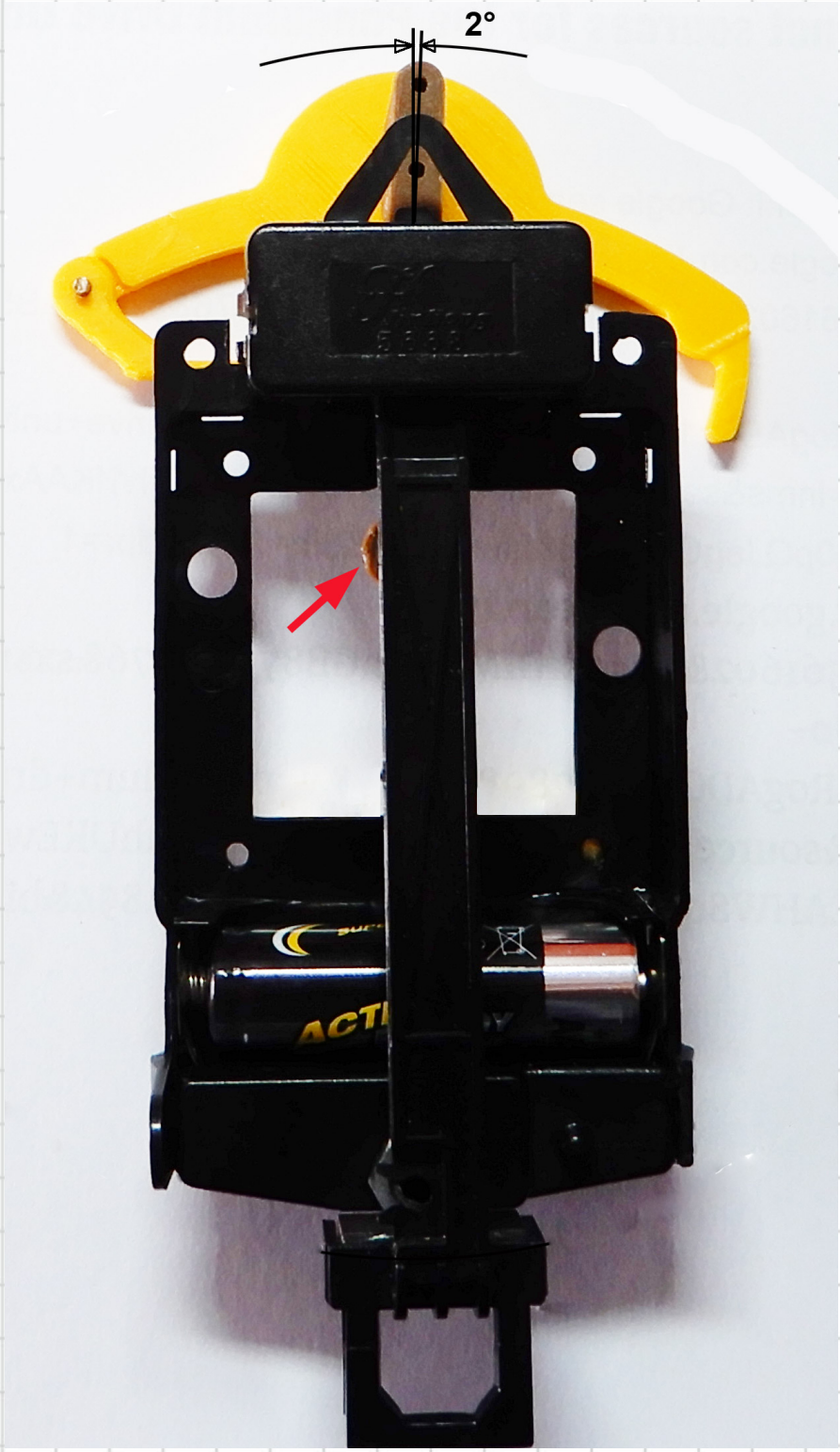
To fit the Connector component you need to remove the Plug in cover on Type 1 by gently prising it off with a small screwdriver or thin blade, it won't come off easily as there are two plugs holding it in and the may break off if your not careful. Once the cover is removed the pendulum can be withdrawn and then the Connector component dropped in and fitted over the Tube at the top of the pendulum and pushed right up to its stop. Now refit the cover. If you broke off the Plugs when removing the cover then use tape to hold it in place.

For the Type 2 unit the procedure is the same but the cover is removed by pulling open the clips and sliding the cover off, much easier this one.

Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

Step 7 Connecting the Drive Arm

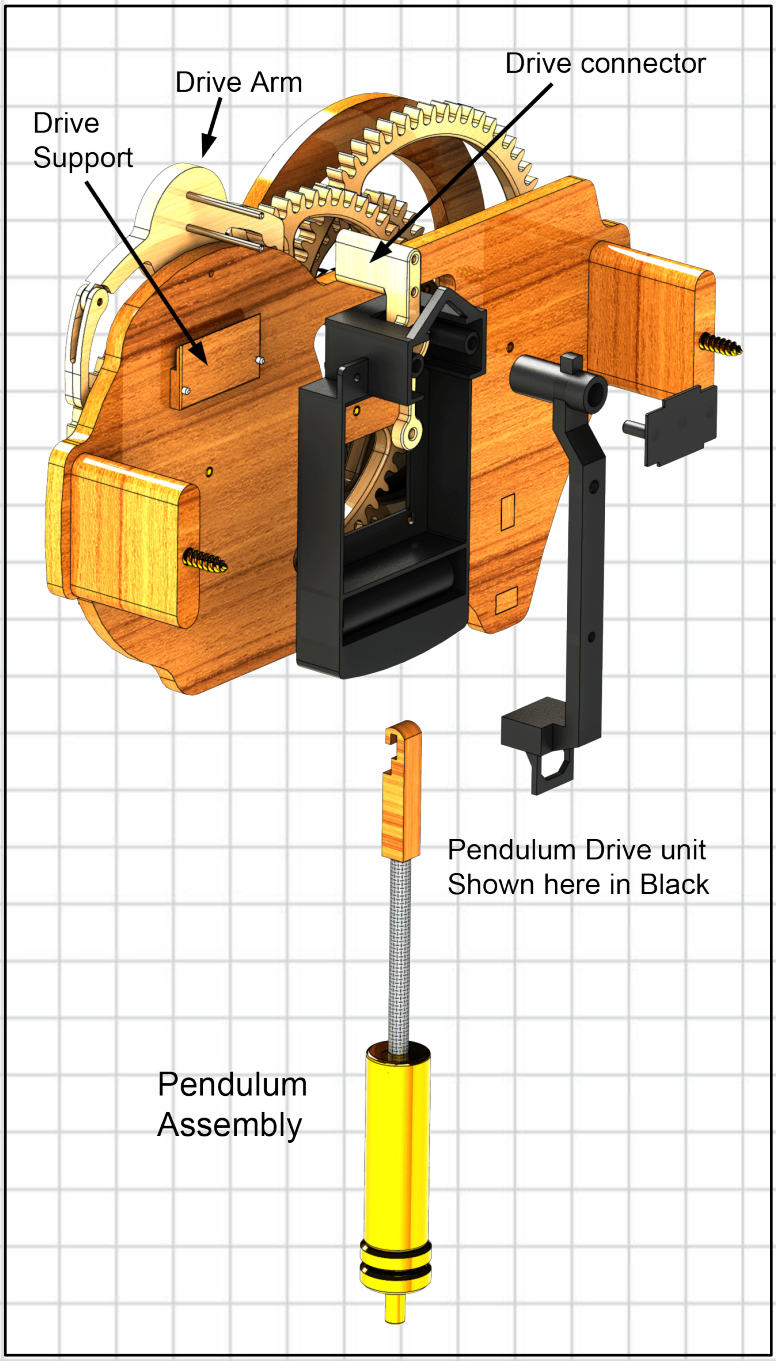


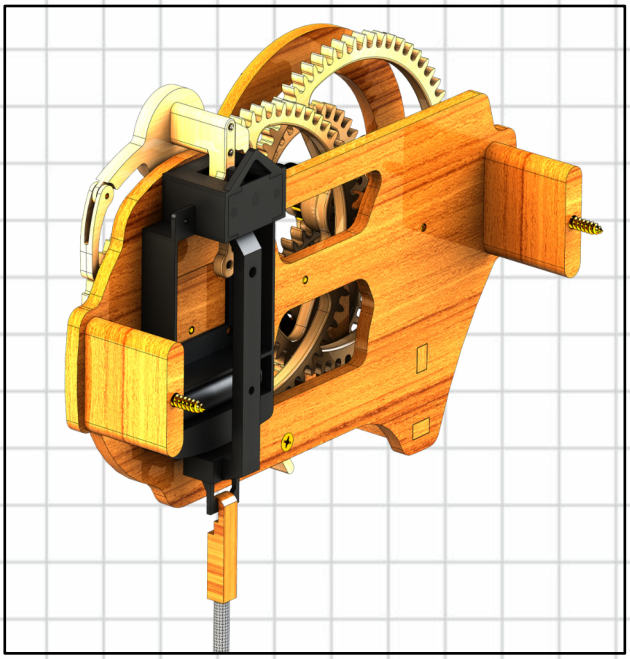
When the Drive arm is fitted to the Pendulum Drive unit I started the set up twisting the Drive connector around a couple of degrees as indicated above, there may be other positions for this settings as the Backstop is also movable to find the right balance between the two them.

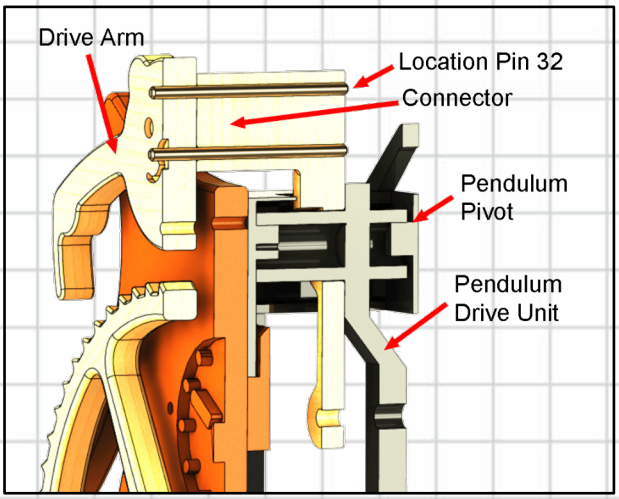
Clock 52 - 24 Hour Clock with Gravity Escapement

Construction instructions for Clock 52

Step 8 Fitting the Pendulum Drive unit







Once the Drive connector is fitted onto the Pendulum Drive unit it should be twisted around so that it runs parallel with the Pendulum itself initially, this will be adjusted later. The Drive support should be fitted next to the back of the Base on the two small pins and gluing if necessary.

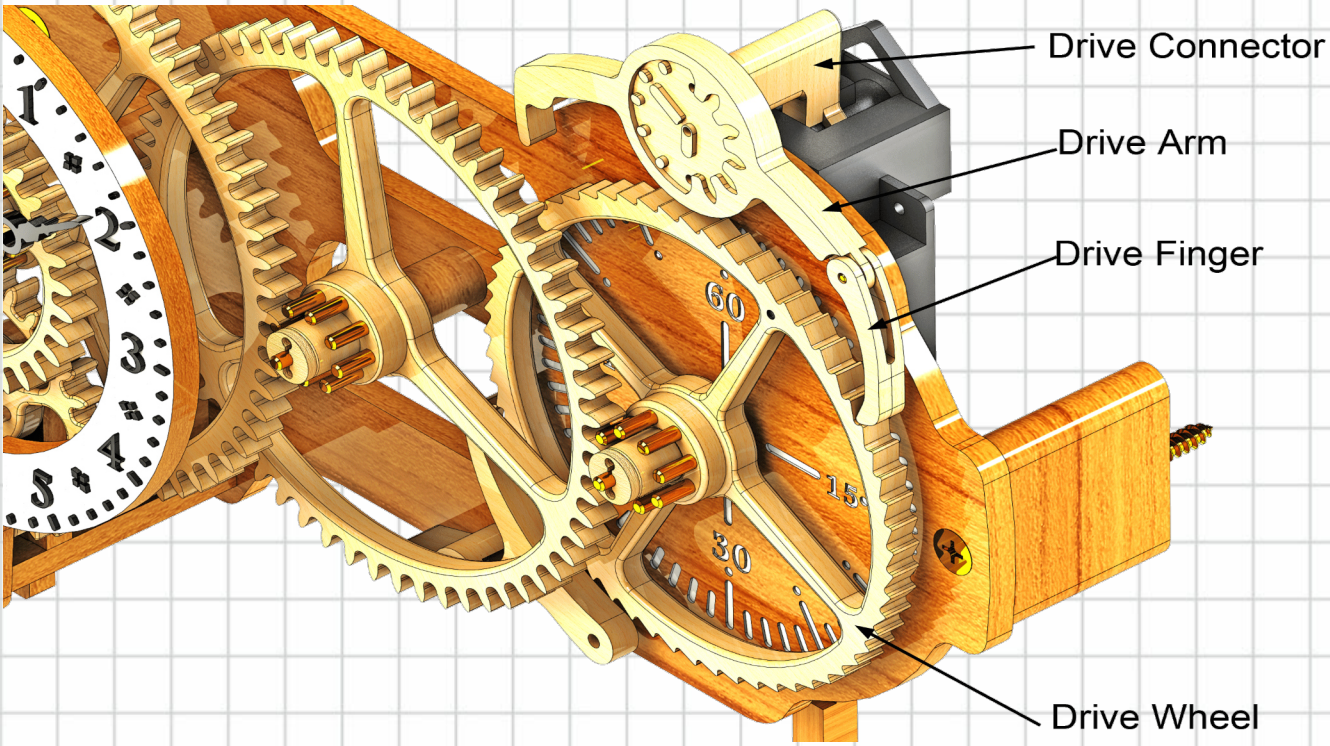
Now you can plug the cylinder part of the top of the pendulum into the drive connector and hang it onto the Drive Support.

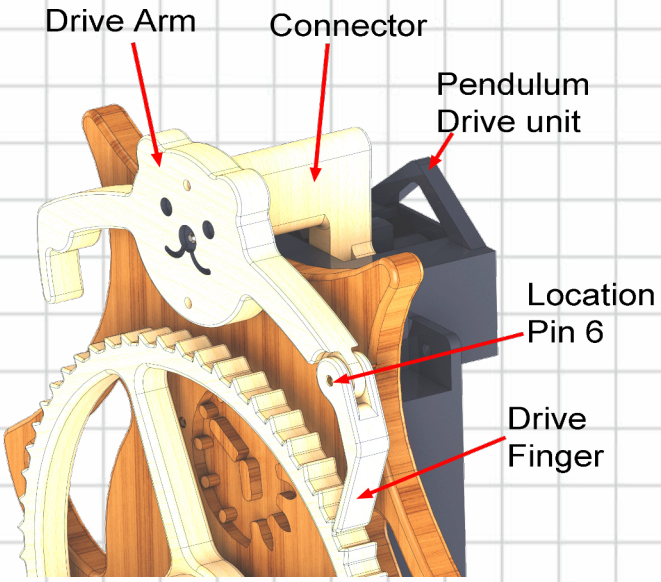
The pendulum assembly goes on next, hanging it onto the bottom of the pendulum part of the Pendulum Drive Unit. To be honest it might be best to leave this last bit until you get the whole lot screwed to the wall.

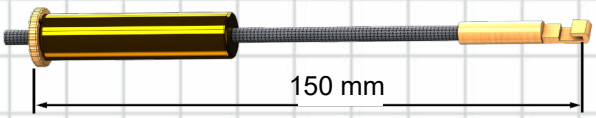
Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

Step 9 Fit the Pendulum Drive Unit to the Back frame





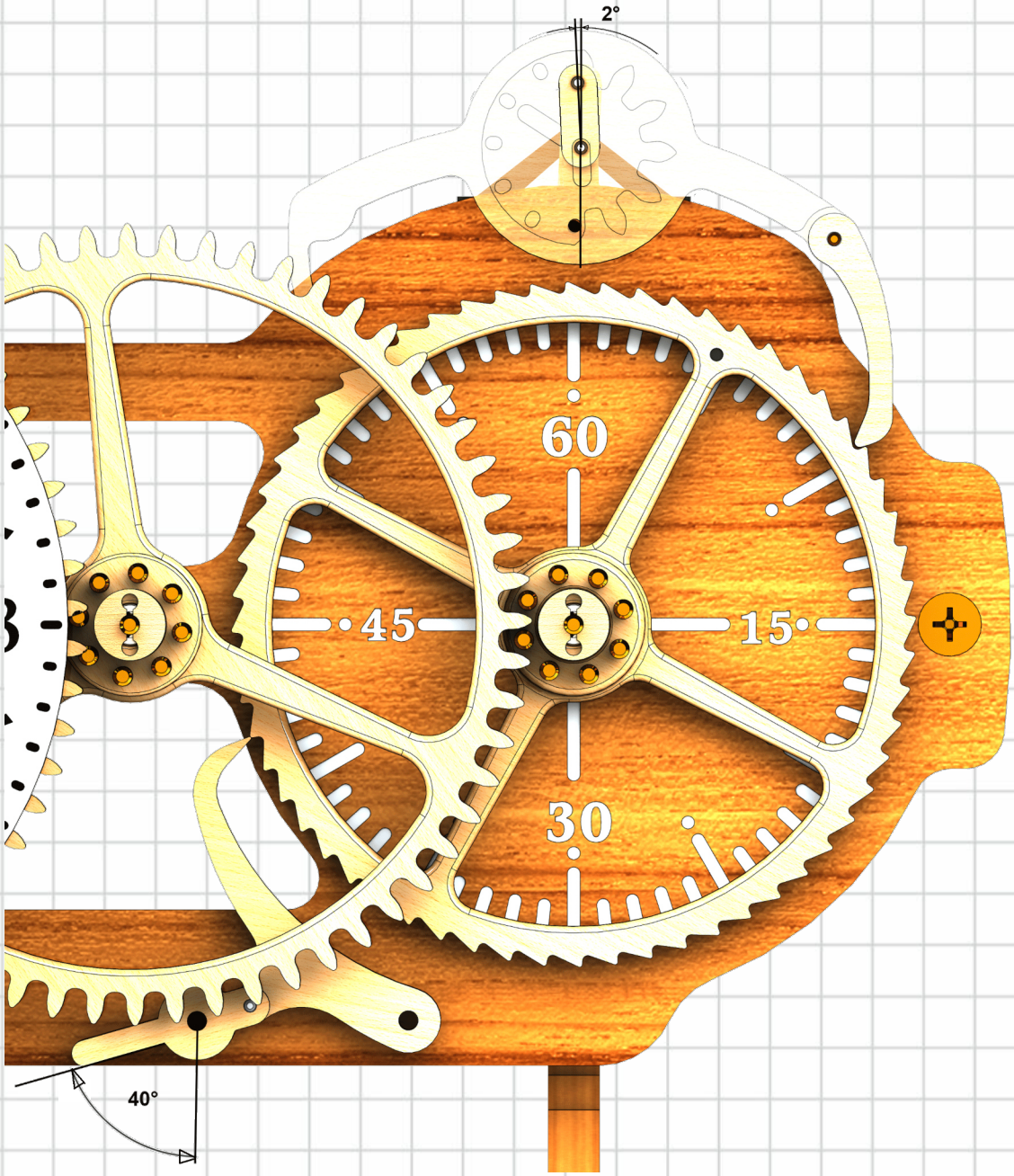


The main picture shows the Pendulum Drive unit sitting on the back of the Back Frame on the Drive support. Hanging from the bottom is the pendulum Hook with the Rod and the weight. Round the front The Drive Arm and Drive finger have been plugged onto the Connector with the Drive finger engaging the Teeth on the Drive wheel. The timing of the clock is adjusted by moving the weight either Up to increase speed or Down to slow it. The position of the weight on my prototype is shown in the bottom picture this clock is running to within a minute per day at this setting.
You will note when you fit the Drive connector into the Pendulum Drive Unit that the pivot for the Pendulum is two short moulded house shaped wedges inside the case that the inside of the tube at the top of the Pendulum sits on. This is super simple and super low friction but it can move around a little when the clock is being handled . So you should ensure that the bore of the tube is resting squarely on the Wedges as it swings back and forth. If its not just give the clock a little jiggle by twisting at the base to help settle it.

Clock 52 - Pendulum Driven clock

Construction instructions for Clock 52

Step 10 Fit the Pendulum Drive Unit to the Back frame



To get the clock running when it has been built can be a little frustrating as it requires you to adjust the Drive connector at the top of the clock and the Backstop on the bottom so that they work in harmony to keep the clock running continuously. I start with the Drive connector vertical and then moving it slightly to the left as shown above, only move it slightly from that position to start. The Back Stop is then adjusted to stop any excessive backwards movement. It is then a gentle dance back and forth with the Backstop to keep it ticking.
The setting shown above is what the prototype finished being set up as.

Once the clock is running continuously adjust the rate using the thumb nuts under the brass weight to push the weight upwards to make it run faster and move it downwards to run slower.

HINTS AND TIPS

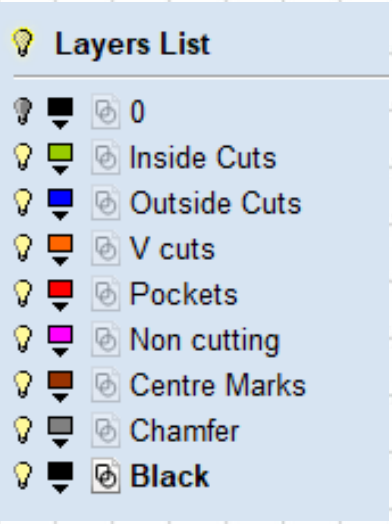
- If you intend to print out the clock profiles for use in conjunction with a Scrollsaw then this article from my Blog should help https://brianlawswoodenclocks.blogspot.com/2014/09/printing-clock-plans-using-pdf-and-dxf.html
- I would also recommend printing the parts using Foxit Reader or Adobe Acrobat.

- 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 separate layers , these being ‘Outside Cuts’ ‘Inside Cuts’ ‘Pockets ’ ‘Non Cutting Profiles’ and ‘V cuts’ and ‘Black’. The layers are colour coordinated as shown.

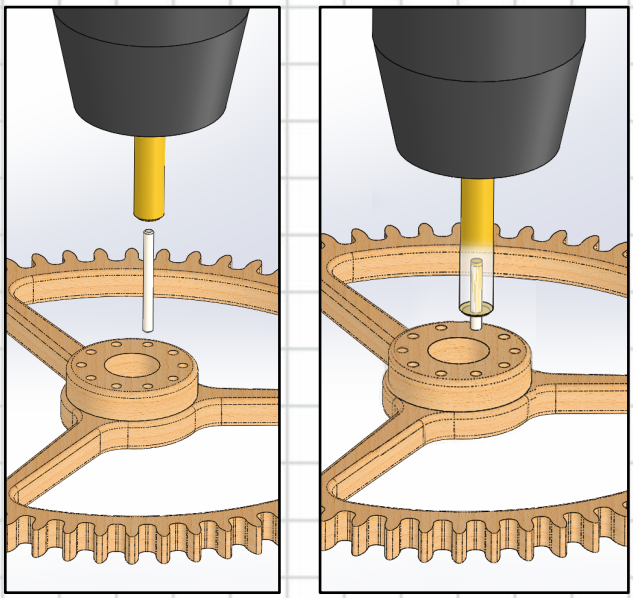


Additional layers have been added as well, the 'Black' layer is for printing out to scale as a PDF file so that you can cut out the profiles for sticking onto the wood when cutting out with a Scroll Saw. The Centre marks can also be used if cutting by hand or scroll saw doe drilling the holes. To get a better definition set the printer to 'Print in Grey scale.

HINTS AND TIPS - continued

When the parts of the clock are just to big to be printed on the Build plate then the part must be split into separate pieces. This is illustrated opposite where the Base panel of the clock has been split into 2 pieces . The parts are printed with 3mm diameter holes into the faces of the splits so that steel pins can be inserted when the parts are assembled back into a whole part. I normally use a thin superglue for this purpose if printing with PLA, but I use a solvent bond technique with Acetone if printing with ABS.

On this clock I have supplied the STL files for all of the parts as well as a separate set of split parts for the Base panel along with a split set for the Base.



Fitting the Lantern Pins accurately can be a bit tricky so I have used a short length of Brass rod 6 mm Diameter with a 2.1 mm diameter hole 10 mm deep drilled in one end. This holds the pin vertical whist you push into place. The 6 diameter of the rod is just small enough to squeeze between pins as the new pin is fitted.