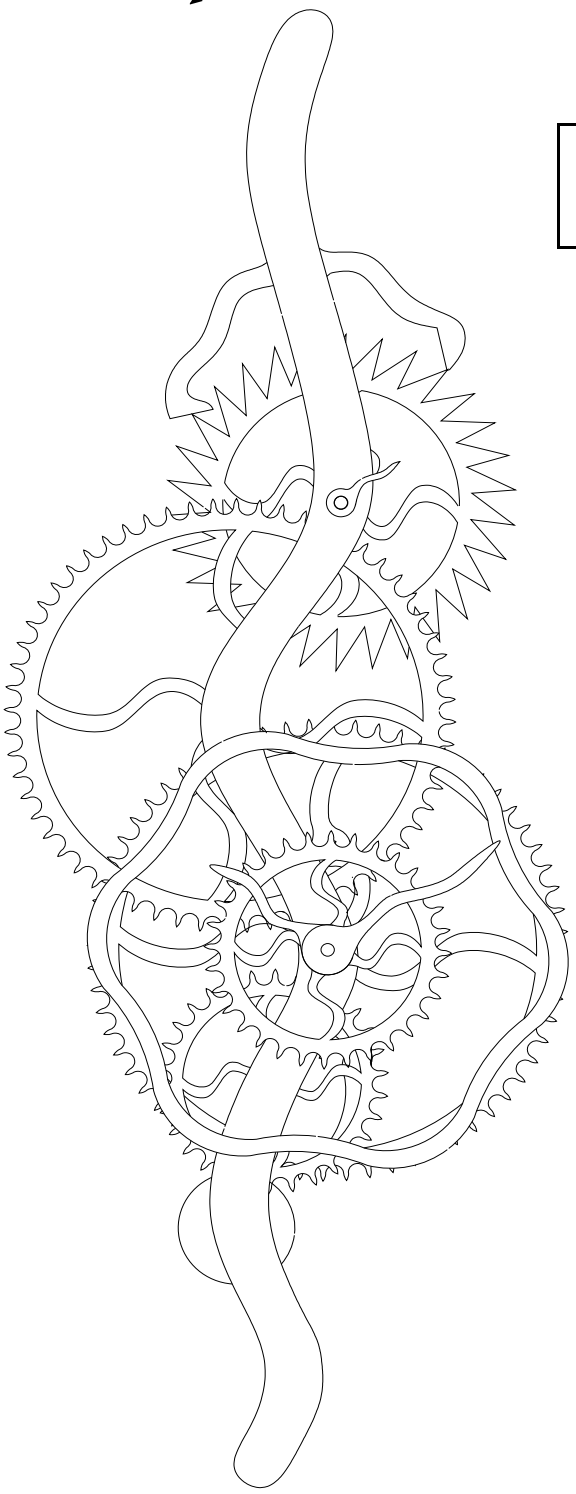
The Serpentine Clock



Do-it-yourself pattern and assembly instructions

Wooden-Gear-Clocks.com
clocks, kits, and do-it-yourself patterns

Introduction

For hundreds of years, mechanical clocks have served as functional timekeepers. During that time, clocks have also been treasured for their artistic and aesthetic value. For most clocks, the artistry involves the shape and ornamentation of the clock's exterior case. However, these cases hide the inner beauty of the clock–the clockwork mechanism.

The Serpentine clock is a wooden gear clock that is a functional timekeeper with an open frame which exposes its mechanical elements. All the moving parts are clearly visible. It is intriguing to watch as the seconds and minutes tick away.

It is enjoyable to see and hear this clock running. However, the most enjoyable part of this clock is the satisfaction gained by assembling the clock yourself, perhaps adding your own creative touches. And, through the process of building the clock, you will gain an understanding of the principles that govern how a clock works.

We truly hope you enjoy building your clock. Please contact us if there is any way that we can help you with your clockmaking project.

Tools and Supplies

The following items will be necessary to build your clock:

- Phillips screwdriver and small slot screwdriver
- knife
- hammer
- clamps (small spring clamps work well)
- 3-4 lbs of metal shot (available from sporting goods or firearms stores)
- wood glue
- sandpaper (150 grit, 220 grit, 400 and 600 grit suggested)
- pencil
- scroll saw
- drill press
- 1/4" plywood (Baltic Birch recommended): 6 square feet
- 1/8" plywood (Baltic Birch recommended): 1/2 square foot
- 1/4" hardwood dowel: 3 feet

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Safety

It is your responsibility to use the proper tools and techniques to accomplish this project, including consulting all owner manuals and label directions for any tools or products used.

This package contains small parts, and should be kept away from young children.

Cutting Tips For Do-It-Yourself Patterns

1) Cut out all parts with the scroll saw. Use temporary-bond spray adhesive to affix the pattern to the wood. When cutting the pieces, try to split the line with the saw blade.

2) All components are cut from 1/4" plywood unless noted otherwise (e.g., 1/8" material) on the pattern. Where important, the grain direction is noted on the pattern by a double-headed arrow.

3) Several pieces are sized to fit together with other pieces. Plywood thicknesses vary slightly. You may want to test fit as pieces are cut out. Reviewing the assembly instructions prior to cutting will help you get an idea of how the parts will fit together.

4) You are encouraged to simultaneously stack cut identical pieces.

5) Several holes are labeled as “1/4" diameter to fit on dowel”. Since dowel diameters vary slightly, you should drill a test hole to determine the proper hole size. For example, you may find that 15/64" holes will provide a better fit on your dowels than 1/4".

6) Several holes are labeled as “1/4" diameter, friction fit on . . .”. These holes should be sized to provide a fit that is tight enough to hold the pieces in place, but loose enough that the fit can be made to slip.

7) Holes must be drilled perpendicular to the workpiece. If possible, use a drill press.

8) Before drilling the arbor holes in the frame pieces, we suggest that you lay out and drill the holes in a scrap piece. This allows you to test the distance between the holes by inserting adjacent gear assemblies and rotating to be sure the gear teeth mesh properly. Once the precise position is established, the scrap piece can be used as a template to locate the holes in the frame pieces.

9) Dimensions labeled “typical” indicate that the same dimension applies to all similar dimensions of similar components.

Assembly Tips

1) To remove precut parts from the original board, carefully bend the parts back and forth to break the small sliver of wood that is holding them in place. If necessary, use a knife to free any pieces that were not completely scored by the laser.

2) You may stain your clock if desired. See the Stain Chart on next page for a suggested color scheme. Although it is possible to do all the staining after the clock is assembled (the clock is easily disassembled), you may find it easier to stain the gears prior to assembly. Since a finish can hinder glue bonding, wait to apply finish to the remaining pieces until the components have been glued together (a suggested sequence for sanding and finishing is included in the step by step instructions). **If you choose to apply a varnish, avoid getting varnish on the contact faces of the gear teeth and escape lever**.

3) A few components require gluing. Glued parts should be clamped while the glue cures.

4) Follow the instructions in order. Carefully complete one step before moving on to the next.

5) For the laser-cut parts: some of the parts might benefit from some light sanding, especially at the breakaway points where the pieces were attached to the original board. Do not sand the mating surfaces of the gear teeth. Note that the backsides of some pieces may show residue from the laser cutting operation. A light sanding will remove this residue, although for nearly all parts this is not necessary because the residue will not be visible once the clock is assembled. If desired, the edges of the non-gear pieces can be sanded to remove the residue left by the laser. The assembly instructions indicate at what point the various pieces should be sanded.

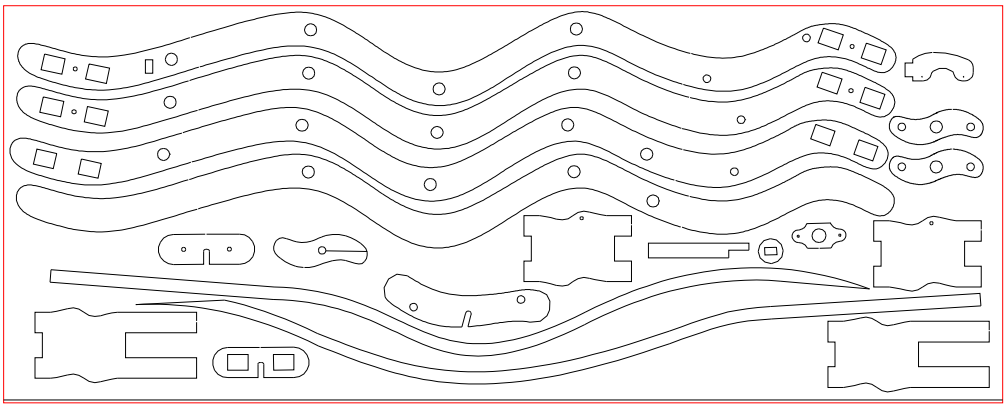
6) Some of the parts fit together tightly. It may be necessary to gently tap them together with a hammer. (Plywood thicknesses can vary slightly. If the fit seems too tight, some light sanding may be necessary to insure a proper fit).

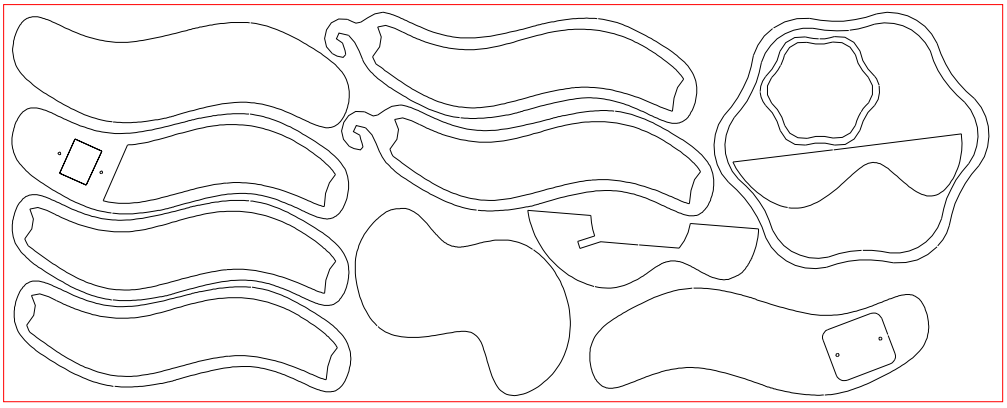
7) Once the clock is assembled and mounted, there will likely be some adjustments required to get the clock running properly. Follow the suggestions found in the Regulating and Adjusting and the Troubleshooting sections of the instructions.

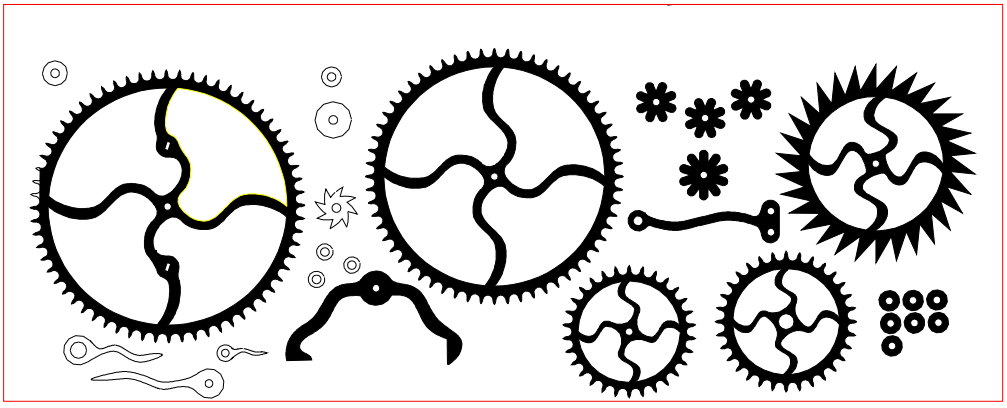
8) Take your time and enjoy the process! Please do not hesitate to contact us if you have any questions during assembly.

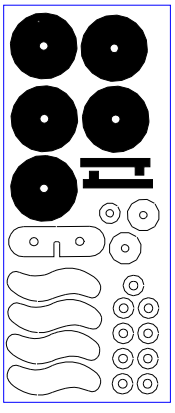
Stain Chart

The diagram below indicates which pieces to stain dark if you choose to use a color scheme with darker gears and lighter frame. Of course, you can use another color scheme, such as light gears and darker frame. However, you may still find the stain chart helpful for grouping parts together that should be the same color. While it is easiest to stain the gears before they are attached to the arbors, the other pieces (frame, weight shell, pendulum, etc) can be stained after the necessary components are glued together.









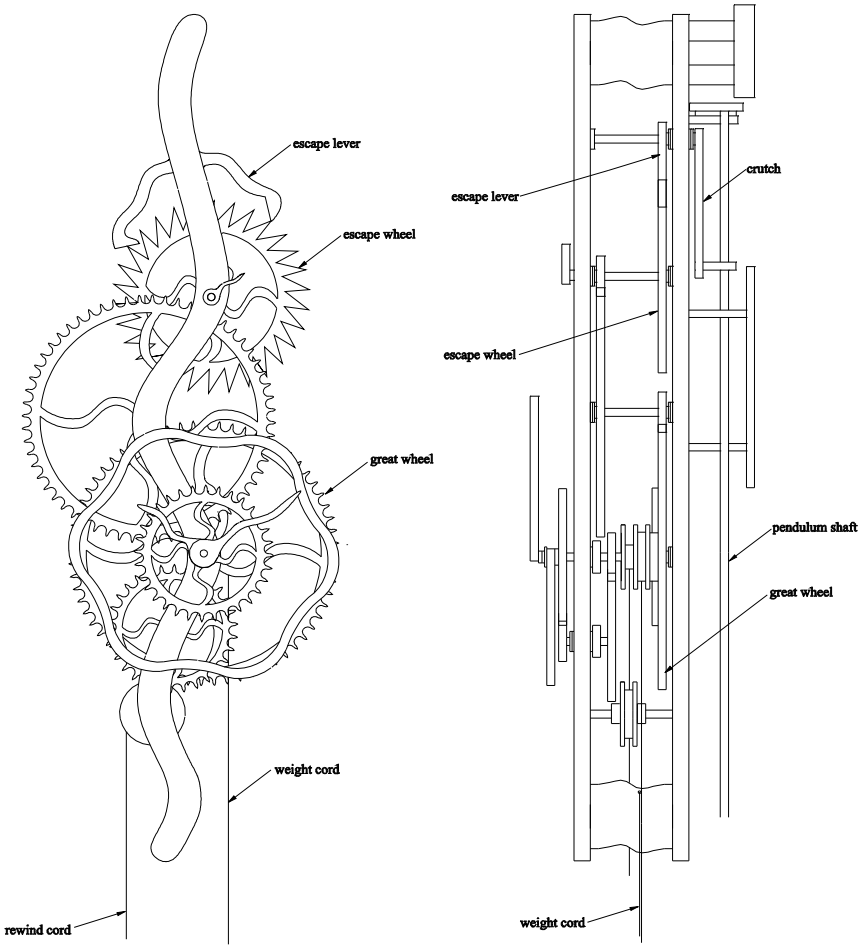
How the Serpentine Clock Works

It will be helpful to have an understanding of how the Serpentine clock works. This insight will be especially beneficial if troubleshooting is necessary.

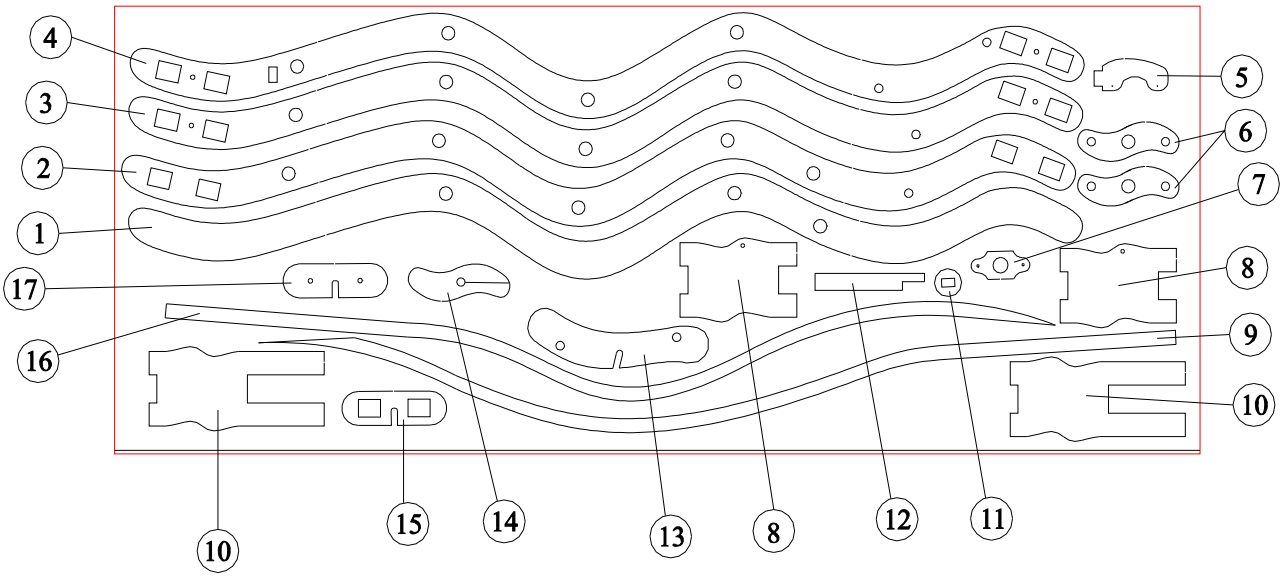
The Serpentine clock is driven by weight. The weight is hung from a cord that is wound around a spool on the great wheel arbor (shaft). The weight unwinds the cord from the spool, causing the arbor to rotate. The gears that are attached to this arbor mesh with a train of other gears, causing them to rotate as well. When the cord has unwound to a point where the weight has nearly reached the floor, the clock is "wound" by winding the cord back around the arbor.

The speed at which the weight is allowed to rotate the gear train is regulated by the pendulum. As the pendulum swings back and forth, it causes the escape lever to rock back and forth along with the pendulum. The escape lever alternately stops and then releases one of the gears in the train (called the escape wheel). These contacts with the escape lever and the escape wheel teeth generate the "tick-tock" sound of the clock.

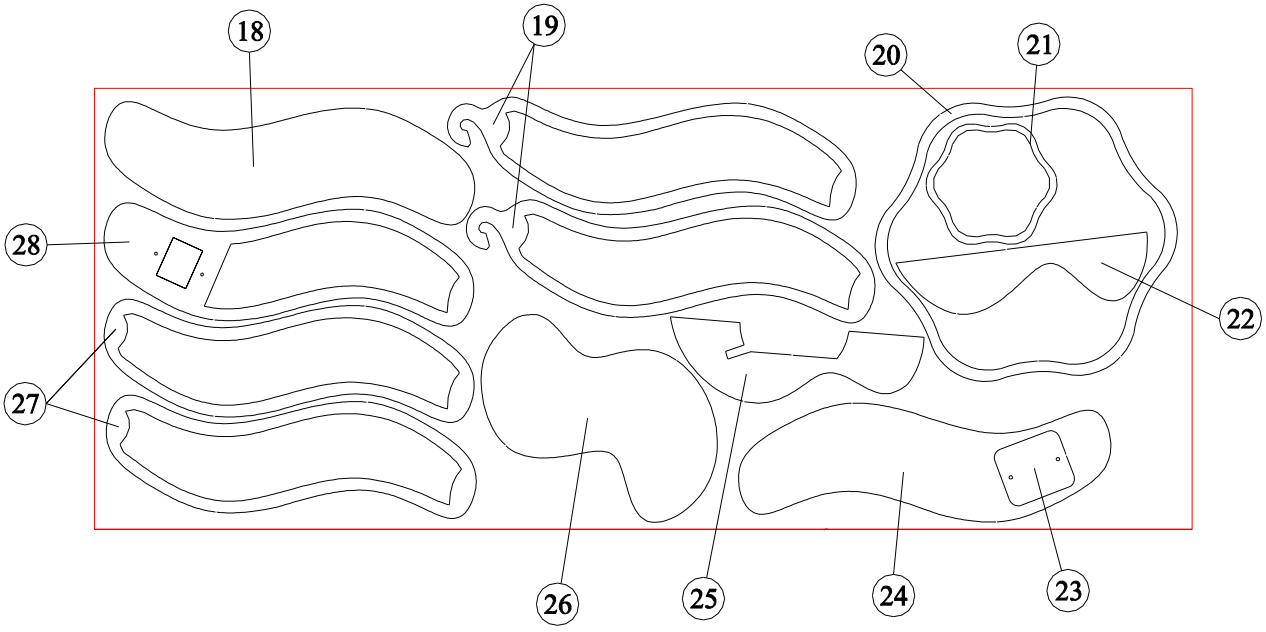
The faster the pendulum moves back and forth, the faster the escape wheel (and the entire gear train) will be allowed to advance. The pendulum swing period is determined by its length (or, more precisely, the length from its pivot point to its center of gravity). Increasing the pendulum length increases the time it takes the pendulum to complete its swing. This makes the clock run slower. Decreasing the pendulum length decreases the time it takes the pendulum to complete its swing, making the clock run faster. Therefore, adjusting the position of the pendulum bob along the pendulum shaft controls whether the clock runs fast or slow and provides a means by which the clock can be made to run "on time."



Part List (1 of 3)

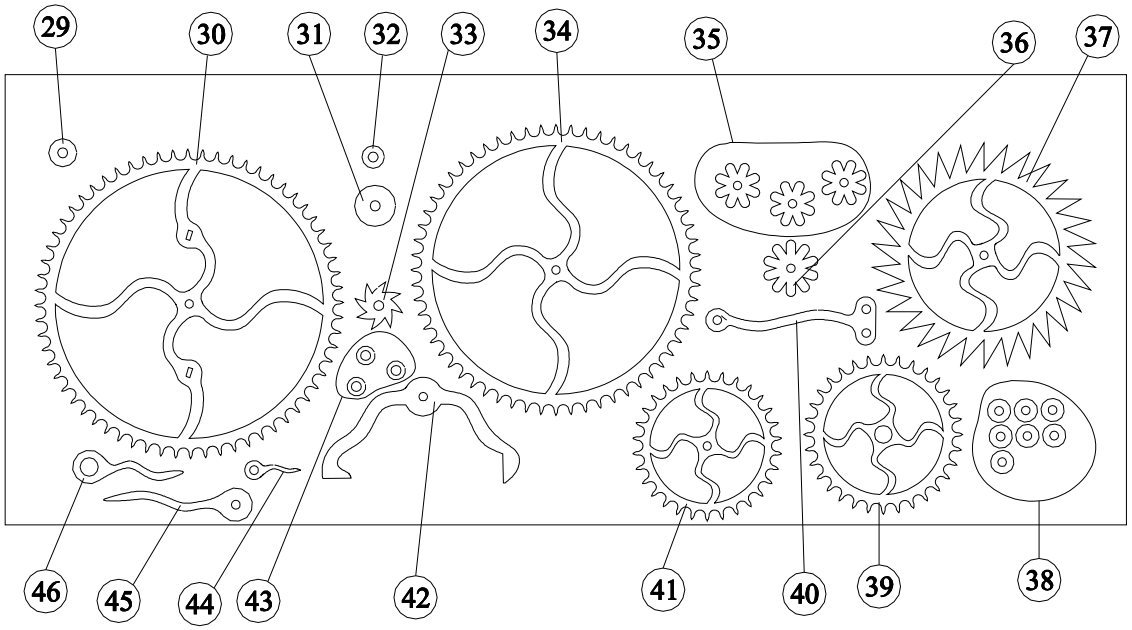


1. Front frame outer piece
2. Front frame inner piece
3. Rear frame inner piece
4. Rear frame outer piece
5. Pendulum support plate
6. Weight pulley sides [2]
7. Pendulum hanger bracket
8. Lower strut piece [2]
9. Pendulum shaft bottom section
10. Upper strut piece [2]
11. Pendulum shaft top
12. Pendulum clamp
13. Lower hanger bracket
14. Winding pull middle
15. Upper hanger front piece
16. Pendulum shaft top section
17. Upper hanger middle piece



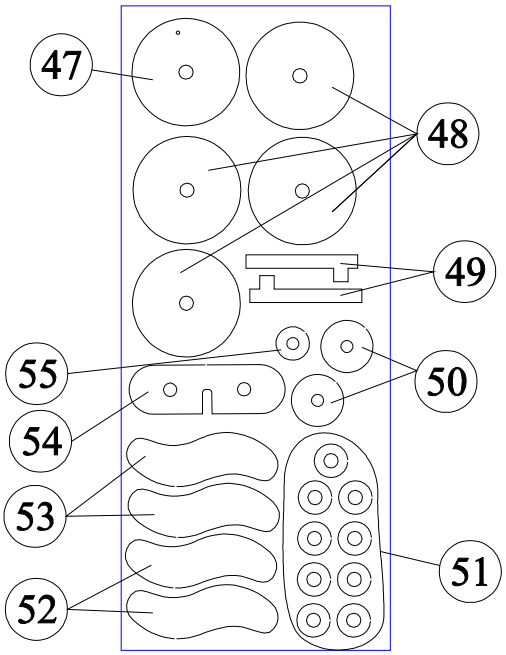
18. Weight shell front
19. Weight shell hook piece [2]
20. Dial
21. Seconds dial
22. Pendulum bob rear piece
23. Weight shell cover plate
24. Weight shell back
25. Pendulum bob rear piece
26. Pendulum bob front
27. Weight shell middle piece [2]
28. Weight shell rear piece

Part List (2 of 3)



29. Winding guide middle
30. 64-tooth great wheel
31. Weight spool hub
32. Winding spool hub
33. Rachet
34. 60-tooth gear
35. 8–tooth gear [3]
36. 10-tooth gear
37. Escape wheel
38. Set washers [7]
39. 32-tooth gear
40. Crutch
41. 30-tooth gear
42. Escape lever
43. Hour pipe pieces [3]
44. Second hand
45. Minute hand
46. Hour hand

47. Spool divider
48. Spool sides [4]
49. Pawls [2]
50. Pulley wheel sides [2]
51. Spacer washers [9]
52. Weight pulley faces [2]
53. Winding pull sides [2]
54. Upper hanger rear piece
55. Pulley wheel hub



Part List (3 of 3)

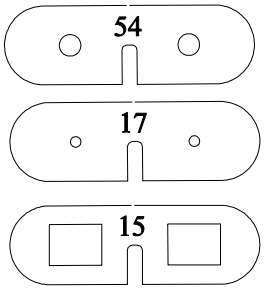
1/4" Diameter Dowels

2 3/4" Middle arbor
3" Winding guide arbor
3 1/2" Escape wheel arbor
3 5/8" Escape lever arbor
4 13/16" Great wheel arbor
1 13/16" Minute wheel arbor
1" Crutch forks [2]
1" Lower pulley shafts [2]
3/4" Lower pulley arbor
2 1/4" Lower hanger bracket posts [2]

Hardware and Miscellaneous

Nylon shoulder washers [12]
18' braided cord
#4 x ½" screws [4]
#6 x 1" screws [4]
#8 x 2" screws [2]
arbor sizing jig [1]

Upper Hanger Bracket

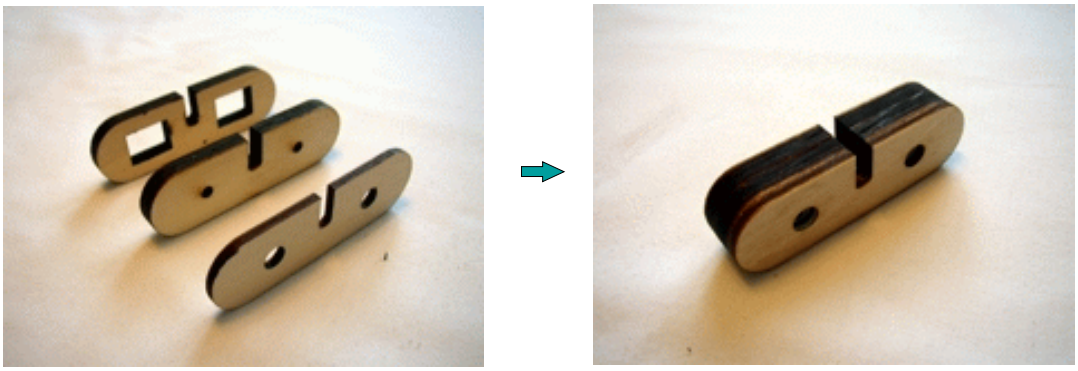


Parts

1 - Upper hanger rear piece (#54)
1 - Upper hanger middle piece (#17)
1 - Upper hanger front piece (#15)

Assembly Procedure

1) Glue together the three upper hanger bracket pieces (#54, #17, #15) with the pieces aligned as shown below.



2) If desired, sand the perimeter of the completed upper hanger unit.

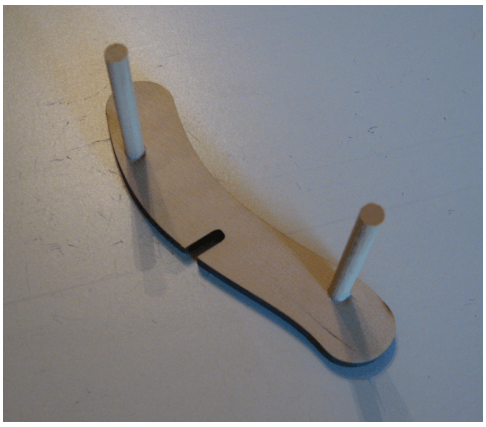
Lower Hanger Bracket

Parts

1 - Lower hanger bracket (#13)
2 - 2 1/4" dowels

Assembly Procedure

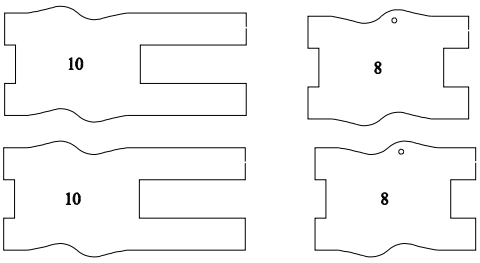
1) If desired, sand the perimeter of the lower hanger bracket (#13). Glue the two 2 1/4" dowels into lower hanger bracket (#13), with the bracket oriented as shown below.



Struts

Parts

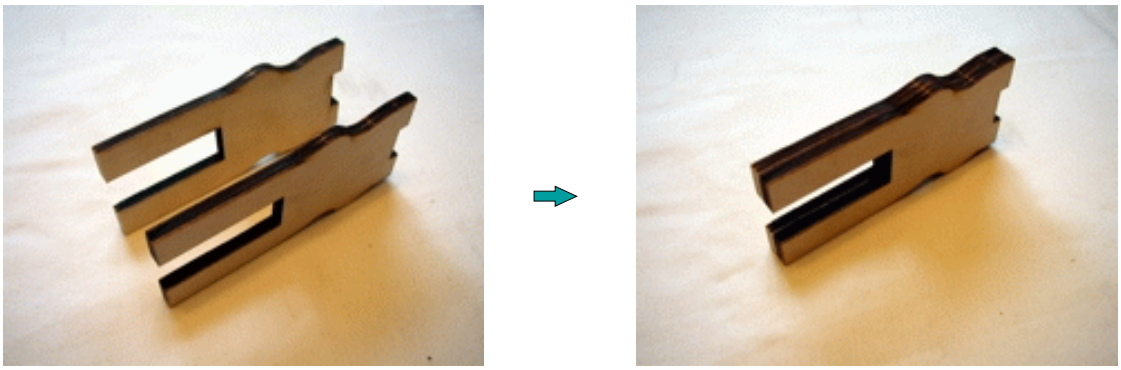
2 - Upper strut pieces (#10)
2 - Lower strut pieces (#8)



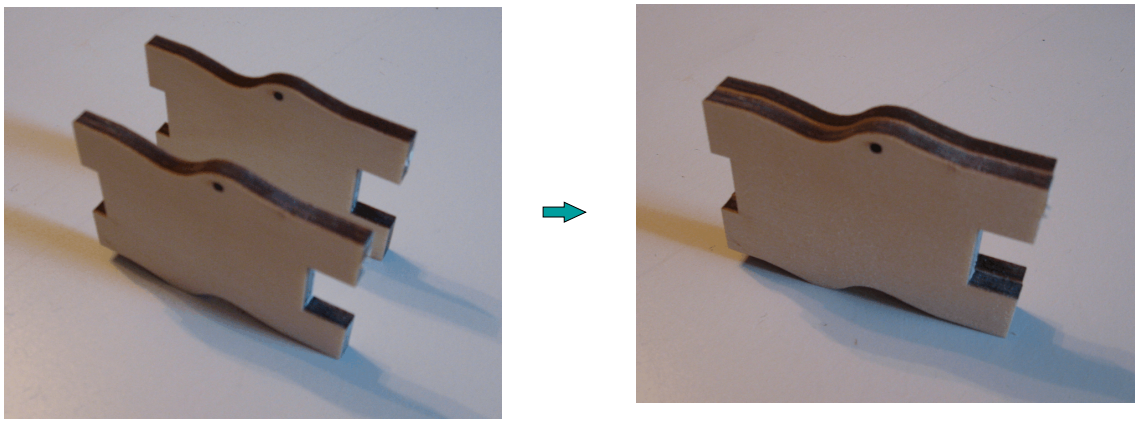
Assembly Procedure

1) Glue together the two upper strut pieces (#10). Glue together the two lower strut pieces (#8). Make sure all edges of both struts are aligned.

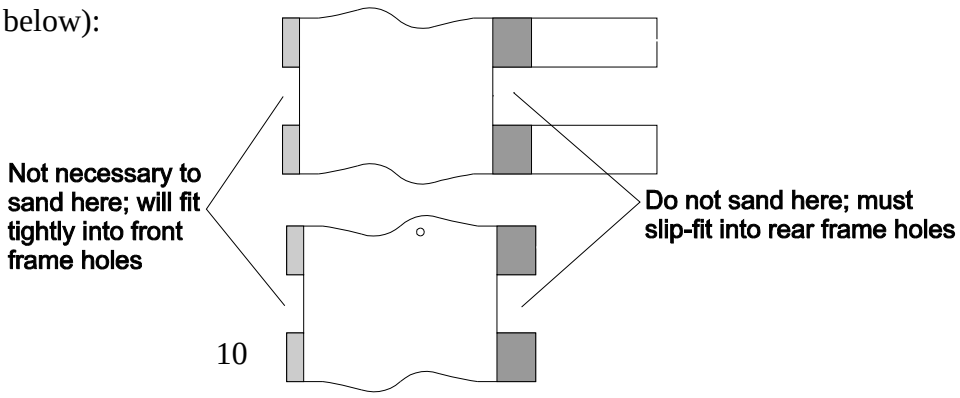
Upper Strut



Lower Strut



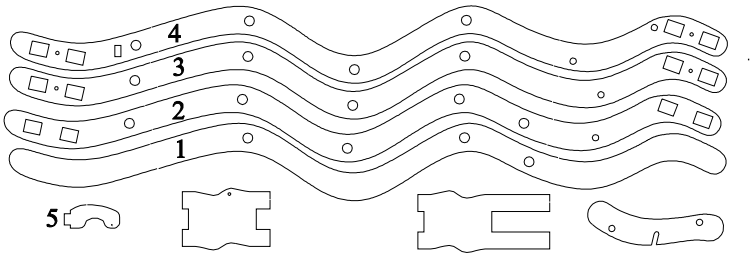
2) Perform any desired sanding of the struts. Do not sand the portions of the strut tabs that will fit into the frame (see diagram below):



Frame Assembly

Parts

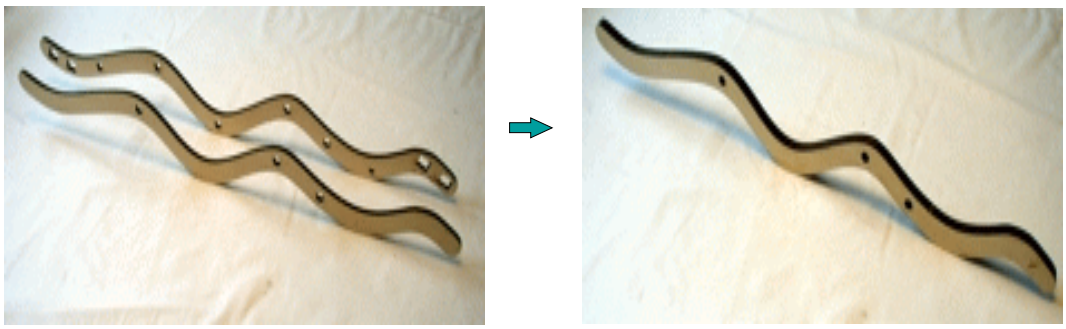
1 - Rear frame outer piece (#4)
1 - Rear frame inner piece (#3)
1 - Front frame inner piece (#2)
1 - Front frame outer piece (#1)
1 - Pendulum support plate (#5)
10 - Nylon shoulder washers
Upper strut (assembled previously)
Lower strut (assembled previously)
Lower hanger bracket (assembled previously)



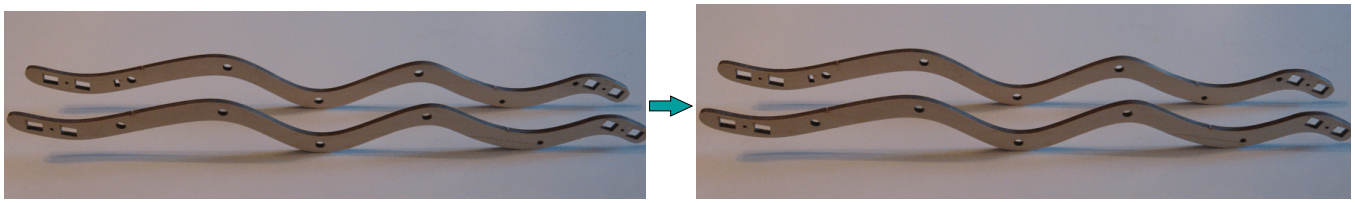
Assembly Procedure

1) Glue together the front frame piece pairs (#1, #2) and the rear frame piece pairs (#3, #4). Make certain that the pieces are oriented as shown and that the holes and edges are aligned. Be sure to clean any glue squeeze out from the square and circular holes in the frame pieces. Clamp to a flat surface while glue dries to ensure that the pieces remain flat.

Front Frame Pieces



Rear Frame Pieces

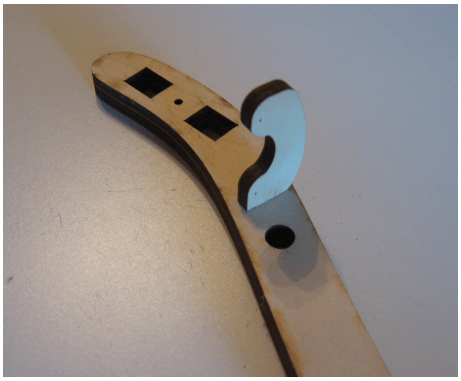


2) Perform any desired sanding on the completed frame units.

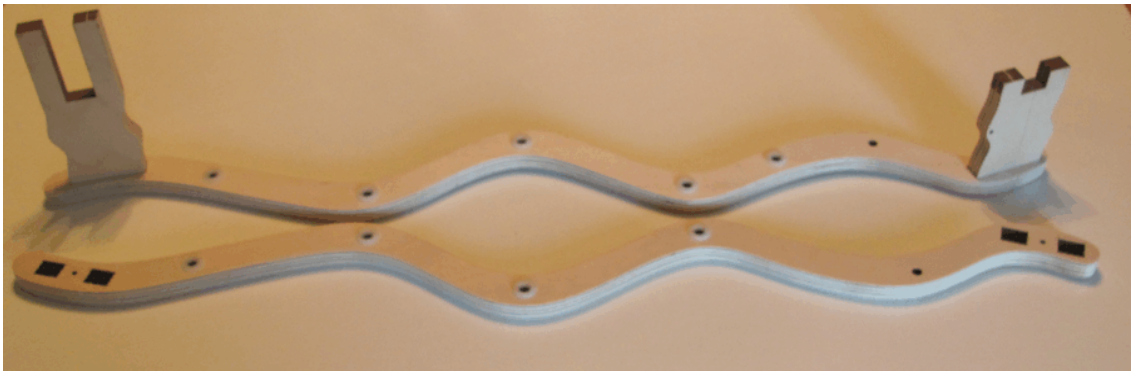
3) Glue the strut pieces into the front frame assembly (the shorter tabs are inserted into the recesses in the interior of the front frame). Make sure the struts are oriented as shown below; note especially the location of the hole in the lower strut (toward the middle of the frame). The fit will be tight–use a hammer to carefully and completely seat the struts into front frame.

4) Glue the lower support bracket unit into holes in rear frame piece with the slot oriented as shown below.

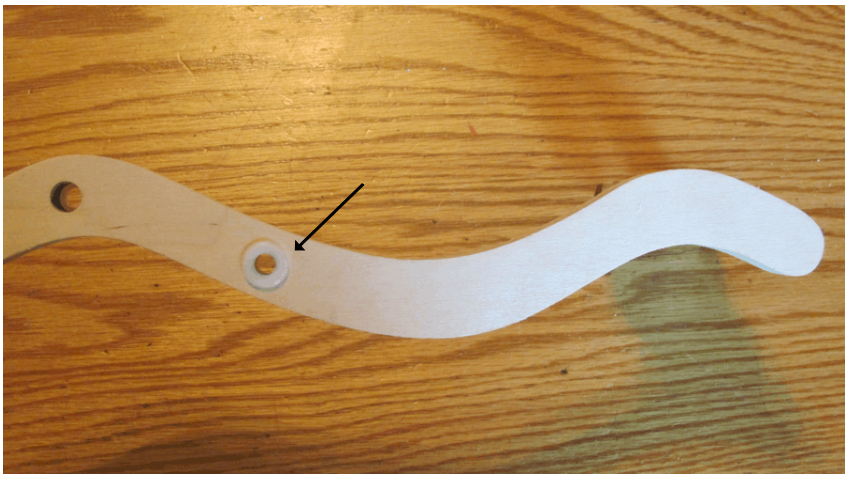
5) If desired, sand the perimeter of the pendulum support plate (#5), but do not sand the rectangular tab. Glue the pendulum support plate (#5) into the slot in the rear frame piece. Make sure the pendulum support plate is oriented as shown below.



6) Apply a small amount of glue around the rim of each of the nine holes on the interior sides (shown face up in the photo below) of both frame pieces (5 in front frame piece, 4 in rear frame piece). Snap a nylon shoulder washer into each of these holes (it might be necessary to tap into place with a hammer).



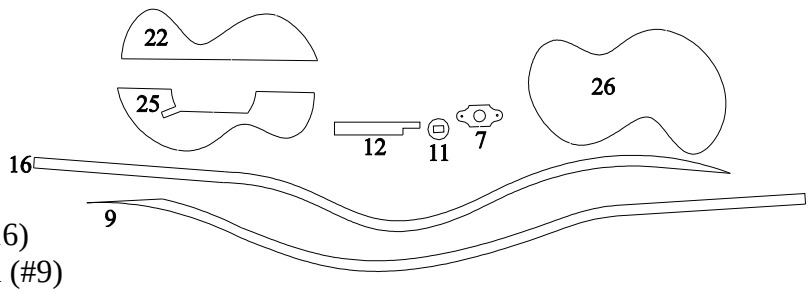
7) Glue a nylon shoulder washer into lowest hole (closest to end) on the front frame outer piece. Do not insert washers into the other two holes on the front frame.



Pendulum

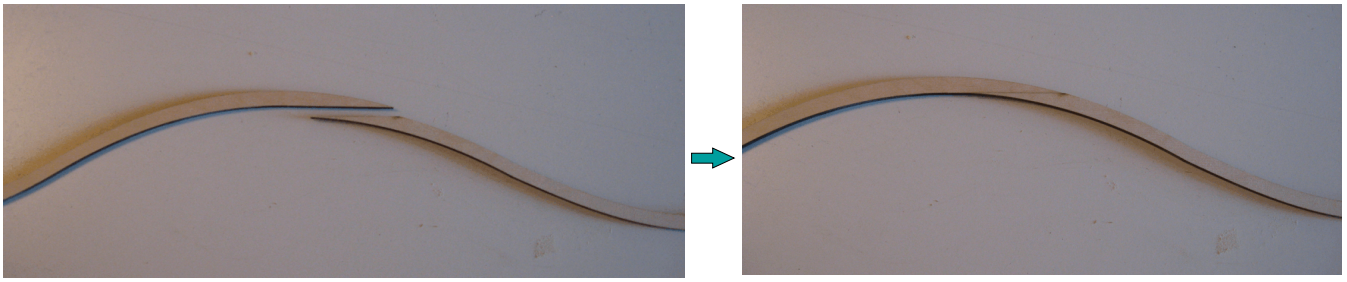
Parts

1 - Pendulum bob front (#26)
1 - Pendulum bob rear piece (#22)
1 - Pendulum bob rear piece (#25)
1 - Pendulum clamp (#12)
1 - Pendulum shaft top (#11)
1 - Pendulum hanger bracket (#7)
1 - Pendulum shaft top section (#16)
1 - Pendulum shaft bottom section (#9)
2 - #4 x ½" screws



Assembly Procedure

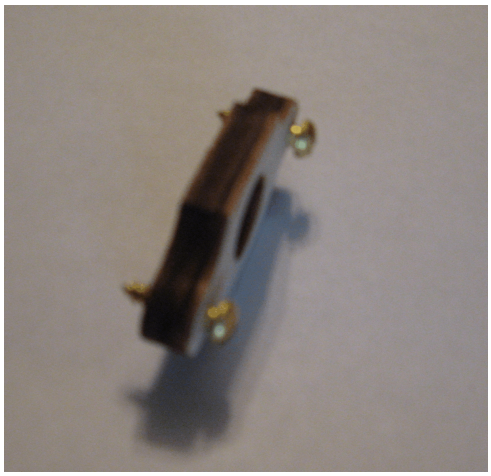
1) Glue together the two shaft sections (#16, #9). Clamp the joint and allow glue to dry completely.



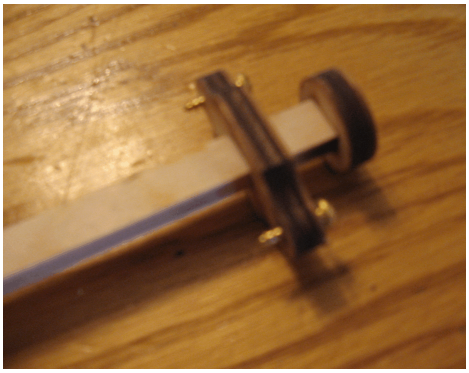
2) If desired, sand the long edges of the pendulum shaft. Avoid sanding the last ½" of the end of the top shaft.

3) If desired, sand the perimeter of the pendulum hanger bracket (#7).

4) Drive two #4 x ½" screws through the predrilled holes in the pendulum hanger bracket until about 1/8" of the tips protrude.



5) Slide the pendulum hanger bracket onto the top of the pendulum shaft with the screw tips pointing down the long end of the shaft. Glue the pendulum shaft top (#11) to the pendulum shaft top section (#16). Be sure it is the pendulum shaft top section that you are gluing it to.



6) Apply finish to the pendulum shaft as desired.

7) Position the two pendulum bob rear pieces (#22 and #25) on the pendulum bob front (#26) with the bottom portion of the pendulum shaft between the rear pieces. Glue the two rear bob pieces to the front bob piece, adjusting their position so that the shaft fits snugly yet is able to slide between the two pieces. *Do not glue the shaft to the bob.*

8) Remove the shaft. Glue the pendulum clamp (#12) into the slot in the back of the pendulum bob with the cutout section over the slot that runs down the middle of the bob. **Apply glue only to the portion of the clamp that fits into the slot in the bob** (the rest of the length must be free to flex).

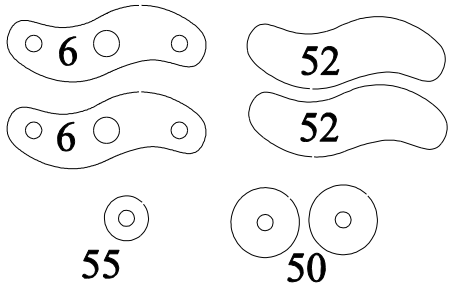
9) Sand the perimeter of the pendulum bob and apply finish as desired.

10) Slide the bottom portion of the pendulum shaft into the slot on the rear of the bob. You will need to flex the spring clamp aside to allow the shaft to pass through. The clamp should hold the shaft in place, yet allow the bob to be repositioned on the shaft

Weight Pulley

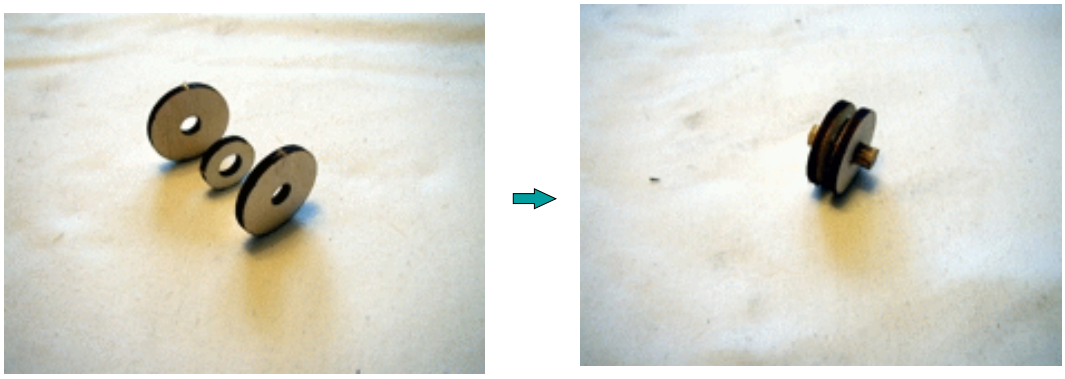
Parts

2 - Weight pulley faces (#52)
2 - Weight pulley sides (#6)
1 - Pulley wheel hub (#55)
2 - Pulley wheel sides (#50)
2 - 1" dowels
1 - 3/4" dowel
2 Nylon shoulder washers

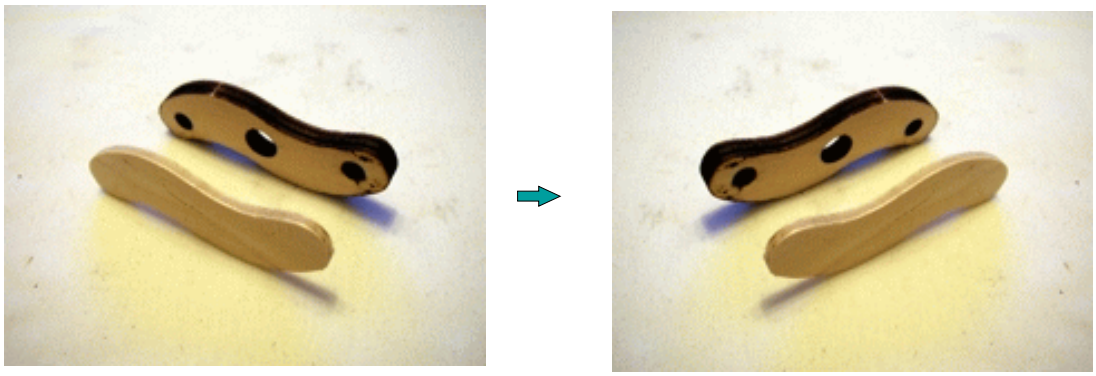


Assembly Procedure

1) Spread glue on both sides of the pulley wheel hub (#55). Spread glue on the center portion of the 3/4" dowel. Sandwich the pulley wheel hub (#55) between the pulley wheel sides (#50) and slide the pulley wheel onto the dowel. The goal is have the pulley wheel pieces glued together as well as glued to 3/4" dowel. Lightly sand the hub to remove any burrs that could snag the cord.

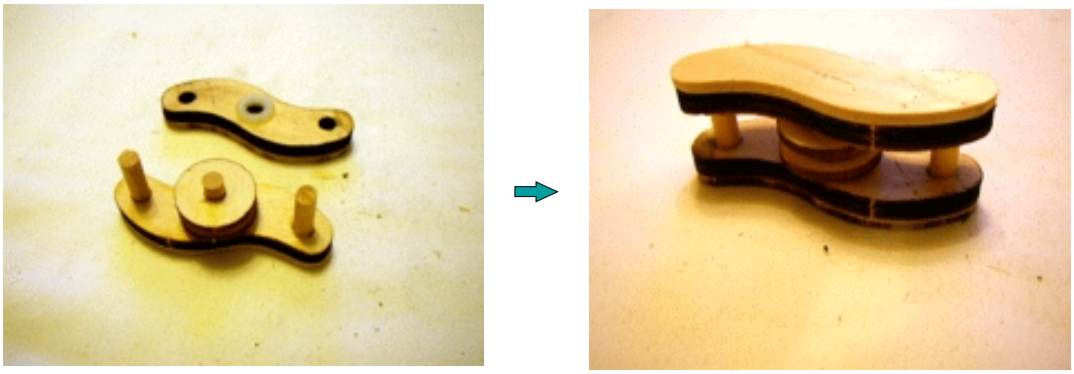


2) Glue one of the pulley faces (#52) onto one of the pulley frames (#6). Repeat for the other pulley face and pulley frame, except glue the pulley face to the opposite face of the frame piece (look ahead to step 4).



3) Sand the perimeter of the two pulley side units.

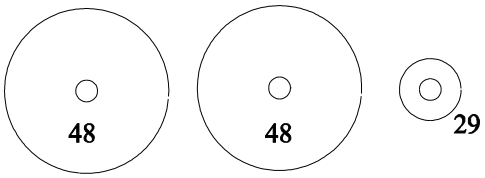
4) Glue a nylon shoulder washer into each of the two holes in the center of the pulley frames. Glue the two 1" dowels into the holes in one of the frame pieces. Set the pulley wheel into the shoulder washer and glue the other frame pieces onto the dowels. Check to be sure the pulley spins freely.



Winding Guide Spool

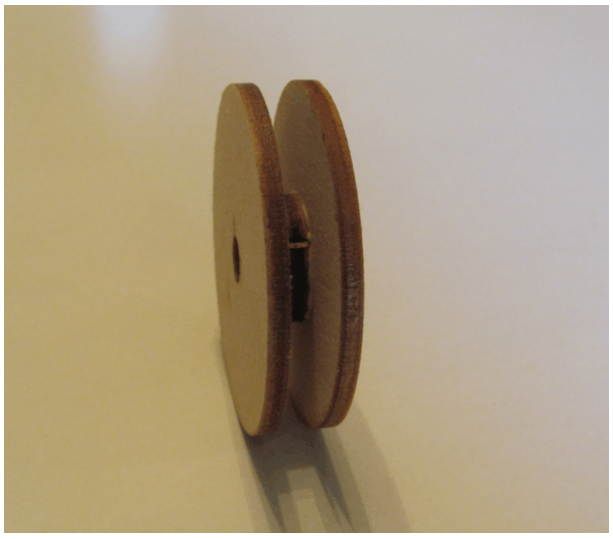
Parts

1 - Winding guide middle (#29)
2 - Spool sides (#48)



Assembly Procedure

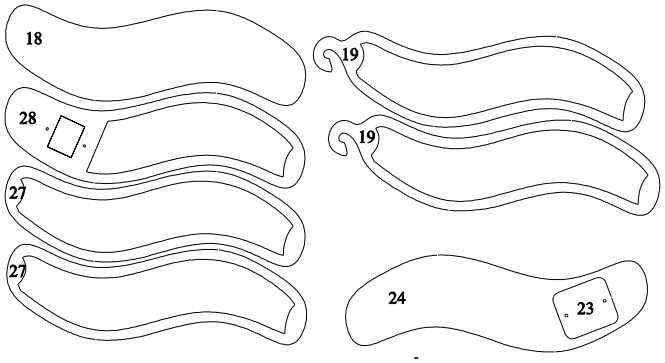
Glue the winding guide middle (#29) between the two spool sides (#48) with the center holes aligned.



Weight Shell

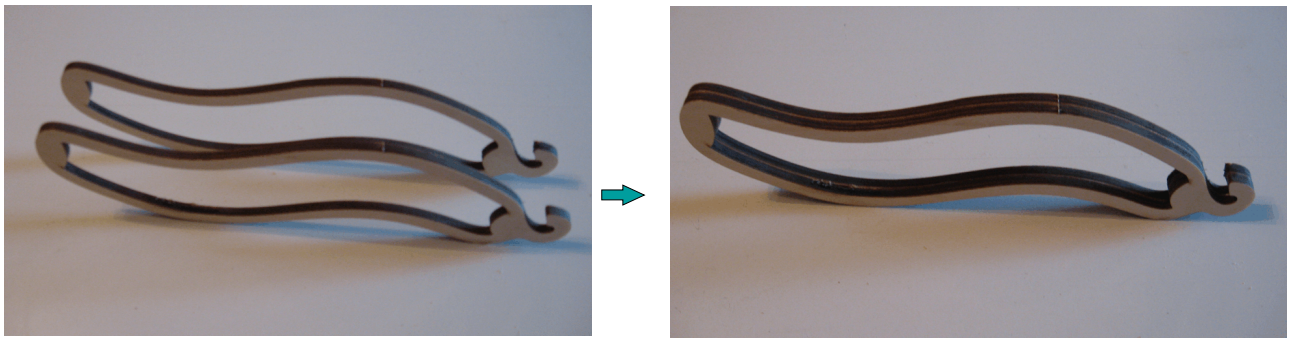
Parts

1 - Weight shell front (#18)
1 - Weight shell rear piece (#28)
2 - Weight shell middle pieces (#27)
2 - Weight shell hook pieces (#19)
1 - Weight shell back (#24)
1 - Weight shell cover plate (#23)
2 - #4 x 1/2" screws



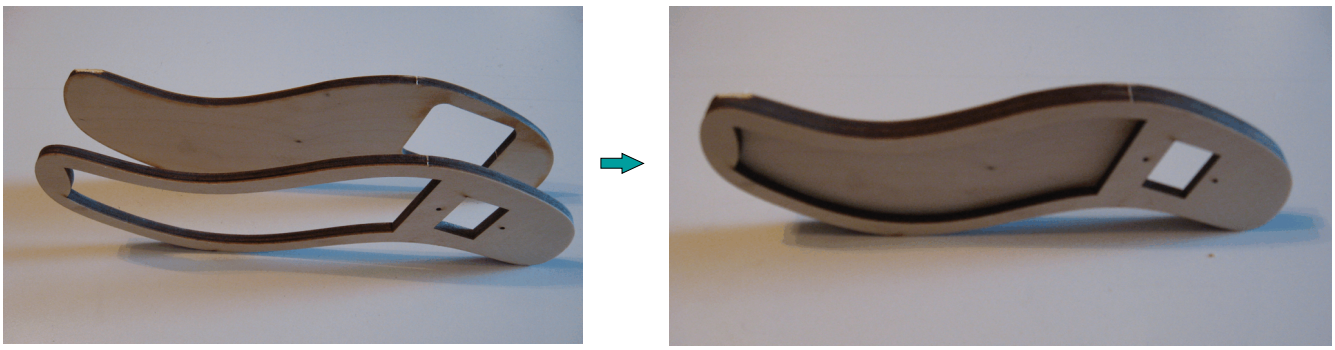
Assembly Procedure

1) Glue together the two weight shell hook pieces (#19), making sure all edges are aligned.

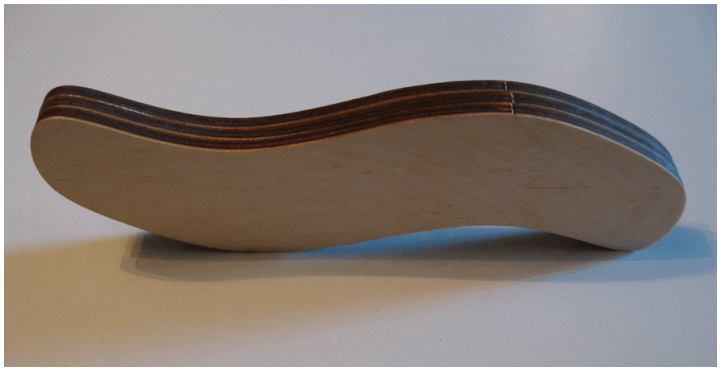


2) Separate the weight shell cover plate (#23) from the weight shell back (#24).

3) Glue together the weight shell rear piece (#28) and the weight shell back (#24) with pieces aligned as shown and the perimeter edges aligned.

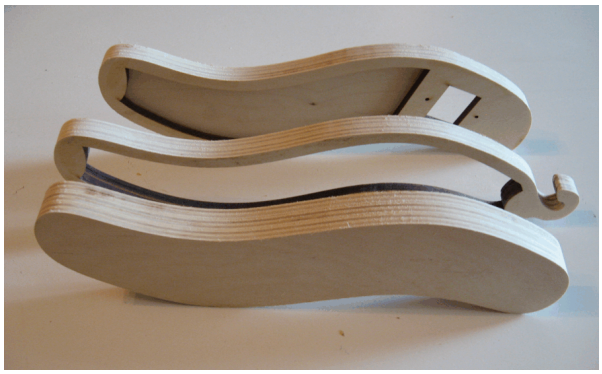


4) Glue together the weight shell front (#18) and the two weight shell middle pieces (#27) oriented as shown below with the perimeter edges aligned.



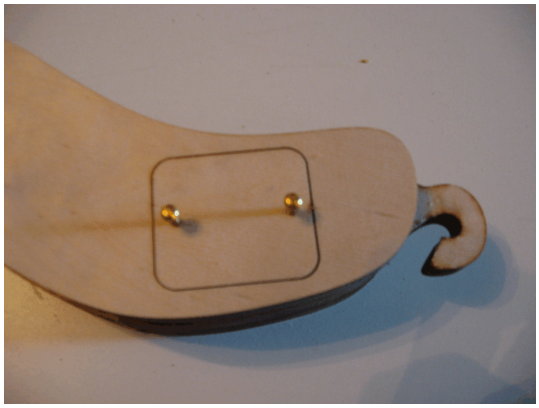
5) Sand the perimeter of the three completed weight shell pieces.

6) Glue together the three weights shell pieces, oriented as shown below. Align the perimeter edges.



7) Perform any final sanding on the weight shell and finish as desired.

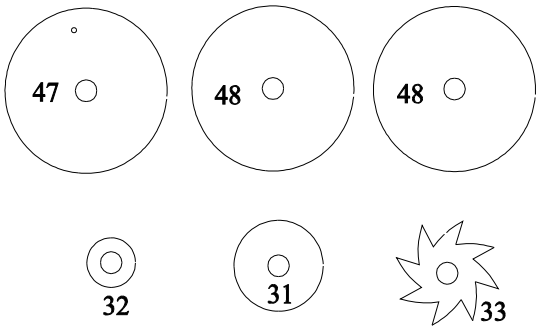
8) Fill the weight shell with approximately 3 lbs of metal shot. Secure the weight shell cover plate (#23) into the recess in the back of the weight shell with two #4 x 1/2" screws.



Winding Mechanism

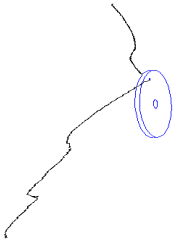
Parts

1 - Rachet (#33)
1 - Spool divider (#47)
2 - Spool sides (#48)
1 - Weight spool hub (#31)
1 - Winding spool hub (#32)
18' cord

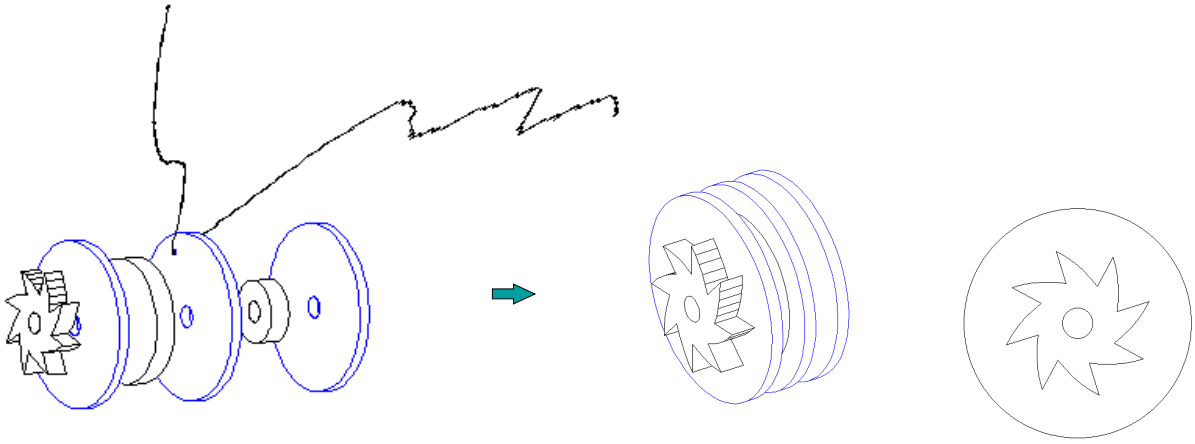


Assembly Procedure

1) Thread the winding cord through the small hole in spool divider (#47). Pull a few inches of cord through the hole and secure with tape so that it does not slip back through during spool assembly.



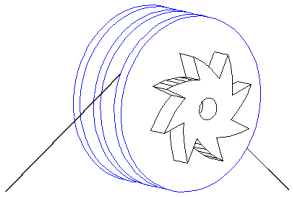
2) Glue the rachet (#33), spool sides (#48), spool divider (#47), weight spool hub (#31), winding spool hub (#32) together in the order shown. **Be careful to orient the rachet teeth as shown**. Use a piece of 1/4" dowel or a drill bit to help align the pieces and to clear the center hole of excess glue (remove dowel before glue sets). It is critical that the glue bonds between all of the spool pieces are solid–ensure adequate glue coverage and clamp time.



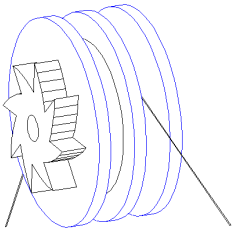
3) Apply finish to the completed spool if desired.

4) Pull the cord through the spool divider (#47) until there is approximately 12 feet of cord on the rachet side of the spool divider.

5) Hold the spool so the rachet is facing you (as pictured below). Wrap the cord protruding from the rachet side of the spool around the larger hub in a counter-clockwise direction. Continue winding until about 16" of cord remains.



6) With the rachet in the same position, wind the other length of cord 3 times around the smaller hub in a clockwise direction (nearly 6 feet of cord will remain).



7) Secure the two strings with a piece of tape so they do not come unwound during the upcoming assembly sequence.

Crutch

Parts

1 - Crutch (#40)
2 -1"dowels

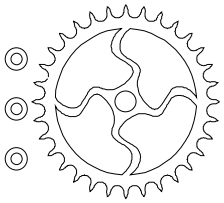
Assembly Procedure

Glue the crutch fork dowels into crutch.

Hour Pipe

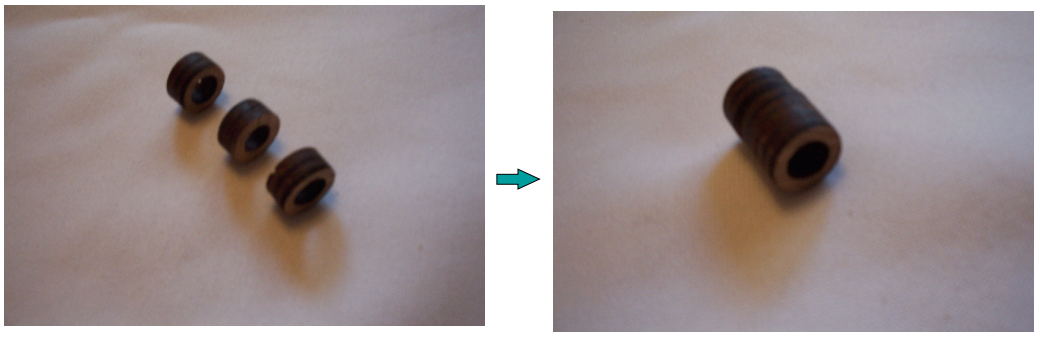
Parts

3 - hour pipe pieces (#43)
1 - 32 tooth gear (#39)



Assembly Procedure

1) Glue the three hour pipe pieces (#43) together. Use a piece of 1/4" dowel to clear any excess glue from the inside of the hour pipe.

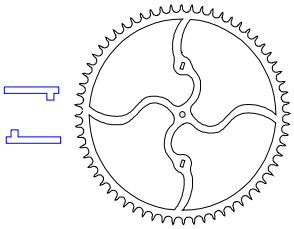


2) After hour pipe glue is completely cured, use a hammer to gently tap the minute pipe into the 32 tooth gear:

Great Wheel Pawls

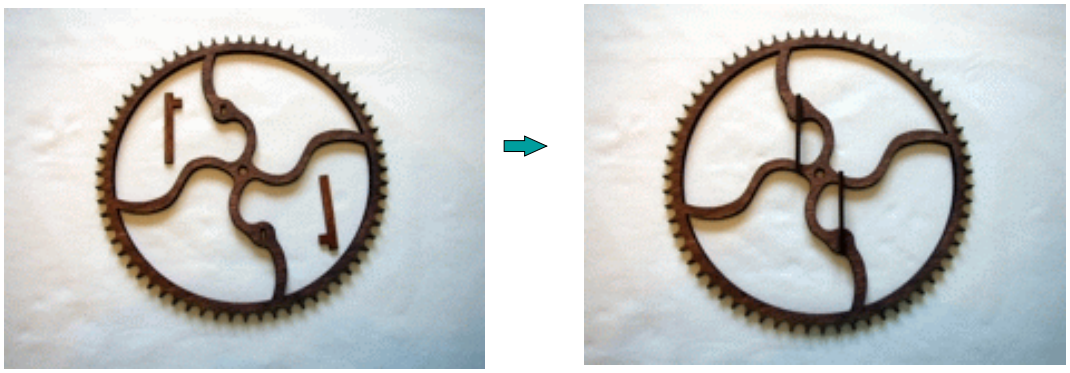
Parts

2 - Pawls (#49)
1 - 64-tooth great wheel (#30)



Assembly Procedure

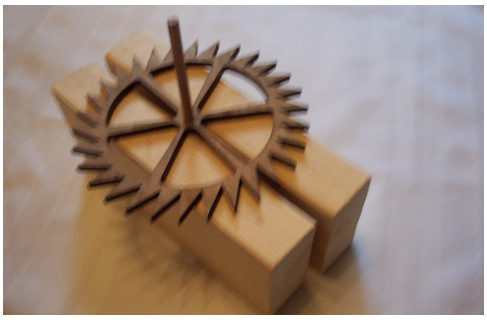
Glue the two rachet pawls into the two slots in the great wheel gear spokes. **Make sure they are oriented as shown below.**

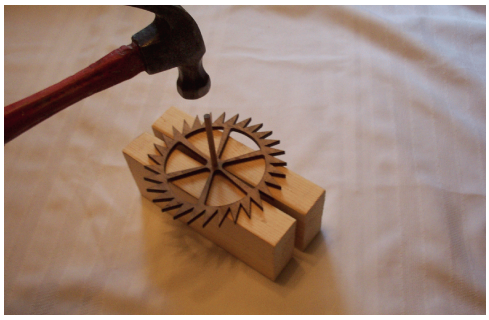


Installing Gears on Arbors

Before installing gears on the arbors, any desired staining should be completed on all gears and set washers (do not apply varnish or polyurethane finish to the edges of the gear teeth). Do not attempt to sand the laser browning off the edges of the gear teeth (this could distort the shape of the gear teeth).

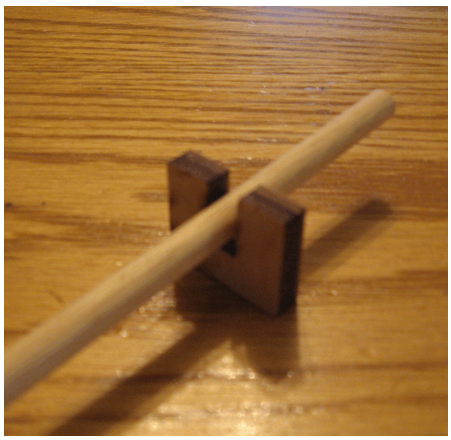
In the following instructions, the assembly procedure is given for each arbor. Begin by using the gear location diagram to mark the locations for the gears, set washers, etc. This is most easily done by laying the arbor directly on the gear location diagram and using a pencil to mark the gear locations. To install gears on the arbors, place the gear on a flat, solid surface. Use a hammer to gently drive the arbor into the gear. Be sure to drive the arbor in perpendicular to the gear. Once the arbor is fully engaged in the gear, place the gear on two blocks of wood spaced apart slightly more than the width of a dowel. Continue to drive the arbor through the gear until it arrives at the marked location on the arbor. **Do not glue the gears in place yet; their positions may need to be adjusted after the clock is assembled!**





Important: After gears have been properly positioned on arbors, use fine sandpaper to smooth the portions of the arbor that will rest in the frame*. This sanding is most easily done by wrapping a small strip of sandpaper around the arbor and twisting the arbor. Use a sanding sequence of 220, 400, and 600 grit.

The arbor should be slick and should easily fit into the arbor sizing jig contained in the hardware pack.



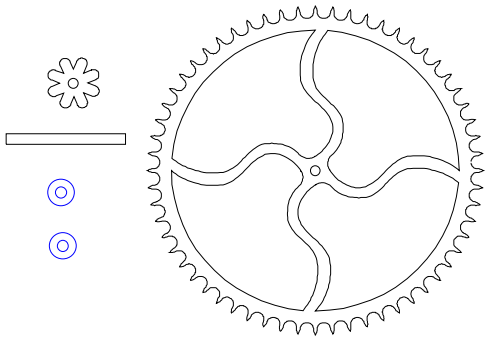
Apply graphite to the contact areas of the arbors by coloring that section of the arbor with a pencil.

***the portion of the arbor that needs to be polished and lubricated with graphite is indicated on the gear location diagrams with gray shading**

Mid Wheel Arbor

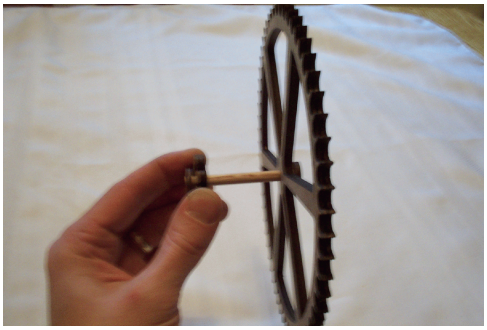
Parts

1 - 60-tooth gear (#34)
1 - 8-tooth gear (#35)
1 - 2 3/4" arbor
2 - spacer washers (#51)

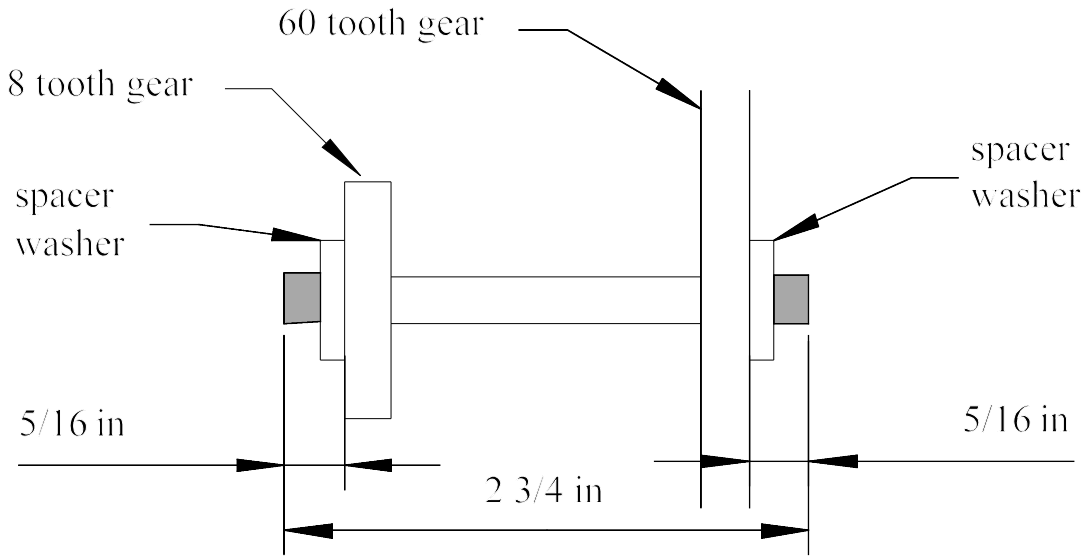


Assembly Procedure

Mount the 60-tooth gear and the 8-tooth gear on arbor in the positions indicated in the Gear Location Diagram. Place a spacer washer on both ends of the arbor.



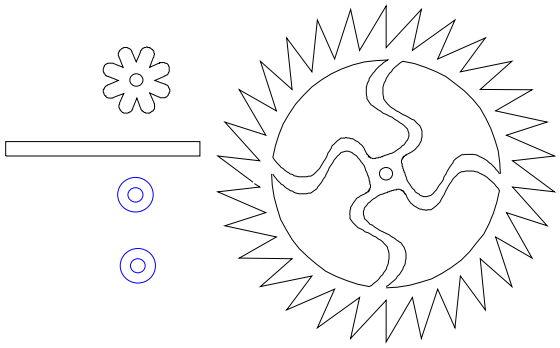
Gear Locations



Escape Wheel Arbor

Parts

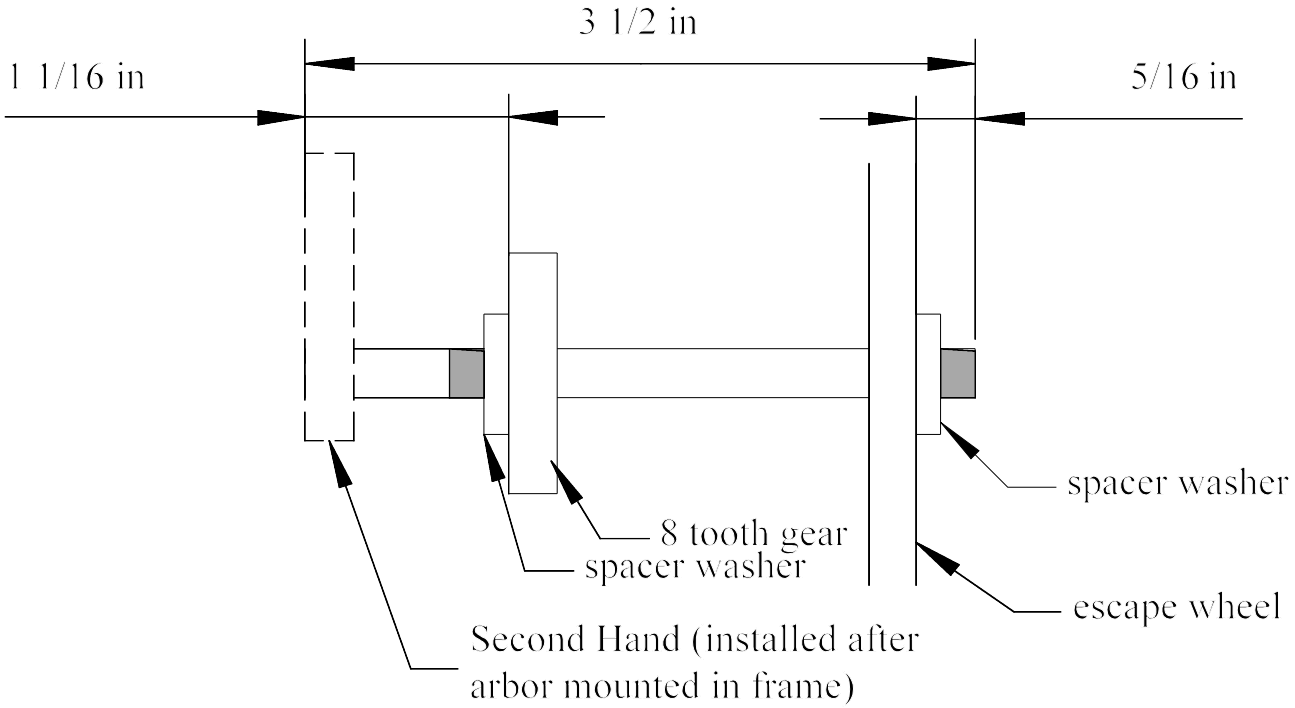
1 - Escape wheel (#37)
1 - 8-tooth gear (#35)
1 - 3 1/2" arbor
2 - spacer washers (#51)
note: second hand will be installed on this arbor after clock is assembled.



Assembly Procedure

Mount the 8-tooth gear and the 30-tooth escape wheel on arbor in the positions indicated in the Gear Locations Diagram below. *Be sure the teeth of the escape wheel are oriented as shown below*. Place a spacer washer on both ends of the arbor.

Gear Locations

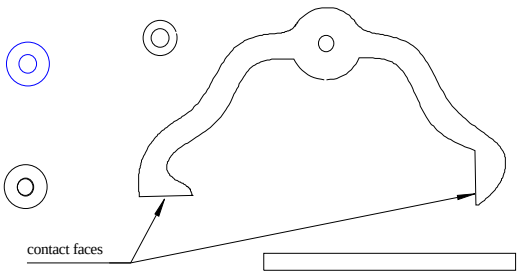


Escape Lever Arbor

Parts

1 - Escape lever (#42)
1 - Set washer (#38)
1 - 3 5/8" arbor
1 - spacer washer (#51)

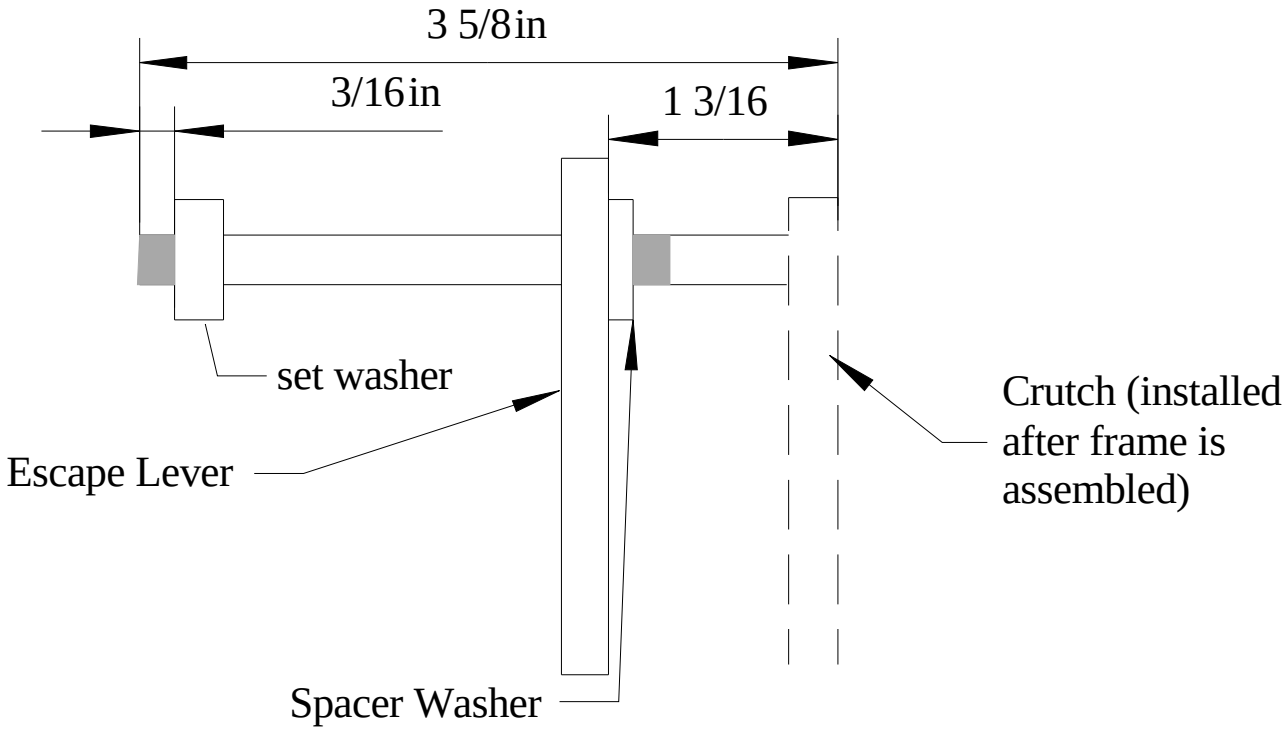
note: crutch will be installed on this arbor after clock is assembled.



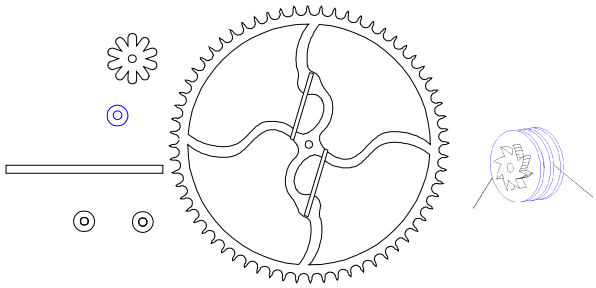
Assembly Procedure

The contact faces ("pallets") of the escape lever must be smooth. Lay a piece of 220 grit sandpaper on a smooth, hard surface and lightly sand these two faces, making sure not to alter the angle or flatness of the faces. Repeat with 400 and then 600 grit sandpaper. Then, rub some pencil lead on the contact faces. Mount escape lever and the set washer on arbor in positions indicated in the Gear Locations diagram. *The escape lever must be oriented as shown in the photo below*. Place a spacer washer on the escape lever end of the arbor.

Gear Locations



Great Wheel Arbor



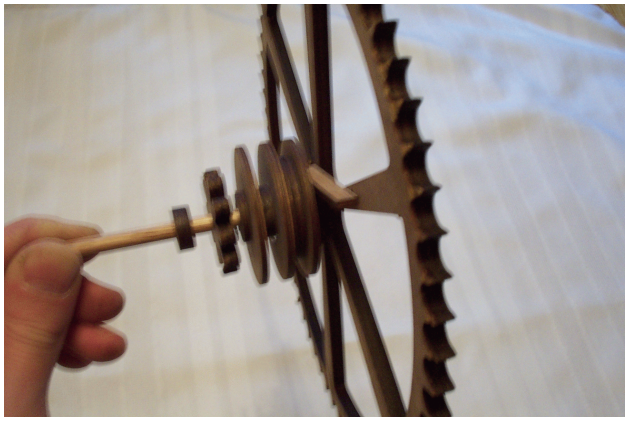
Parts

1 - 64-tooth gear (with pawls) (#30)
1 - Set washer (#38)
1 - 10-tooth gear (#36)
1 - 4 13/16" arbor
2 - spacer washers (#51)
Winding spool (assembled previously)

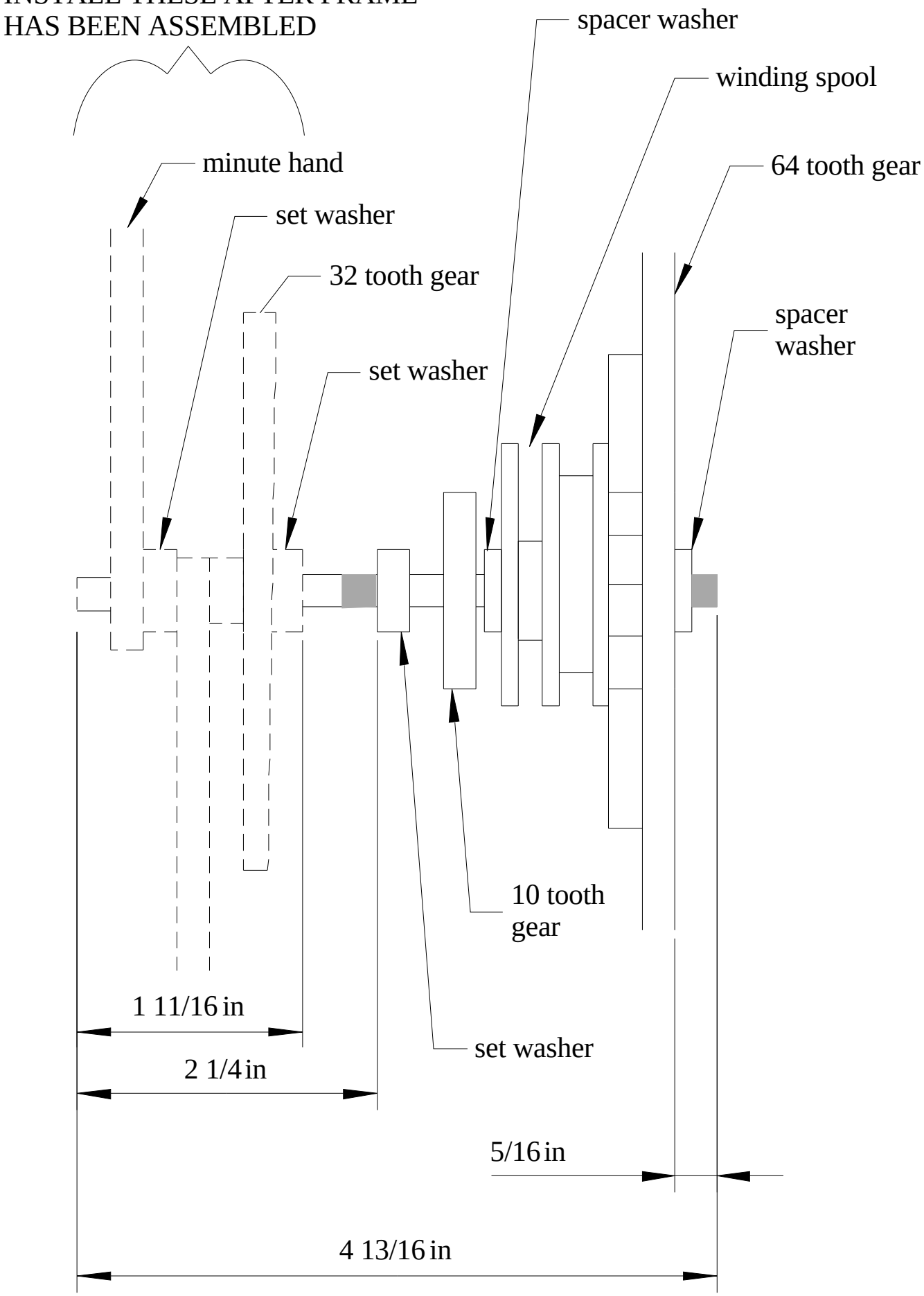
note: hour gear, set washers, and minute hand will be installed on this arbor after clock is assembled.

Assembly Procedure

Mount the 64-tooth great wheel on arbor in position indicated in the Gear Locations diagram (see next page). *The side of the gear containing the rachet pawls must be toward the long end of the arbor.* Slide winding spool, rachet side first, onto the arbor. Twist the spool so the rachet teeth mesh with the pawls. Slide a spacer washer onto the arbor adjacent to the spool. Mount the 10-tooth gear on the arbor, bringing it nearly in contact with the spacer washer (leave about 1/16" gap so that the spool is free to rotate on the shaft without binding). Mount the set washer on the arbor in the position indicated in the Gear Locations diagram. Place a spacer washer on the great wheel end of the arbor. The remaining components will be installed on this arbor after the arbor has been assembled in the frame.



Gear Locations

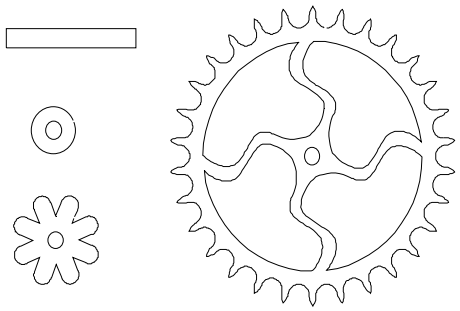


Minute Arbor

Parts

1 - 1 13/16" arbor
1 - Set washer (#38)
1 - 30-tooth gear (#41)

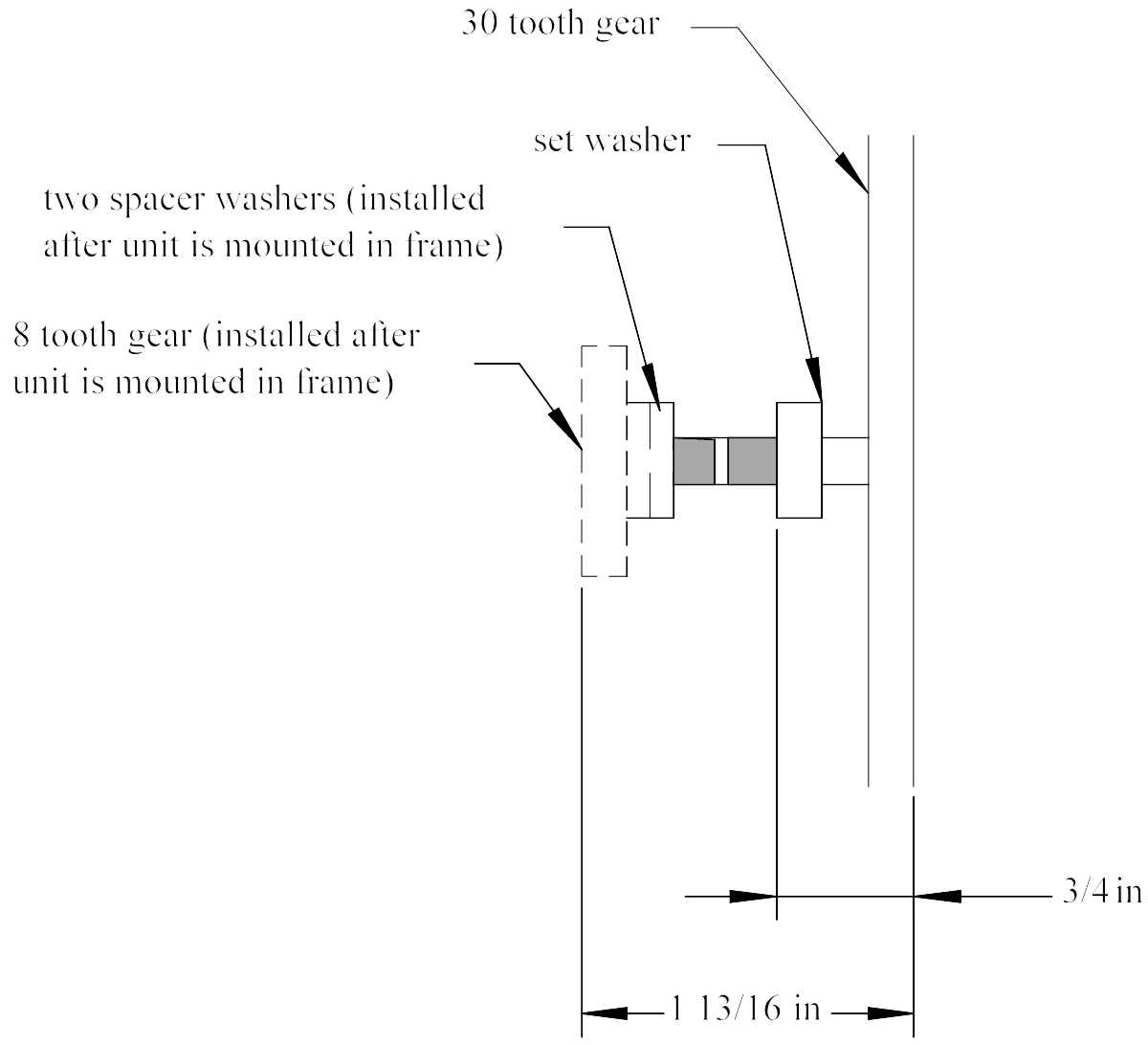
Installed after clock is assembled:
8-tooth gear (#35)
2 - spacer washer (#51)



Assembly Procedure

Mount the set washer and the 30-tooth gear and the set washer on the arbor in the locations indicated in Gear Locations diagram (8-tooth gear and spacer washers will be mounted after arbor is mounted in frame).

Gear Locations



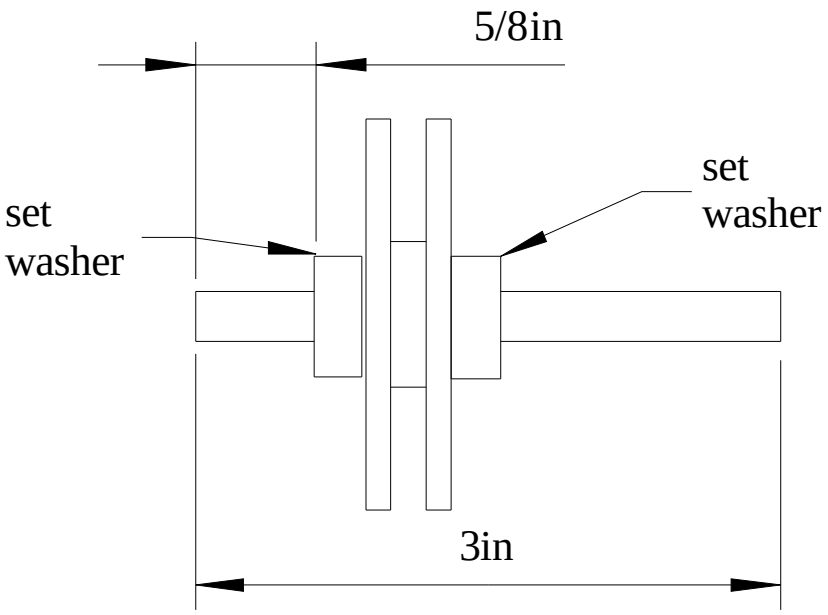
Winding Guide Arbor

Parts

1 - 3" arbor
2 - set washers (#38)
Winding guide spool (assembled previously)

Assembly Procedure

Slide the winding guide spool onto the 3" arbor. Position two set washers on the arbor in the locations shown. There should be enough clearance between the set washers to allow the spool to spin freely.



Preliminary Assembly

Parts

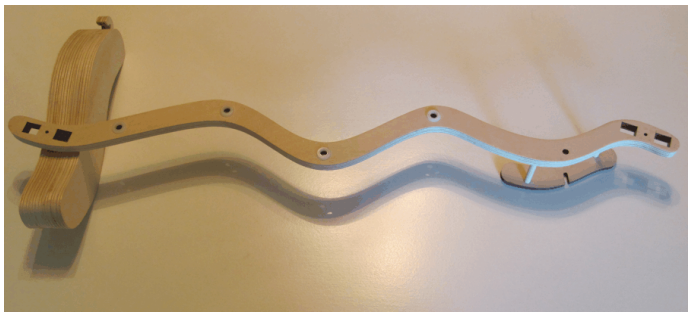
4 - #6 x 1" screws

All of the following units have been assembled in previously:

- Rear frame unit
- Front frame unit
- Crutch
- Escape lever arbor
- Escape wheel arbor
- Mid wheel arbor
- Great wheel arbor
- Winding guide arbor
- Weight pulley

Assembly Procedure

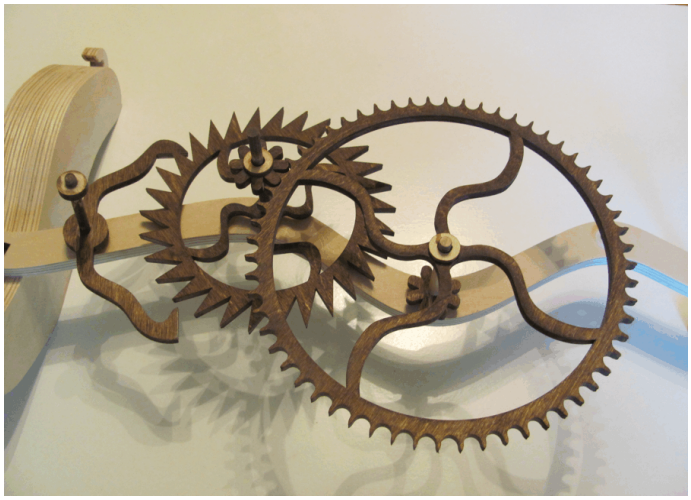
1) Set rear frame unit on a flat surface, resting on the hanger bracket. Prop the upper end of the frame with the weight shell so the rear frame unit remains stable.



2) Insert the escape lever arbor into topmost bushing with the escape lever down. Be sure a spacer washer is located between escape lever and shoulder washer bushing.

3) Insert the escape wheel arbor into the next highest bushing with the escape wheel down. Be sure that a spacer washer is located at both ends of the arbor.

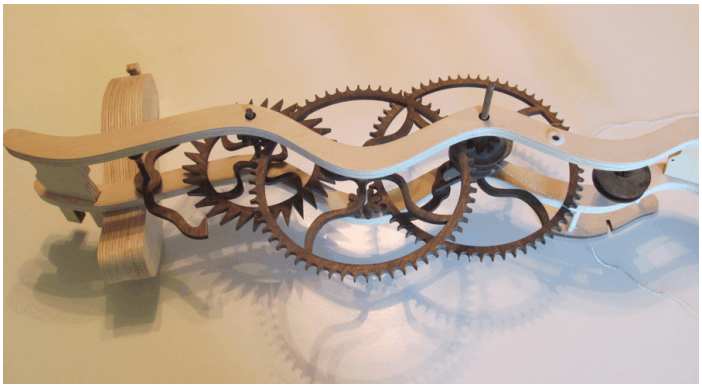
4) Insert the mid arbor into the next bushing, with the 8-tooth gear down. Be sure there is spacer washer at both ends of the arbor. The 60-tooth gear should mate with the 8-tooth gear on the escape wheel arbor.



5) Insert the great wheel arbor into the next available bushing, with the 64-tooth gear down. Be sure there is a spacer washer adjacent to the 64-tooth gear. The 64-tooth gear should mate with the 8-tooth gear on the mid arbor. (Note: the 10 tooth gear on the great wheel arbor does NOT mesh with the 60-tooth gear nearby.)

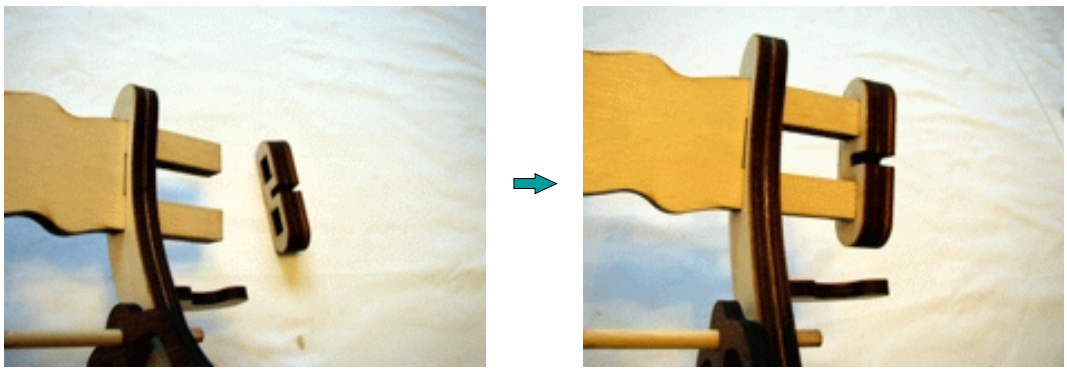
6) Insert the longer length of the winding guide arbor into the 1/4" hole in the rear frame.

7) Carefully attach the front frame unit. Note that the escape wheel arbor and great wheel arbors extends through the front frame. Line the arbors up with the bushings as the frame front is applied. NOTE: the strut forks should slip into the rear frame holes. Some sanding may be necessary if the parts were slightly misaligned or there was glue residue on the strut forks or in the holes.



8) Drive a #4 x 1" screw through each of the two the predrilled hole in the back side of the rear frame piece. The screw holds the rear frame piece tight to the upper and lower struts.

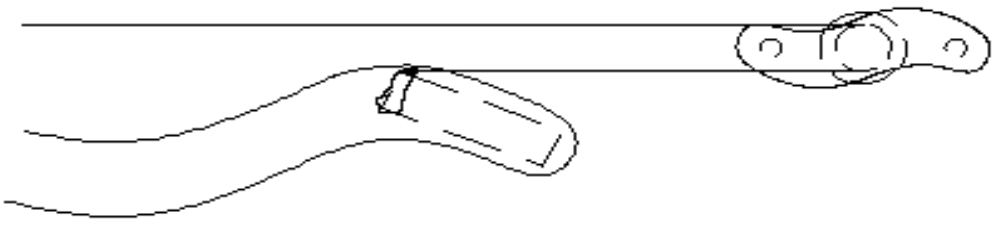
9) Push the upper hanger bracket onto the upper strut forks, making sure the slot in the hanger bracket is oriented as shown.



10) Drive two #4 x 1" screws through the predrilled holes in the back side of the hanger bracket into the upper strut.

11) Attach (but do not glue) the crutch to the escape lever arbor protruding through the rear of the clock frame. Orient the crutch so that it is approximately perpendicular to the escape lever (the exact position of the crutch will be adjusted after the clock is mounted on the wall). The crutch should fit firmly on the arbor so it cannot slip on the arbor.

12) Thread the weight cord (the cord coming off the larger spool hub) around the wheel on the weight pully. Then thread the cord through the hole in the lower frame strut (see diagram below). Pull enough cord through so that the weight pulley is suspended just below the frame strut. Tie securely and cut off any excess cord. (TIP: If the cord is difficult to thread through the hole because the end is frayed, apply a small amount of glue to the end of the string and allow to dry before threading through the hole.)



Mounting Instructions

1) Determine the location to hang your clock. Be sure to consider the following:

a) The clock must be mounted securely to the wall. Locate a stud within the wall for the solid mounting.

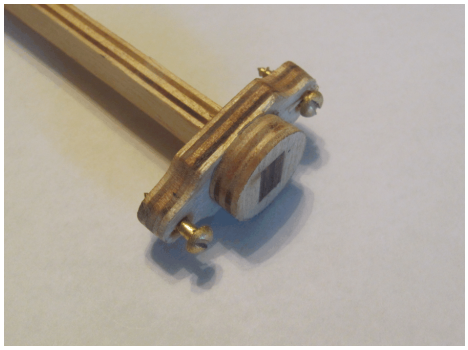
b) Choose a location which is free from obstructions to the swinging pendulum or the descending weight.

c) For best operation, select a location that will be free from vibration and drafts (adjacent to a door may be problematic due to vibrations or air currents from slamming doors)

d) The clock has a hanging weight and cords, which pose a potential hazard to children. Keep young children away from the weight and cords.

2) Drive the 2" screw into the wall at a height of approximately 81" above the floor. Leave approximately 3/8" of the screw protruding from the wall. The screw should fit snugly into the slot in the upper hanger bracket. Adjust the screw depth until the screw seats firmly into the slot. Hang the clock on the wall with the two arbors protruding from the front of the frame in an approximately vertical line.

3) Practice putting the pendulum into place: Push the pendulum hanger bracket up tight to the pendulum shaft top. Position the bracket so a line joining the screws is perpendicular to the longer edge of the shaft.



If the fit is not snug, use a piece of tape to hold the bracket in this position. Thread the pendulum between the crutch forks, and up toward the pendulum support plate. Place the screw tips onto the two small holes in the pendulum support plate. NOTE: <u>The screw tips simply rest in the pendulum support plate holes; these screws do not get driven into the pendulum support plate</u>.

4) Remove the pendulum from the clock by reversing the previous steps. Separate the pendulum support bracket from the shaft top, apply glue to the support bracket and push it back up to tight to the pendulum top. Immediately thread the pendulum back up into position. Note whether the pendulum bob aligns parallel with the wall. If necessary, rotate the pendulum shaft to correct the alignment of the bob (since the glue is still wet, the position of the shaft can be rotated within the pendulum bracket). With the pendulum bracket screws properly seated in their platform holes and the shaft properly aligning the bob with the wall, allow the glue to dry.

5) Next, adjust the vertical alignment of the pendulum shaft by either raising or lowering one or the other screw in the pendulum support plate. The pendulum shaft doesn't need to be perfectly vertical, but it cannot be rubbing on the wall or interfering with the weight shell.

6) With the clock hanging vertically on the wall, the escape lever should appear to be balanced from left to right as shown below. If necessary, reposition the crutch by holding the escape lever firmly and rotating the crutch on its arbor.

7) The weight pulley is suspended by the weight cord. Make sure the string passes over the pulley wheel rather then beside it.

8) Hang the weight shell hook on the lower dowel on the weight pulley.

9) Gently push the pendulum to one side and release to start the clock's motion.

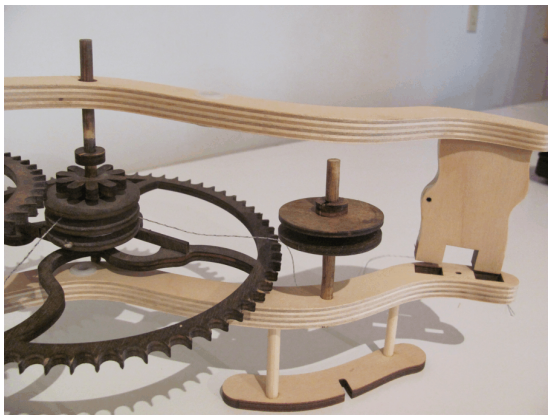
10) The vertical orientation of any pendulum clock is critical. As the escape lever rocks back and forth, it must deliver an even, balanced "tick-tock". In order to achieve this, the orientation of the clock on the wall needs to be adjusted. If the escape lever stalls on its right side, nudge the bottom of the clock slightly to the left. If the escape lever catches on the left side, nudge the bottom of the clock slightly to the right. If you find it necessary to tip the clock far off plumb in order to bring it into beat, then you will need to adjust the crutch orientation as described in step 6 above.

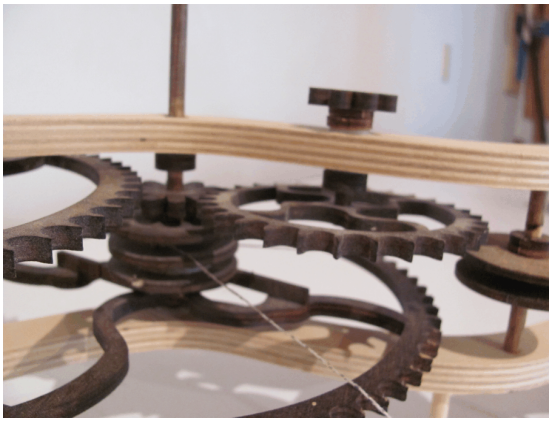
It will be helpful to secure the lower hanger bracket to the wall with a piece of masking tape to maintain its position on the wall. Let the clock run for at least several hours to be sure the main movement is functioning properly. If you have difficulty getting the clock to run, refer to the Troubleshooting section later in this manual.

Final Assembly

Assembly Procedure

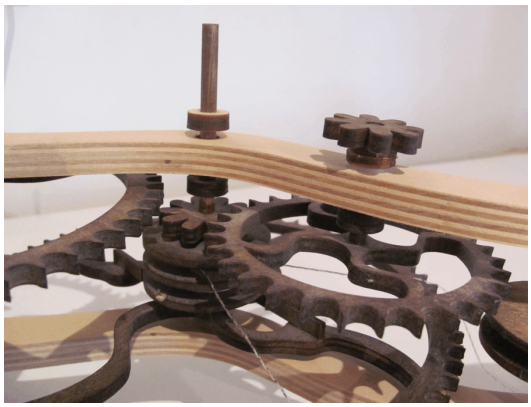
1) Loosen the screws that secure the clock frame together. Separate the frames enough to allow insertion of the 30-tooth gear arbor into the lowest hole in the front frame. The 30-tooth gear meshes with the 10-tooth gear above it. Slide two spacer washers and then the 8-tooth gear onto the minute arbor protruding through front of frame. Make sure there is just enough clearance so that the wheel will be able to rotate when being driven by the 10-tooth gear. Reassemble the frame together.





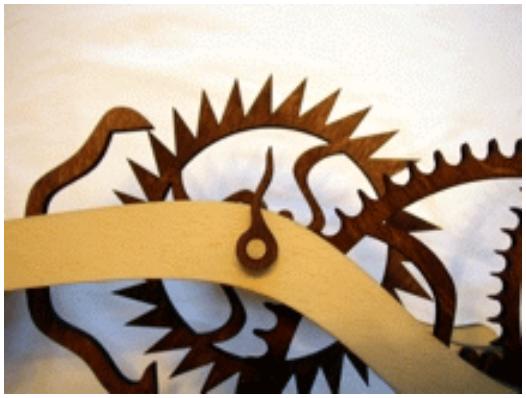
2) Install the hour hand on the hour pipe. The hour hand should be loose enough so that it can be rotated on hour pipe, yet tight enough so it will not slip on its own. Next, push a set washer onto the great wheel arbor, followed by the minute hand. The minute hand should also be loose enough so that it can be made to rotate on the arbor. Both hands must hold their position on the shaft, but must be able to be rotated to set the time. *If either of the hands are too loose (causing the hands to slip), apply a small amount of glue to the shaft to build it up slightly. Allow to dry completely before attaching hand. If the hands are too tight, sand the shaft or interior hole of hand.*

3) Push or twist a set washer onto the great wheel arbor until it is about 1/8" from the front of the frame. Slide the hour pipe (installed in 32-tooth gear) onto the great wheel arbor. The 32-tooth gear should mate with the 8-tooth gear.



4) Push or twist a set washer onto the great wheel arbor until it is about 1/16" from the hour pipe. There should be just enough clearance to hold the hour gear in position while still allowing it to rotate. Next, twist the minute hand onto the great wheel arbor. As with the hour hand, the fit should allow the minute hand to be repositioned on the arbor.

5) Push the second hand onto the escape wheel arbor protruding through top of front frame (do not glue). Make sure that the second hand does not contact the frame.



Dials

Parts

1 - Dial (#20)
1 - Seconds dial (#21)

Assembly Procedure

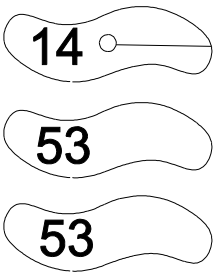
1) With the clock mounted and running in its desired position, hold the dial up to the front frame and use a small pencil mark to indicate the location of the time ring on the frame and on the dial. Be sure to center the dial over the great wheel arbor and orient it so two of the ‘humps’ lie on a vertical line (12 o’clock and 6 o’clock). Glue the dial to the front frame.

2) Follow a similar procedure to glue the seconds dial to the frame.

Winding Pull

Parts

1 - Winding pull middle (#14)
2 - Winding pull sides (#53)



Assembly Procedure

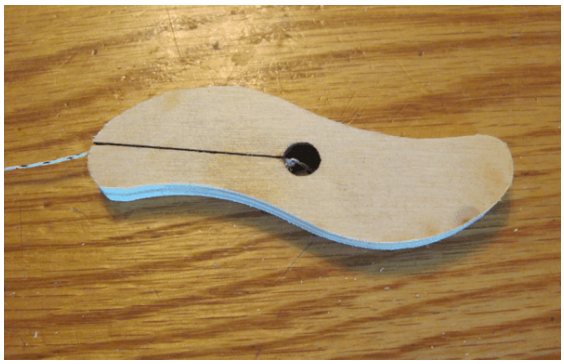
1) Sandwich the middle piece (#14) between the two side pieces (#53). With the pieces held together, sand the perimeter if desired and then apply finish as desired.

2) With the clock mounted on the wall, wind the clock fully by pulling down on the rewind cord with your left hand while simultaneously raising the weight with your right hand.

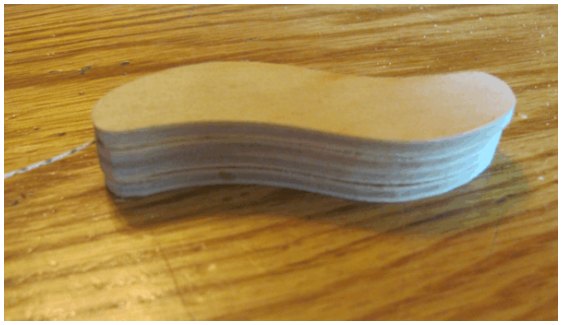
3) Verify that the winding cord passes over the left side of the winding guide spool.

4) If necessary, cut off the winding cord so it hangs just to the floor.

5) Tie a large knot near the end of the winding cord. Insert the cord into the slot on the winding pull middle piece (#14), with the knot located in the hole in the center piece. Make sure the knot cannot pull through the slot.



5) Glue the two winding pull sides (#53) to either side of the center piece (#14).



Adjusting and Regulating

1) Setting the time

The hour and minute hands need to be set independently. Both hands should be friction fit on their shafts so that they can be rotated. If the hands fit tightly, it may be necessary to grasp the great wheel when setting the hands to prevent the entire motion train from moving. After positioning the hands, verify that neither hand was inadvertently angled inward or outward so that it rubs on or interferes with the other hand or with the gear on the front of the clock.

2) Regulating the clock

The pendulum keeps the clock running at a constant pace. The position of the bob on the shaft determines how fast the clock runs. If the clock runs slow, move the pendulum bob higher on the shaft. If the clock runs fast, move the pendulum bob lower on the shaft. Patiently adjusting the bob over the course of several days should result in the clock keeping reasonably accurate time. Expect your clock to gain and lose time with changes in temperature and humidity. Also, expect your clock to require a “break-in” period of a week or so during which it may not be as consistent as it will in the future.

TIP: use a stopwatch to time a series of 60 tick-tocks and see how close to one minute it is. Make adjustments to the bob until it is close to one minute. Now, set the time and let the clock run for a day to make finer adjustments to the bob.

3) Winding the clock

Wind the clock by pulling downward on the rewind pull or rewind cord with your left hand while simultaneously lifting the weight with your right hand. It takes a little practice to lift enough on the weight shell so that some tension is removed from the cord, yet not so much tension is removed that the cord jumps off of the pulley or weight spool. It may be necessary to restart the pendulum after winding. Also it might be necessary to lift the pulley wheel back onto the weight cord if it jumped off during winding. The clock should run for about 25 hours on one winding.

Your clock will wind easier after it has been wound a few times. If you find it very difficult to wind, you can carefully flex the pawls out away from the spool so that they are not grabbing the ratchet so forcefully.

4) Lower support bracket

Once the clock is position on the wall is established, you can secure the lower support bracket to the wall by doing the following: mark the location of the slot in the lower bracket on the wall. Rotate the bottom of the clock to the right so that you are able to drive the 2" screw into the wall, leaving about 3/8" protruding from the wall. Rotate the clock back into position, allowing the slot in the lower support bracket to slip behind the screw. Tighten the lower support bracket to the wall with a right angle screw driver (or a driver bit/wrench combination).

5) Final gluing

The friction fit of the crutch and set washers is purposely looser than the gears to permit easy adjustment. Once the proper position of the escape lever and crutch have been determined, the crutch should be glued onto its arbor. Remove the crutch, apply a small amount of wood glue to the arbor, and reattach the crutch. Then, before the glue sets, start the clock in motion and finalize the position of the crutch in relation to the escape lever. Once the correct position is established, stop the clock and allow the glue to dry. The set washers may also be glued in place once their positions have been finalized. Note: do not glue the following pieces: second hand, hour hand, minute hand, 8-tooth gear on the short arbor at the bottom of the frame, and the set washers on either side of the 32-tooth hour gear.

Troubleshooting

If the clock fails to operate properly, refer to the suggestions below.

Gear Train Will Not Advance

If the gear train will not advance when weight is applied to the weight cord, check the following possible problem sources. If you are having difficulty with the gear train, it might be easier to troubleshoot if the escape lever is moved out of the way to allow free movement of the gears.

Friction between arbors and bearings

The arbors must spin freely in the nylon bearings. Check to see that the arbors have been sanded smooth where they contact the bearings. Additional sanding may be necessary if the arbors are too tight in the bearings.

Play in gear arbors

There must be a small amount of play in each of the arbors. There should be about 1/16" of free play so that the arbor can be jiggled back and forth between the frame pieces. If the spacers are pushed too tightly against the nylon bearings so that no back and forth movement is allowed, move one of the gears inward on the arbor to allow a small space between the spacers and the nylon bearings.

Gear alignment

Check to see that each gear is aligned with its mating gear. Reposition gears on the shaft as necessary so that mating gears fall in line with each other.

Hands rubbing

Check that neither the hour nor minute hand is toed inward or outward, causing them to rub on each other or on the gears on the front of the clock. Adjust hand positions as necessary so that hands are able to rotate completely without interference.

Pendulum pivot seating

Check to make sure that both of the pendulum pivot screws are resting in the holes in the pendulum support plate.

Gear tooth obstruction

Inspect the gear teeth to be sure that each tooth is clean and free of burrs, shards, or stain/varnish build up.

Clock Runs For A While Before Stopping

If the clock runs for awhile but then stops, there are a number of factors that could be involved. Check each of the following:

Gear train

The problem may be with the gear train itself. Slide the escape lever out of the way of the escape wheel and troubleshoot the gear train (see above section for possible causes of gear train problems).

Escapement out of beat

If the escape lever has stopped the clock by not releasing a tooth of the escape wheel, try to restart the clock by restarting the pendulum in motion. If it continues to run for a while and eventually stops on the same side of the escape lever as before, then the clock is likely out of beat. The clock is brought in beat as described in the step #10 of the Mounting Instructions section of these instructions.

Weight

As the escape lever releases a tooth of the escape wheel, the escape wheel should advance immediately and freely until its motion is stopped by the escape lever. If the wheel seems to lag, follow the suggestions in the above section on troubleshooting the gear train to minimize sources of friction. If this does not help, it might be necessary to add more weight to overcome the friction that is present. Try increasing the weight to see if this solves the problem. (You should not use more weight than is necessary to drive the clock, as this will place undo strain on the parts and may increase wear and tear on the components.) You might find that more weight is required during the "break-in" period, so that the amount of weight can be reduced after the clock runs for a week or two.

Escape lever, crutch, or gear slippage

Make sure that none of the motion train components slip on their arbors. In particular, check that the escape lever and crutch are not loose enough to slip. Glue any components as necessary.

Crutch fork clearance

It is important to have the proper fit between the pendulum shaft and the crutch forks. Friction between the crutch forks and the pendulum shaft can rob energy from the clock and return the pendulum to a stop. If it is too tight, sand the section of the pendulum shaft that passes between the forks. This section of the pendulum must be smooth, as must the interior portions of the crutch forks. On the other hand, the gap between the shaft and the forks should not be larger than 1/16". If the gap is too large, add a piece of tape to the shaft to build up its thickness.

Lower support tightness

If the lower support bracket screw is not tight enough, the clock's vertical orientation can change. This is especially likely to happen when winding the clock. Make sure that the screw is tight enough to prevent the bottom of the clock from moving left or right without a deliberate effort to do so.

Pendulum plumb

The pendulum bob must not rub against the wall or on the weight casing. If the pendulum shaft does not hang straight down, adjust the pendulum support bracket screws in or out to alter the alignment of the pendulum shaft.

Gear tooth obstruction

Inspect the gear teeth to be sure that each tooth is clean and free of burrs, shards, or stain/varnish build up.

Miscellaneous

Variations in humidity and temperature can affect the accuracy of your clock.

Technical Support

If you have any problems with this clock, please contact Jeff Schierenbeck for assistance:

E-mail: jeff@wooden-gear-clocks.com
Telephone: 715-955-4104

Comments?

We'd love to hear from you about your experience with the Serpentine clock. Please drop us a note if you want to share any thoughts about the Serpentine clock or if you have any suggestions for improvements that can be made!