Building a Ropewalk

by Phil Krol

Many model builders who have reached the rigging stage on their models wish they had better cordage. Most have heard that a contraption called a ropewalk makes model rope, but have no idea where to begin. Let me assure you from my own experience that if you can build a ship model to the rigging stage, you can build a ropewalk. The obvious advantage of using one is that you can lay up (twist) high quality rope in all the necessary diameters to fully rig the model. While some ropewalks are very com-plex and require advanced machining skills, my approach keeps it as simple as possible without sacrificing functional-ity. A ropewalk consists of three components:

1) The whorls (gears) that twist the individual strands.
2) The topper, a cone-shaped bobbin with three grooves, that holds the strands.
3) A spinning looper that keeps up with the twist as the rope is formed.

As the strands twist, torsion builds up until they want to knot or break. The three strands come together at the narrow end of the topper and with the aid of the looper begin to spin in the opposite direction to relieve this stress and form the rope. During the rope making process, the topper moves toward the whorls as if it were motorized.

Traditional rope is made in three different styles.

1) Hawser laid has three strands with a right-hand twist.
2) Cable laid has three lengths of hawser laid (nine strands) with a left-hand twist. This is sometimes referred to as two stage rope as you first make hawser laid and use that as feed stock for cable laid. These large ropes are used for anchor cable, lower stays, and sometimes the shrouds.
3) Shroud laid has four strands with a right-hand twist around a center core called a goke. Laying up this type requires a fourth whorl. In my opinion, it's difficult to see the difference between shroud and hawser laid rope, and the fourth strand with a goke adds complexity making the rope making process more difficult. It simply isn't worth the effort.

THE COMPONENTS

The whorls are nothing more than a set of four gears that simultaneously twist the strands. The center or drive gear turns three gears spaced equidistantly around it. Their size and pitch aren't important, since the gear train is built around the gears you find. I found 15/8" diameter nylon gears with a bronze bushing in a surplus store.

I laid out the gears on a rectangle of 3/8" tempered Masonite® 5" x 6½" and drilled four holes to press fit bronze bushings with ¼" inside diameter. The gears were pinned to ¼" brass shafts that slid into the bushings and were held in place by collars locked with setscrews. These are available in the parts bins of most hardware stores. The center drive gear shaft extends 2" beyond the collar so it can be connected to a motor. See Figure 1.

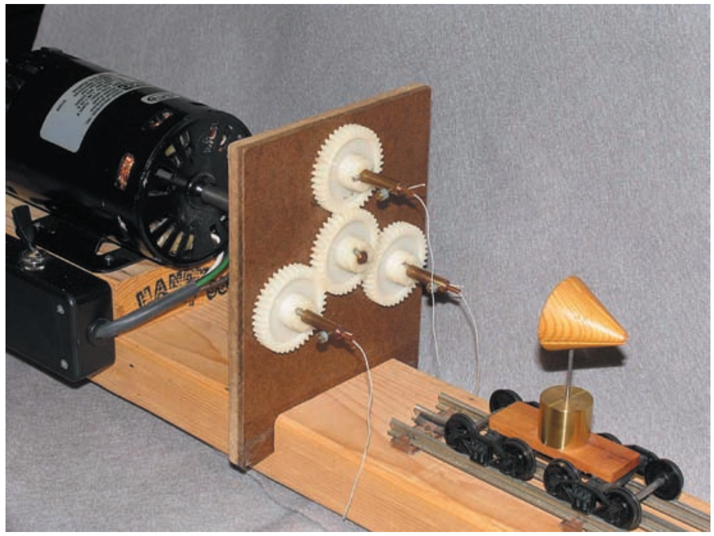

Figure 1

To attach and hold the strands to the whorls, I first counter bored the shafts on the three twist gears to take a 1/16" copper tube ¾" in length. Next, I drilled and tapped 3 holes for a 2-56 thumbscrew to hold the tubes in the shaft holes.   See Figure 2.

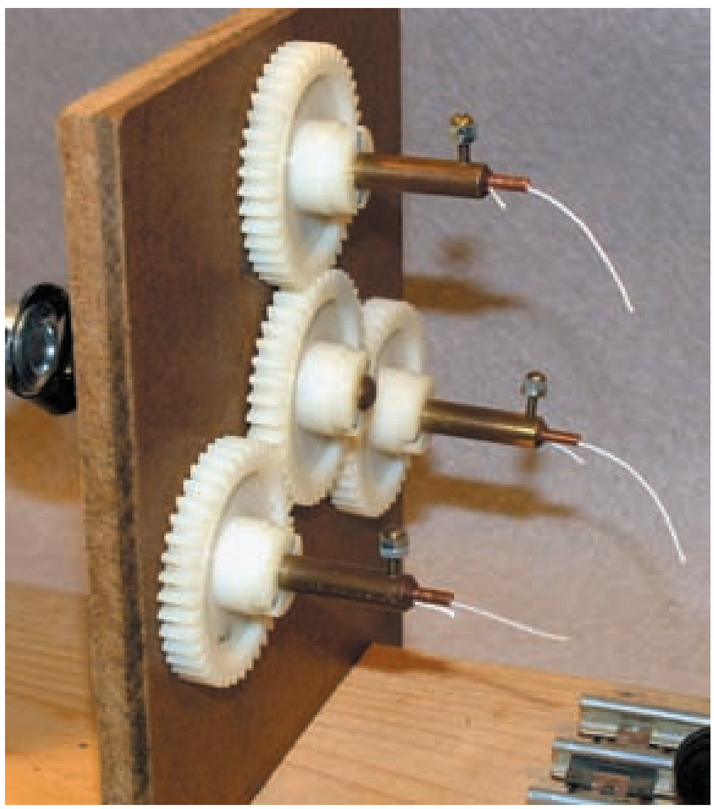

Figure 2

The topper is a cone-shaped piece of wood 1½" long by 1¼" in diameter with three grooves to hold the strands spaced equidistant from each other. The point is hollowed out a little to allow space for the rope to form. These dimensions are not critical and variants of this shape will perform equally well. The topper is mounted on a rod which is inserted into a ¾" x ¾" piece of brass rod to give the assembly some heft. This was mounted on a 7/8" x 2 ¾" x 1/8" wood platform which was mounted on a pair of O-gauge railroad trucks to make a facsimile of a flatcar with a topper as its cargo. See Figure 3.

Figure 3

The flatcar topper assembly travels on O-gauge track which is mounted on a 2" x 4". Mine is 10' long and half-lapped at a track joint so it can be taken apart to facilitate storage. The 10' length produces finished rope about 7' long. However, you can make the bed longer or shorter, as you wish. See Figure 4.

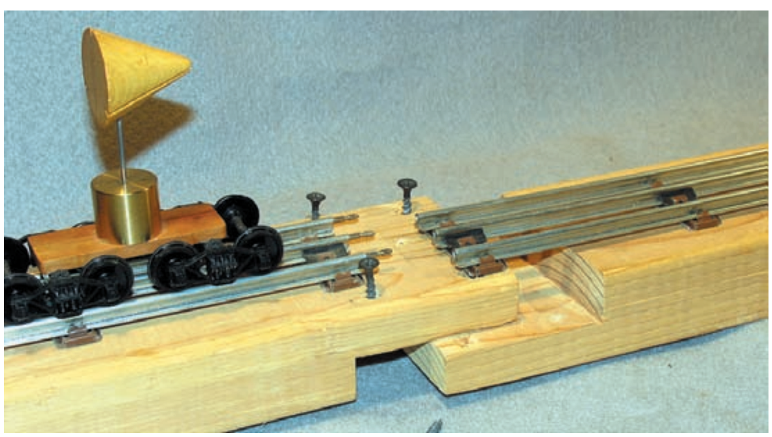

Figure 4

The looper is the spinning device the three strands are attached to facing the narrow end of the topper. Some advocate the use of a reversible motor to assist this process. However, I prefer using a quality ball-bearing fishing swivel for the looper. This is a simple yet effective approach. As rope begins to form at the tip of the topper, the looper starts spinning and the topper starts moving on the track towards the whorls. You just stand there and watch it work with little to no help from you. See Figure 5.

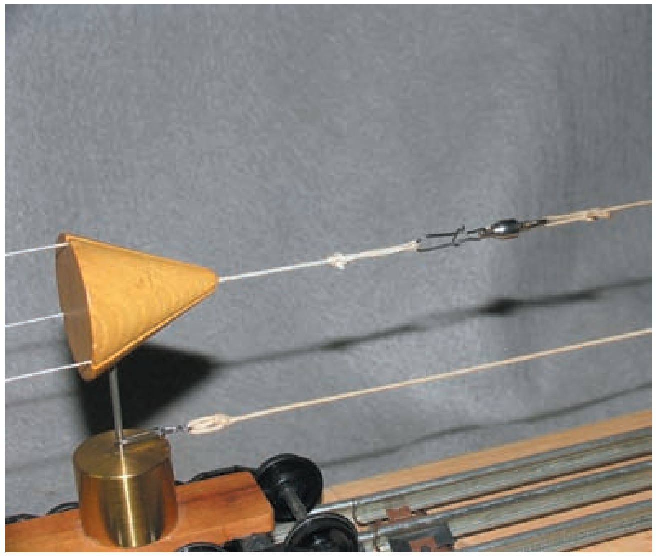

Figure 5

A variable counter weight should be used to tension the strands and the forming rope. The weight is attached to a cord on the end of the swivel and extends over the end of the bed to the floor. A pulley or sheave or even a smooth groove on the end for the cord to ride in is helpful. The amount of weight varies from ¼ oz. for small rope to 1½ oz. for heavier rope. As the rope forms, the strands get shorter, pulling the weight off the floor to about one-third the length of the bed. A counter-weight, attached to the flatcar to create some resistance to its travel, is also needed. This varies from nothing, for very small rope, to about ½ oz. for heavier rope. Since this weight travels the entire length of the bed, a gaff was installed to compensate for the shorter distance to the floor. This works by placing the cord in a sheave at the base of the gaff, running it over a sheave at the extended end of the gaff and down to the floor. The flatcar travels along the bed pulling the weight. When it reaches the top of the gaff, stop the motor, transfer the weight cord from the tip to the base of the gaff and then restart the motor. See Figure 6.

Figure 6

The gear train is mounted on the track bed in a dado cut for a press fit at the head of the track. The motor is mounted on an extension of the track bed past the gear train and connected to the drive gear shaft with a universal joint. See Figure 7.

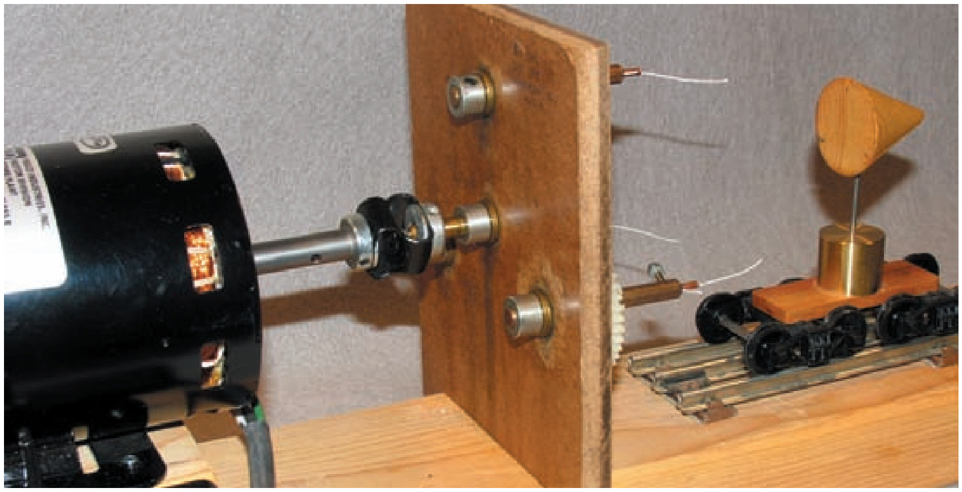

Figure 7

THE MOTOR

My initial drive motor was a 3/8" reversible drill mounted to the track bed with a couple of wedges and a web clamp. A functional universal joint was made with a piece of ¼" inside diameter heavy plastic tubing. One end was secured to the drive gear shaft with a small hose clamp. A dowel was inserted in the other end for the drill chuck to grasp. This functioned quite well for years and finally failed in the middle of a ropewalk demonstration at a club meeting. In the process of repairing this failure, I found a motor that could be wired with a reverse switch and installed a universal joint. A rheostat to control motor speed is recommended. For heavy rope the whorls should spin at a slow speed and for finer rope a much faster speed is needed

GENERAL OPERATION

Strands of feed stock material cut to the length of the track bed are attached to the whorls. To "load" the ropewalk, insert a strand in the end of the copper tube, slip it into the shaft hole and tighten the thumbscrew on each of the three shafts. These are carried to the end of the track bed and each strand is pulled tight to create equal tension on all three strands. They are then tied into a knot. Equal tension on the strands is important so good quality rope will start forming with no waste. Unequal tension will cause defective rope to form for several inches or until the tension is automatically equalized. This is now attached to the looper (fishing swivel) and the counter weight placed on the floor. If too much counter weight is used, the twisting can cause knotting or doubling up. The motor is reversed to untwist, saving the setup. Practice and experimentation with motor speeds and counter weights will quickly enhance operator skills allowing the production of high quality model rope.

FEED STOCK MATERIALS

Virtually any thread can be twisted into rope; however, some are more suitable than others. The thread should be smooth and free of fuzz. Linen, cotton, polyester, silk and fly-tying threads all make nice rope. Once you become addicted to rope making, you look at thread wherever you may see it for the potential it may have on your ropewalk. You never know what the outcome will be until you try it. There are many thread shops catering to bobbin lace makers that can be found on the Internet. These shops carry a variety of threads in a full range of sizes. DMC® and Anchor® are two brands of Egyptian cotton tatting threads that are made in a range of 10 sizes starting with number 10 through 100, which is the thinnest. Three strands of 100 will lay up into rope measuring .020" in diameter which is 1" rope in 1:48 scale. Threads are sized by number and number of plies. A thread sized 80/2 has two plies and an 80/3 will have 3 plies and be a little heavier. However, there is no standard in the industry so threads with the same number can vary by manufacturer.

Figure 8 shows coils of finished rope in various diameters. The second coil from left in the top row is cable laid, and stained. It was twisted in two stages. The smallest coil measures .010". Two balls of DMC® thread in size 10 and 100 are shown. The other two are 80/2 and 100/3 threads. The coils at bottom right are futtock shrouds with seized hooks in thimbles, stained with Jacobean MinWax®.

Figure 8

HARDENING
When the rope is finished twisting, hardening is a process that sets the lay and removes any stresses remaining in the twist. This can be accomplished by giving additional twists at the looper end and then stretching the whole length. You will find the swivel will spin some more. When this is repeated and all the spin is exhausted, the rope is hardened and will not unravel when removed from the setup.

CONCLUSION
Twisting your own rope is a gratifying experience and allows you to produce whatever diameter is called for in the rigging tables. Most rigging books have reference tables listing the block and rope size for virtually every line on a ship by tonnage and/or rating. Rope circumference is almost always used and must be converted to diameter for our purposes. The easiest way to measure your rope is to take a dowel and mark it with a ruler to show ¼ inch and ½ inch. Wind your finished rope within these marks and count the turns, thus ½" divided by 26 turns = .019". This method is actually more accurate than using a micrometer as there is no compression of the fibers between the anvils. It is good practice to measure everything you produce and document the thread and counter weights used to produce it. When you need more of that particular size, you can produce it without experimenting. Incrementing the number of strands using the same size thread will expand your possibilities. You can go to six, nine and twelve or more strands to vary the size. Once you gain some experience, you will be able to determine just about what it will take to produce a given size rope minimizing the number of runs to achieve your objective.

Finally, coloring your rope can be done with various dyes or stain. I use Minwax® stain. Jacobean is good for standing rigging as it resembles Stockholm tar. Fruitwood, by itself or mixed with a little colonial maple, is good for running rigging. I wind a coil around my fingers, grasp with a forceps and dip in the can of stain for a moment. Then blot with a cloth and hang to dry. Treating the rope with beeswax makes it more supple.

I hope you have found this article and accompanying photographs helpful in getting you on your way to making your own cordage. Perhaps you will be motivated to tinker some more and develop a continuous feed mechanism and take up spool so a large quantity can be made on a single run.