

Semaphore Signals Part 1—Construction

by Jim Atkinson

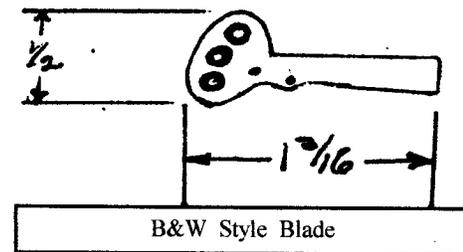
I wanted to add semaphore signals to the branch line on my Baltimore & Western layout. First of all, I researched the subject from my library and found there were many variations of semaphores. Besides upper and lower quadrant, and two and three position, there were numerous blade styles and mast heights as the most prominent varia-



tions. The Railroad Standard Code illustrates a multitude of combinations with multiple blade signals. As a modeler, I was only interested in a simple, single blade, three positions, upper quadrant signal. My first semaphores could only operate as two position units using a standard Tortoise switch machine. For block signals, I used the red and green positions and for turnout signals, I used the green and yellow positions for my signal situations. Its control rod sets the upper and lower travel limits of each signal. If you are up to some electrical work, you can make them operating three position signals.

Rather than purchase a manufactured signal, I preferred to design and build my own. If you've done any scratch building with brass, it isn't difficult to build your own signals, and you can build the style you desire. My eight semaphores cost less than two Tomar units.

First we make the blades. Cut enough 5/8" x 2" blanks from .020" styrene sheet for all the units you need plus several spares. Stack the blanks up and carefully cement only the ends together - NOT the center areas! Lay out the blade design in the middle of the blanks. Using a Dremel tool and files, cut the profile out in the entire stack at one time (making them identical) leaving the ends to hold the stack together. Drill the holes in the entire stack (three 3/32" holes, one .040" hole, one .025" holes). Now cut the ends off and file each of the blade ends to shape. Deburr as necessary. The blades are now complete.

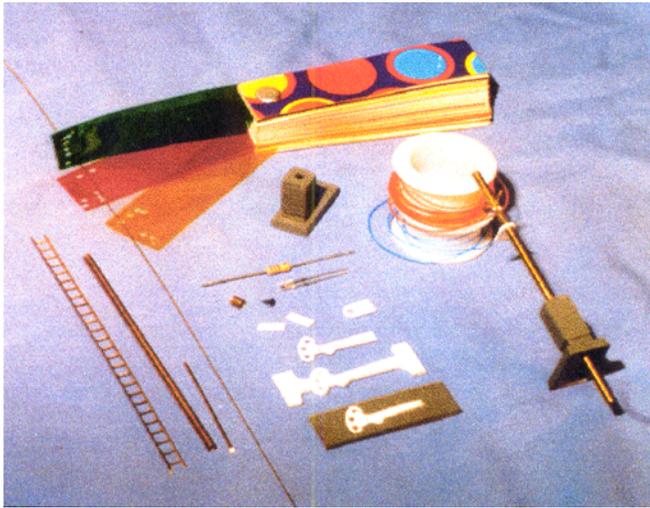


Moving on to the mast, I used 1/8" outside diameter brass tubing. I know it's oversize, but I wanted the strength that smaller tubing lacks and the internal diameter is needed for two light wires and the control rod to pass through. I cut the tube 4 3/8" long yielding a finished signal 28' tall. 5/8" from the top and using a small round file, make a 5/32" diameter cut .030" deep in the mast. Cut a 5/32" long piece of 5/32" outside diameter brass tubing and deburr it. This is the LED "light" casing and it should fit in the groove you filed in the mast. By sliding a longer piece of 1/8" tubing through the light casing it is easy to hold the casing in place on the mast. Line up the front of the casing with the mast and neatly solder the two parts together. With

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a standard cutting tool in your Dremel tool, cut the groove on the 45-degree angle close to the dimensions shown. This is for the blade control rod. Deburr the mast inside and out

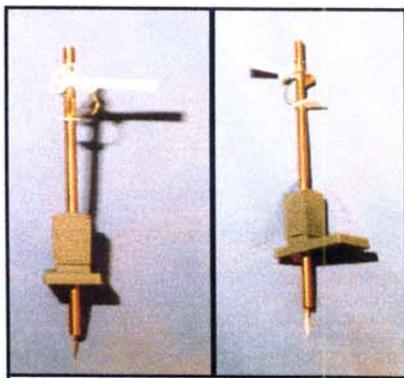


The parts you'll need

and check the slot to make sure the .022 control rod will slide freely in it. Now, solder an .040" brass wire to the mast in line with the top of the light casing as per the drawing for the blade pivot pin. Cut the back off flush and cut the front with about 1/4" overhang. We'll cut the excess later. Now, we need to drill a clearance hole for the wires just below the light casing on the back of the mast. Using a pin vise drill a 1/32" hole first, then enlarge it to about .050" so that two #30 wires will slide through it.

Make the maintenance platform from .040" styrene sheet as per the drawing and slide it on the mast. The base can be made from scratch using a .60" x 3/8" x 7/8" piece of styrene, a 1/4 x 3/8" x 3/8" block of styrene, and a 3/16" outside diameter x 3/8" long piece of styrene tubing.

Another method is to use the base from any commercial dummy mast signal available. I used the bases from Selley dummy semaphore signals (available from English) or AHM signal part. I had to cut the cast mast off and file the top of the base flat. Using a drill press, I

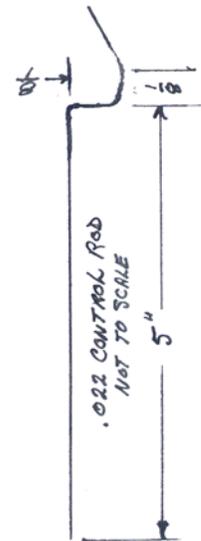


Basic finished mast with working blade

drilled a 1/8" hole through the base. Once you have the base ready, put the mast into the base with 3/4" of the mast protruding below the base. Glue them together, making sure the front of the mast and the front of the base are in line. Locate the maintenance platform and glue it in place on the mast. Now make four small washers from .020" styrene sheet about 1/8" in diameter and .022" holes in three and a .040" hole in one. Glue a .022" hole washer on the back of the blade at the control rod pivot hole to reinforce it. Slip the .040" hole washer on the .040" blade pivot pin on the mast.

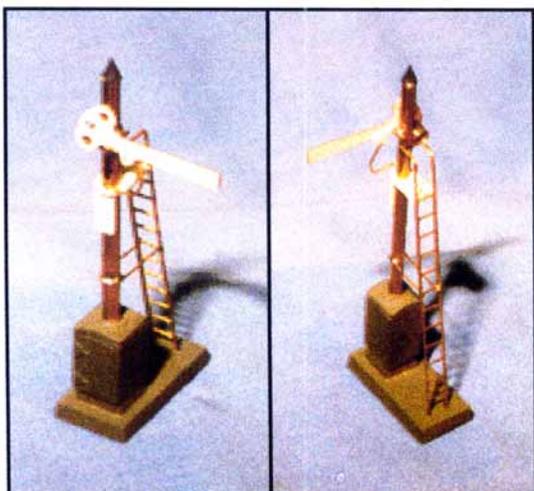
Next, put the blade on the pivot pin and check it for freedom of rotation. Once you are satisfied with the movement and that the lens holes in the blade properly line up with the light casing, force a .022" washer on the pivot pin. Allow for free blade rotation and carefully super glue the washer to the pin. Cut the excess pivot pin length off.

For the control rod, cut about 6" of .022" hard brass wire. Bend it in a flat plane as per the drawing. Slip the rod into its slot and behind the blade. Now position the blade in its lowest desired position and the control rod in its lowest position and note where the rod intersects with the rod pivot hole in the blade. Using needle-nose pliers, bend the control rod forward to 90 degrees at the noted location. Push the rod through the rod pivot hole in the blade. Hand-test the unit to see if the blade moves close to the desired positions at maximum rod travel. It doesn't have to be exact yet, just close. If it's close, put the last .022" washer on the portion of the pivot pin extending through the blade. Allowing for free movement, carefully glue the washer to the control rod. Again check for proper blade movement. If the alignment is slightly off it can be adjusted by carefully bending the control rod behind the blade with pliers. On your first try it may take a second control rod to get it right. So you are satisfied with the blade positions and movement (it must be smooth), the hardest part of the construction is done and you know you are going to like the results. I used brass ladder stock from Walthers for the ladder. Cut it to length, remove the unwanted rungs, bend, and glue it in place on the back of the signal. Make the number plate from .020" styrene sheet and glue it in position on the mast. I had some cone-shaped pinnacles left over from my earlier signal projects (AHM parts) and glued one on top the mast.



Control Rod

Paint your signal as desired. I used grimy black as it helps to hide the oversized mast. After the paint dries, insert a white



Signal mast ready to paint

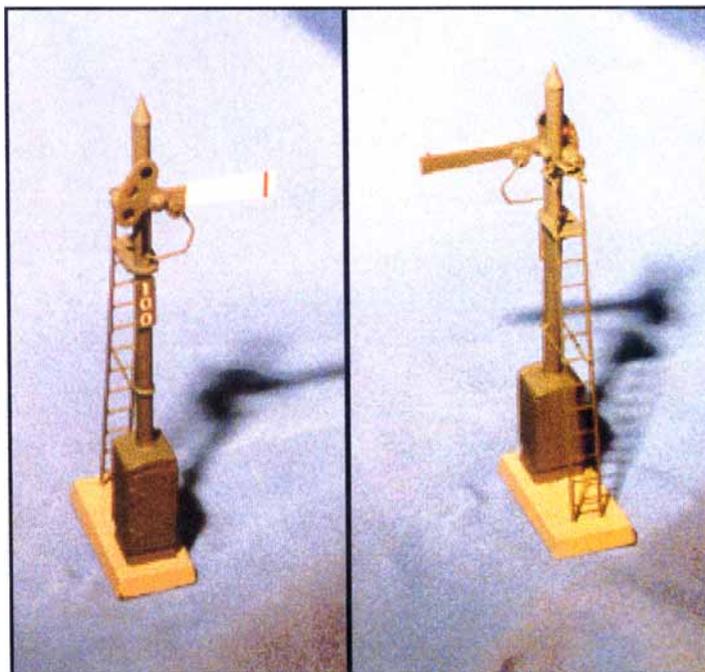
LED in the light casing and anchor it with a touch of super glue. Cut the LED hard leads off to about 1/8" long and bend them toward the mast. Keep space between them. They are an electrical circuit. Remember which lead is positive. Cut two lengths of #30 wire (preferably two different colors to differentiate polarities under the layout) long enough to reach from the signal head to the power source under the bench work. Thread the wires through the .050" hole into the mast and down through the mast. Solder the wires to the LED leads. Pull the wires slack into the mast. Brush paint the wires and back of the LED to match your signal hardware. Paint the front of the blade your desired color (usually white or yellow). I added small red stripes to my blade using decals. Decal the numbers onto the number board as desired. I used the assigned block numbers they work with. For light lenses, Edmond Scientific sells sample photographic color filters (Y40675 \$5.50) that will give you enough material for hundreds of lenses. Cut out small pieces, about 1/8" diameter, of the colors you want. Carefully position each one, one at a time, on the rear of the blade and glue with a small touch of super glue. Check it for proper operation manually. Your signal is now complete.

You could change the design of your signal from mine. Decide the blade style you want, then consider the location of the light casing and pivot pin. Your style might necessitate relocating the control rod on the blade and the slot in the mast. Experiment, it can be done.

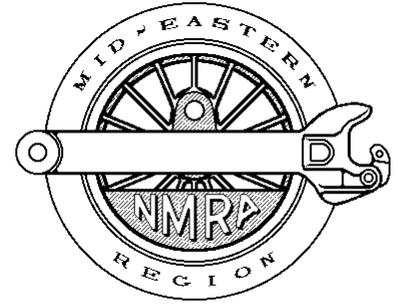
Bill of Materials:

- 4 3/8" long 1/8" OD Brass Tubing
- 5/32" long 5/32" OD Brass Tubing
- 1 White T1 LED
- 8" of .022" Brass Wire
- 1" of .040" Brass Wire
- 1" x 2" piece of .020" Sheet Styrene
- 1" x 1" piece of .040" Sheet Styrene
- 4" of Brass Ladder Stock
- 1 Signal Base (scratch built, Selley, AHM, or ?)
- 1 Pinnacle (AHM or ?)
- 1 680 Ohm Resistor
- 24" #30 electrical wire (2 colors 12" each)

Part 2 will follow with installation of your semaphore signal and how to operate it as a two or three position signal.



Finished Semaphore Signal
Ready for Installation



Semaphore Signals Part 2 TWO-POSITION SIGNAL Installation & Control

by Jim Atkinson

In the last issue of **The Local**, I showed you how to build a three-position, upper quadrant semaphore signal. Now I'll cover the installation of your semaphore and the means of operating it from a track polarity signal system as a two-position unit for blocks or turnouts or the more complicated three-position unit.

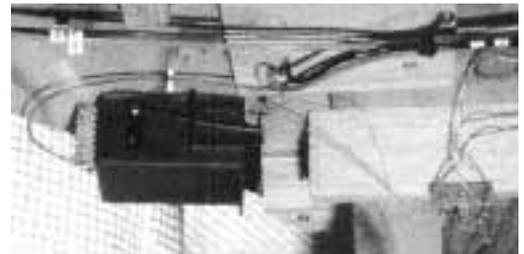
After following Part 1 to build your semaphore signal, it is ready to install on your layout. Choose your semaphore's location, and check under the layout for the necessary clearances for the mast lower extension and the Tortoise machine. Drill a 1/8" hole where you want the signal, and thread the signal's wires and control rod through it. Then push the mast extension into the hole to seat the signal base on the layout surface. If everything looks good, for a two-position signal, it's time to work under the layout.



Three-position block semaphore signal

I removed the mounting lugs from the side of the Tortoise machine so I could flush mount it on its side under the layout. I also replaced the throw wire with .040 brass wire. The heavier wire yields a smoother action. Locate and anchor the machine where you want it. I used super glue, but you may prefer another way of anchoring it such as double sided foam tape. Center the Tortoise machine's travel and center the signal's movement noting where the throw rod meets the signal control rod. Bend a tight 360-degree loop in the control rod at that location and slip it over

Tortoise mounting and wiring for Two-Position Semaphore

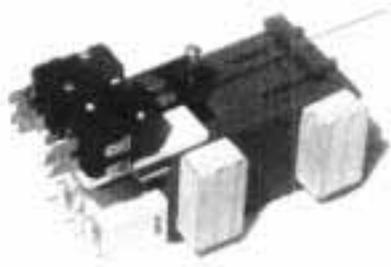


the throw rod. For a block signal (in a block polarity signal system), connect two 26 AWG wires from power connections 1 and 8 on the Tortoise machine to the block rails. For a turnout signal, connect the wires to the same connections on the Tortoise. Check the polarity before soldering the wires to make sure the signal displays green for forward and red for reverse for a block. For a turnout, it should display yellow and green. If the signal indications aren't correct, just reverse the wires. With the semaphore now powered,

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keep in mind that the block signal will only move when the block is powered to the polarity oppo-



Tortoise rigged for Three-position Operation

site from what the signal is already set for. Adjust the Tortoise throw action to get the full desired action at the signal blade. Next connect the LED leads with the required 680 ohm resistor in series on the positive side to your 9 volt DC fixed power supply. The LED's illumination should be steady, regardless of the semaphore's position. The last step is to build up the scenery around the signal base. Your two-position semaphore signal is completed and operational.

THREE-POSITION SIGNAL

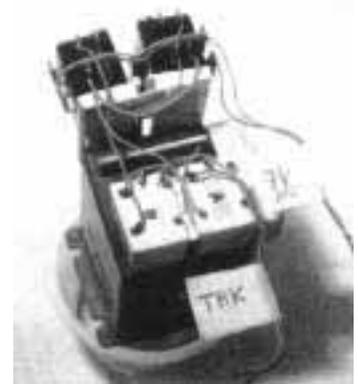
Since building and installing my semaphore signals, I have designed a fairly simple and low cost method to have three-position semaphore operation for blocks in a block polarity signal system. Besides looking more realistic, I can now tell the total block power situation (off, on-forward, or on-reverse) by looking at the signals as I can with my standard three-color light signals. Using four paired limit switches working off the Tortoise machine movement and two relays to reverse power and change the power source to the Tortoise, the three-position system works like this.

When power is on to the block (tracks), the track power closes the relays, and track power goes to the Tortoise machine causing it to go to the proper end of its movement, giving you a red or green signal. When track power is shut off, the relays open for the track power and close for the 9 volt DC fixed power which is supplied to the Tortoise

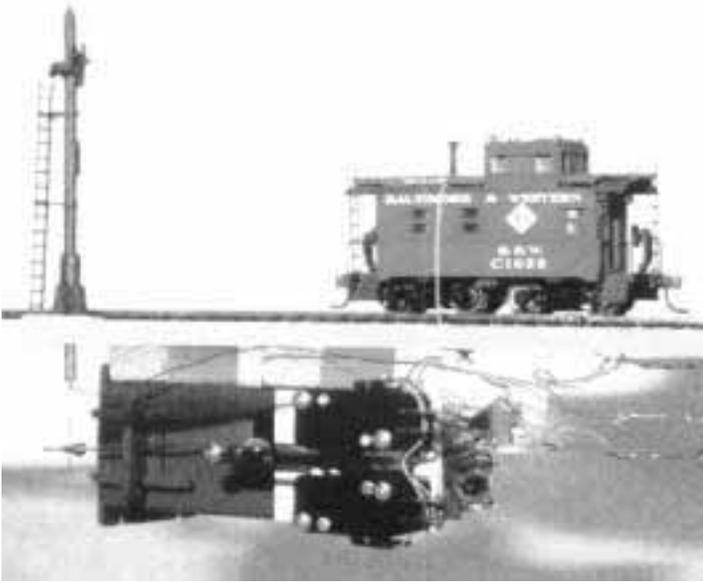
in the proper polarity via the paired limit switches. This causes the Tortoise movement to shift to center where the limit switches open and power to the Tortoise is cut off, leaving the machine dead at center. This yields a yellow signal. Turning track power on again starts the cycle over.

From the photographs, you can see the Tortoise switch machine has the four limit switches and two relays added to it. The three-position operation requires no modifications to the Tortoise itself, but to operate the limit switches, you need to replace the small rod containing screw with a 1" long No. 4 sheet metal screw. Slip a 2" length of 5/32" OD tubing and a No.4 washer on the new screw. The tubing is the wear surface for the limit switches while the washer retains the throw rod. Remember to use .040 brass wire to replace the original throw rod spring wire. Behind the Tortoise movement, glue a block of styrene measuring 3/16" x 1 2" x 1 7/8". This is the mounting pad for the limit switches. I used four, single-throw limit switches

from All Electronics (SMS 166). It is necessary to straighten their actuating arms for this installation with a pair of pliers. Attach the limit switches in pairs on the mounting pad. I screwed the limit switches to the pad to allow for possible adjustment. You can adjust the switches by bending the actuating arms as well. With the Tortoise movement centered, each limit switch should just click to the open position. I choose to mount the two single-pole, double-throw relays on the rear of the Tortoise to keep the mechanism a single unit. On your work bench you can wire the entire unit, leaving the four power leads as long as necessary. At your work bench, test the unit for basic operation.



Three-position Tortoise bench-wired

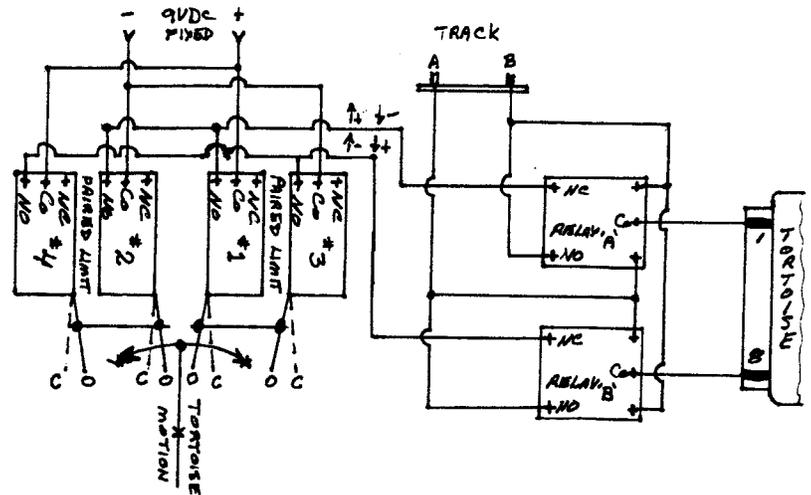


Three-position Semaphore Installation
Complete and Operational

Installation of the Tortoise machine for a three-position signal is the same as for a two-position signal, except you need to space the Tortoise away from the underside of the layout to allow for its added bulk. I used two, 2" thick wood blocks as spacers. When connecting the signal control rod to the Tortoise throw rod, make sure the Tortoise movement is centered and the semaphore is on (or at least close to) the middle (yellow) position. With your control unit mechanically attached to the layout and the semaphore, connect the block (track) power wires from the unit to the track. Make sure the semaphore signal displays red and green indications properly. With that done, connect the power supply wires and check the semaphore for proper operation. When the block power is turned off, the signal should shift to yellow—the center position. If it stays on red or green, either your power supply is off or you need to reverse the polarity by switching the wires. Once the semaphore moves to all three positions correctly, you can adjust the Tortoise throw rod by bending it to get the middle position lined up on the yellow semaphore lens. The normal Tortoise adjustment will yield the proper full travel. Now connect the signal light LED to the power supply, remembering to include the required 680 ohm resistor in series with the LED. Add scenery around the signal base. Your semaphore signal is complete and adds an impressive operating detail to your layout. It counts toward your Electrical AP, too.

BILL OF MATERIALS

- 1 - Tortoise switch machine
- 2 - relays (All Electronics RLY 264)
- 4 - limit switches (All Electronics SMS 166)
- 4" - .040 brass wire
- 5 - No. 4 x 1" sheet metal screws
- 2" - 5/32" OD brass tubing
- 1 - No. 4 washer
- 26 AWG electrical wire (two colors)
- 1 - 9 volt DC fixed power supply



Three-position semaphore control for the
Block Polarity Signal System