Centerless Turning Applied To Building A Kaleidoscope

featuring Jim Duxbury

Our demonstrator for the May meeting was Jim Duxbury of Graham, North Carolina. He was accompanied by his wife who assisted him in his presentation. Both were delightful people and provided a very enjoyable learning experience for the audience.

Although Jim's primary turning interest now is the design and construction of heirloom quality kaleidoscopes, he turns many other objects of exceptional beauty which he exhibited at the meeting including inlaid pens, hats, bird houses, toys and even a one-of-a kind pair of jockey shorts. He has published articles in several woodworking magazines. He is also a prolific inventor and has patented several respirators especially well adapted to woodturning and woodworking environments.

Initially Jim briefly reviewed the history of kaleidoscopes. They were invented by a Scotchman, Sir David Brewster, in 1816 while experimenting with prisms and other optical tools. Because mirrors were not available at this time, the first kaleidoscopes used polished silver plates to reflect light and create the multiple geometric images seen through the eyepiece. Today, first surface mirrors are used in to provide the reflections. These mirrors have the silvering on the front surface of the glass and not the back which is the most common form of mirror construction.

According to Jim, the design and assembly process which he has developed for kaleidoscopes represents the best approach available today. For those interested, he makes available plans for four different types of kaleidoscopes through his website at www.resp-o-rator.com/ec/scopes.htm . The type of kaleidoscope he demonstrated building in his presentation was a basic, hand-held model with three reflecting mirrors set to form an equilateral triangular cylinder. For this model the source of light is the ambient external light and not internally mounted small electric lights. The typical length of the kaleidoscopes he builds is approximately 10 inches and about 2.75 inches in diameter.

The construction process he followed consisted of six basic steps. These were: (1) building the central cylinder, (2) constructing the eyepiece end, (3) making the rotating barrel end to contain the object box, (4) assembling the object box, (5) cutting and assembling the triangular mirror cylinder, and (6) assembling the finished kaleidoscope. In his presentation Jim did not illustrate or undertake to complete the entire procedure for each of these construction steps but instead focused on the essential techniques required. This summary of his demonstration will do the same. He also provided many useful turning tips involving jigs and tools which are applicable to a variety of different woodturning

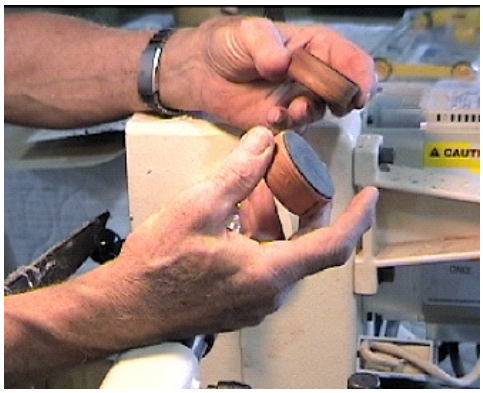
applications.

To build the central cylinder, he glues three staves of 3/4 inch wood together that have been tapered at 30 degrees on each edge. These staves can be of different wood species or laminated to obtain colorful patterns in the final rounded cylinder. He uses radiator clamps to compress the glued staves together while drying. The width of the staves is carefully chosen so the resulting internal equilateral triangular opening will precisely accommodate the triangular reflecting mirrors. To turn this rough cylinder to round, Jim introduced the concept of "centerless" turning. This technique consists of turning conical jam chucks that can be tightened into the interior triangular opening of the central cylinder between the lathe spindles. These chucks can also be used to hold any other glued up form for turning where the central hollow is symmetric. Very interestingly, after he had rough turned the central cylinder to round, he used a belt sander to smooth it.

The eyepiece can be turned from a glued up form also using the centerless turning technique. This object is turned as a disc with a diameter slightly larger than the central cylinder and width of about 1 inch. It is hollowed on one side to fit snugly over a tenon that has been turned on the central cylinder. This hollow is deepened in the center to accommodate a glass or Plexiglas lens that will serve as a protective barrier to users of the kaleidoscope should the mirrors break. Before gluing the lens in place, a 5/8 inch viewing hole is drilled through the eyepiece disc. Jim uses two part epoxy to glue the lens in place. This completed eyepiece assembly is then glued the central cylinder which can be mounted on the lathe using the conical jam chucks to complete any turning necessary.

The rotating barrel end is perhaps the most difficult component of the kaleidoscope to turn. Jim constructs these as glued up forms to match the woods used in the central barrel. After turning this piece round, he turns a tenon on one end for mounting into a chuck on the head end of the lathe. He also typically embellishes this piece by burning several lines on the outer surface at this time. The piece is first hollowed to fit loosely over the tenon which has been turned on the receiving end of the central cylinder opposite from the eyepiece. A groove is then cut into the hollowed interior end of the rotating barrel at precisely the height of the receiving tenon. This groove is to accommodate three small metal washers that are screwed into the tenon end at 120 degree separation. When in place, these washers will secure the barrel to the central cylinder and permit it to

turn freely. However, before this is done, the barrel is reversed on the chuck and hollowed to accept the object box.



Jim builds his object boxes from appropriate diameter PVC couplers. He mounts the coupler in the chuck, squares the end with a small skew chisel, and then cuts a groove on the interior surface sufficiently deep to accept a glass or Plexiglas lens. He then parts off a portion of the coupler that will form the body of the object box, mounts this piece and turns a corresponding groove on the opposite end. Next he drills a small hole on one side of object box cylinder that is counter sunk.

The Plexiglas lenses can be easily turned to the correct diameter by securing them between two cylindrical wooden jam chucks faced on the holding side with inner tube rubber. Jim uses sanded or prismed Plexiglas for the outer lens of the object box to make it opaque. When the lenses have been turned, he glues one in place on the PVC cylinder using epoxy, adds the objects to be used such as beads, buttons or shells, and then glues the other lens in place. As the final step in assembling the object box, he uses a syringe to add glycerin oil to the cavity through the hole which had been drilled in the side earlier. A small bubble of air is left in the cavity to accommodate expansion of the oil with temperature changes.

He cuts the first surface mirror glass using a jig which allows him hold the glass sheet securely and to precisely cut 1.5 inch strips. He strongly recommends using a high quality diamond wheel glass cutter for this purpose. He indicated that both the first surface mirror glass and quality cutters can be obtained from craft supply outlets that specialize in stained glass products. He stressed that you score the glass only once when cutting to avoid damaging the diamond wheel of the cutter. He uses as a cutting surface a hard Masonite board. Once scored it is imperative that pressure be applied uniformly along the edge of the glass to be broken.

To assemble the triangular reflecting cylinder, he first places the mirror strips on a flat surface about 1/16 apart and tapes them together using masking tape. He then rolls them together to form an equilateral cylinder and tests if it fits in the cavity of the kaleidoscope. If it does, the protective film is removed from the mirrored surfaces and the assembly firmly bound together using duct tape. He is very careful not to introduce any fingerprints at this stage on the mirror surfaces. He uses a small amount of silicone cement to secure the mirror cylinder in the kaleidoscope body.

The final assembly step involves securing the rotating barrel end to the central cylinder using retaining washers and screws into the tenon end, inserting the object box and turning a wooden retaining ring to hold this in place.

By Walter McRae