Description of Motorized Open Segment Jig

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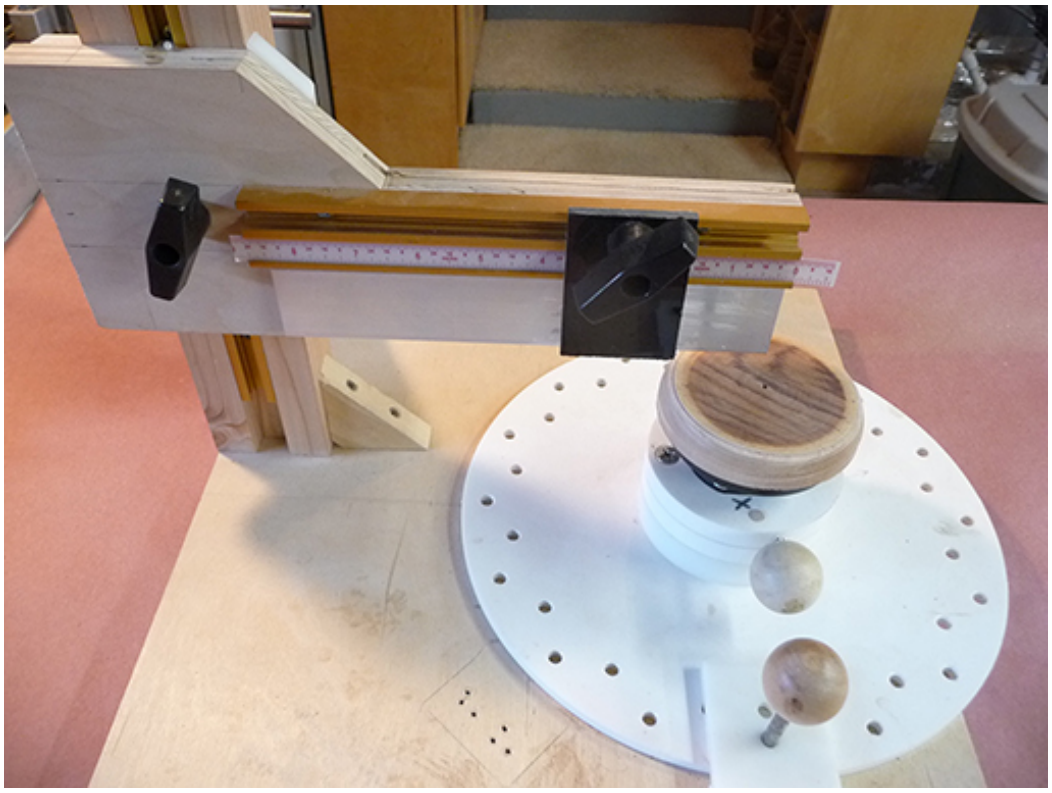
There are numerous jigs in the community to support assembly of open segment vessels off the lathe. My original jig, Figure 1, is patterned after Tom Lohman's jig and others. Segment angular placement is controlled by lower plate locating holes that correspond to the number of segments per layer. The arm and the stop guide radial segment placement. Multiple sets of holes can be drilled to support differing number of segments.

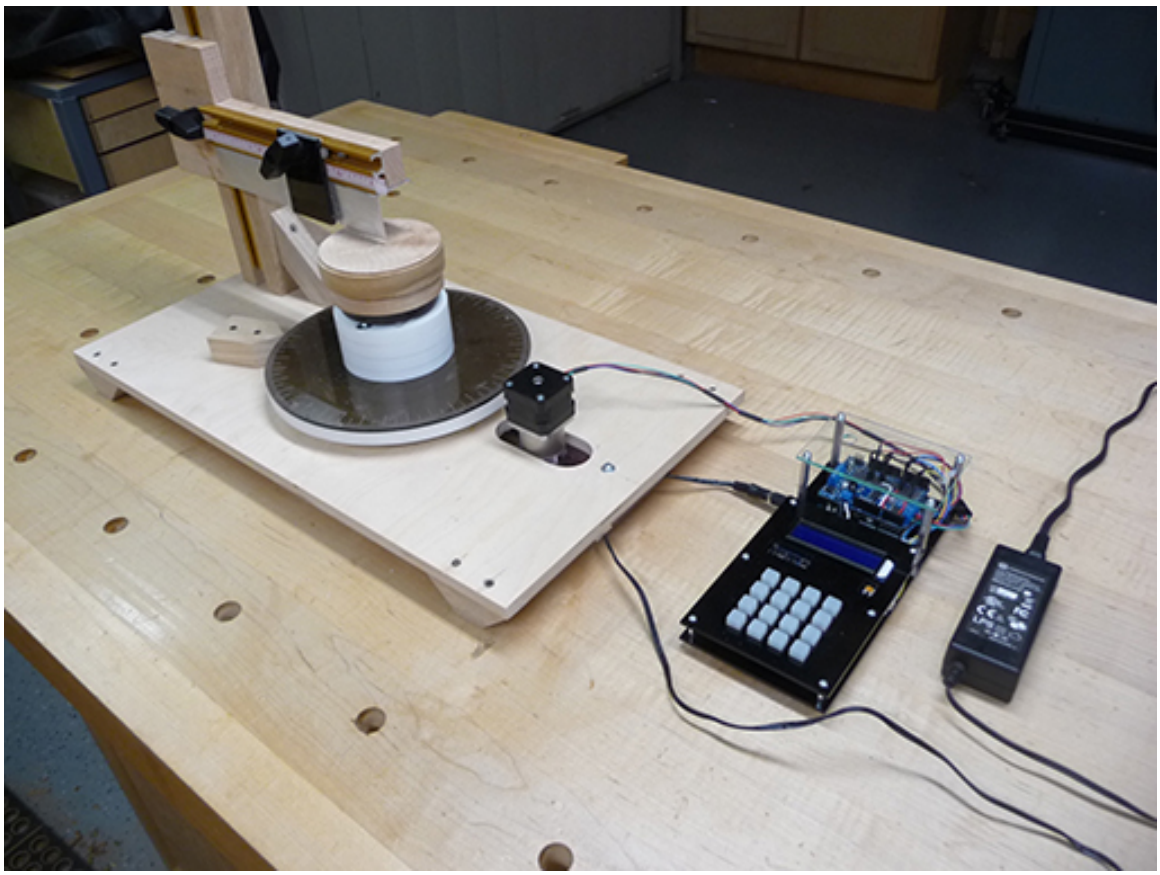


Original Open Segment Jig
Figure 1

Because of the small base plate size, 9", there are a limited number of hole sets that can be drilled. Eventually, a new base plate would be required. If the lower plate could be made universal, independent of the number of segments, a new base plate would never be required, thus the project was born.

There have been two versions of the jig. The first, entered into the Spring/Summer Challenge of 2016, used a patch board for board interconnection. The second version, Figure 2, has improved capabilities and is packaged differently. This second version is described in this article.

I'm a mechanical engineer by education and worked as a system engineer on large government systems, so I had no experience in DIY electronics and very little experience programming. So this was a real challenge in all aspects.



Revision 2 of the Motorized Open Segment Jig
Figure 2

Motorized Open Segment Jig provides;

- Manual positioning of zero point. The pointer and the degree wheel are not really required, but I found them useful during development. Zero point can be repositioned initially and/or between layers.
- Number of Segments can be specified. Maximum number of segments is 150. The jig will calculate the appropriate motor commands for each step. Steps are manually initiated.
- Nominally the between layer reposition is one half of the segment degrees. This can be adjusted thru use of the manual repositioning function.

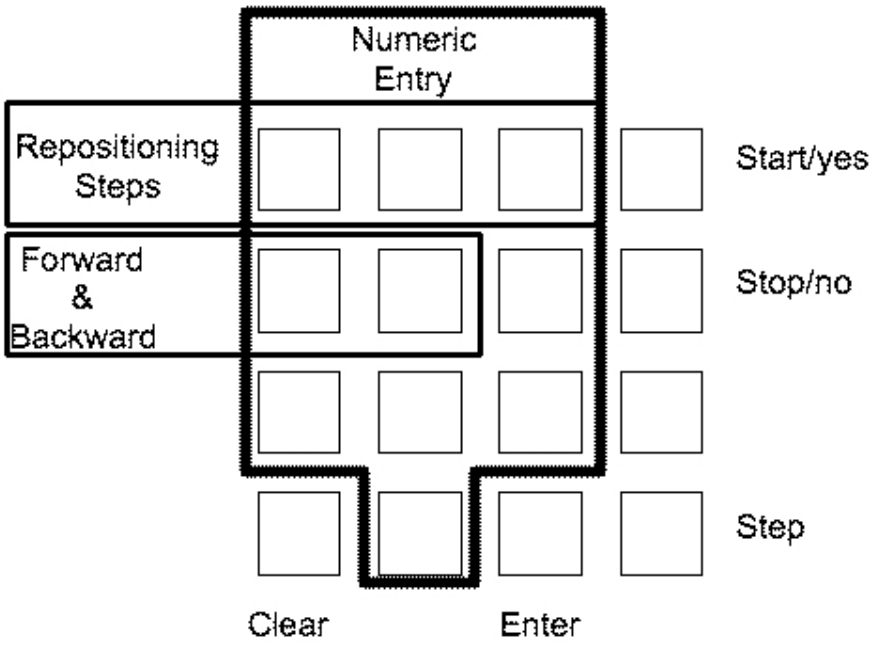
Jig consists of;

- The base plate/degree wheel/hub are locked together and rotated by the stepper motor. A Lazy Susan is under the plate and a nylon bushing is in the platform. The hub accommodates a Powermatic 3520 lathe hub. The lathe hub is removable, allowing the segments to be sanded between layers.
- The stepper motor drives the base plate through a toothed timing belt at 1:1 ratio. The stepper motor has 200 steps per revolution and drives

through a reduction gearbox with a gear ratio of 26 103/121:1 (nice round number to deal with). Thus, there are 5370 steps per revolution for a positioning accuracy of .067 deg.

- Micro processor/display/keypad are mounted on a common base plate.
  - Microprocessor - Arduino UNO microprocessor is the heart of the jig. Arduino is very popular in DIY electronics. Two auxiliary boards, called shields, are used.
    - Stepper Motor Driver shield providing the stepper motor interface and a small prototyping area used for connecting the boards together.
    - LCD display and buttons providing a sixteen-character row by two row high LCD display and six buttons, that are not used.
    - Sixteen back lit keypad
- 12v AC/DC power supply.

Operation is controlled via the LCD display and backlit keypad. Typically a message is displayed on the LCD and the permissible keys are backlit. Keypad layout showing the key functionality is shown in Figure 3.



Keypad Functionality
Figure 3

A typical display/keypad combination is shown in Figure 4.

Typical Display & LED Lighting
Figure 4

Assuming the vessel's base has been glued to the lathe hub and flattened, jig operation is started by powering the jig. Zero can be repositioned, for example to have a major degree wheel division line up with the pointer. To reposition zero, a direction is selected and one of three movement values, .5, 5, and 30 degrees is selected.

Number of segments is entered and the jig calculates numbers of steps for each segment. In most cases, the number of segments will not divide evenly into 5370 – there will be a remainder, I call this residual. Residual has to be accommodated; otherwise the segments will drift out of alignment over layers. How this is dealt with is discussed in later paragraph. Segment related information is then displayed:

- Number of segments
- Number of steps per segment
- Residual
- Number of residual insertions

After the first segment is placed, the step key is pushed and the vessel is moved to the next position. This continues until the last segment is placed. When the vessel is ready for the next layer, the start key is pushed and the vessel is moved to the position for the first segment of the new layer. The default value for this move is one-half of the segment degree. Again, the zero position can be adjusted if necessary.

This process is repeated till the vessel is complete.

As noted above, almost always when the number of segments is divided into the number of steps per revolution (5370), there is a remainder or residual.
Arbitrarily, I established a minimum number of residual adjustments to three and the maximum eight. The first attempt at residual distribution determines if the residual can be evenly divided into any number between three and eight. If so, then the larger number is used as the number of insertions and smaller number used as the number of steps inserted. If this doesn't work, the residual is divided by eight and the balance inserted at the last segment position.

I used the Spring/Summer challenge deadline as a target to get the first bowl done using the jig. I made with a few hours to spare. I had valuable help from a good friend on the art of soldering. Lots of up and downs, but retrospect it was a fun challenge to do and I learned a lot.