Kitbashing Yosemite Valley Railroad Locomotives Nos. 22 and 23 from Spectrum Ma & Pa 4-4-0s

Overview

The following describes changes one can use to make the Bachmann Spectrum "Ma & Pa" 4-4-0s more closely resemble YV 4-4-0s No. 22 and No. 23.

Here is a stock Spectrum #83401 before starting the conversion:

Bachmann Models

Spectrum provides a number of different configurations for these engines. The major differences between the models are the steel cab vs. a wood cab, slide valves vs. piston valves, and running board air tanks vs. frame-mounted air tanks. The YV engines were delivered with wood cabs which were replaced with steel cabs at a later date. The suggestions included here are for modeling the No. 22 and No. 23 after the original cabs were replaced and other modifications, such as the addition of a second air pump, had taken place. Here, as far as I can tell, are the variations in the different Bachmann models:

- #83401 – Unlettered, wood cab, slide valves, frame-mounted main tank
- #83402 – Unlettered, steel cab, piston valves, running bd. tanks
- #83403 – Ma & Pa #4, wood cab, slide valves, frame-mounted main tank
- #83404 - Ma & Pa #5, wood cab, slide valves, frame-mounted main tank
- #83405 – Ma & Pa #6, steel cab, piston valves, frame-mounted main tank
- #83406 – Painted green rather than black, steel cab, slide valves, running bd. tanks
- #83407 – Lettered for Maine Central, steel cab, slide valves, running bd. tanks
- #83408 – Lettered for Seaboard, wood cab, slide valves, running bd. tanks
- #83409 – Painted Russian Iron, wood cab, slide valves, frame-mounted main tank

As shown, there are no versions perfectly suited for modeling the YV engines, i.e., unlettered, steel cab, slide valves, frame-mounted main tank. #83401 is the closest choice but Bachmann no longer lists it on their website. However, it is currently available from some other Internet sources. #83404 is the next best choice since, except for removing the lettering, you need only to replace the cab. #83407 has the correct cab and valves but you have the less-than-correct air tanks. The cab is easier to change than the valves but, if you decide to change the air tanks, you still need to disassemble the engine. Avoid, if you can, a model with piston valves since the piston

valve models also have long running boards and front ladders that are inappropriate for the YV engines and thus need to be changed.

For my first conversion, I used a #83402 but I hadn't looked carefully at the options for this version. That required that I replace the valves, running boards, and air tanks. To get the different running boards, I had to order a whole new "boiler" which included the running boards I needed. Unfortunately, while the boiler included the correct running boards, it didn't include the air tank I needed. I used a #83404 for my second conversion and had to change out just the cab. To order the correct replacement parts, ask for a replacement part for a model with the part you want. For example, if you want a steel cab, order a replacement cab for a #83402 or #83405 engine; check the parts list provided with the model for the different variations.

Parts and Materials
I also purchased the following parts to replace stock parts on the engines or add to the engine; note that 2 parts (or 4 parts in some instances) are needed if you are modeling both the No. 22 and No. 23 at the same time:

- Generator - Cal Scale 190-211
- Bell - Cal Scale 190-281
- Whistle - Cal Scale 190-250
- Safety valves - Cal Scale 190-247
- Classification Lamps - Cal Scale MA-312*
- Train Indicator Boards – Cary 13-178**
- Air pumps - Cal Scale 190-256
- Main air reservoir (Left side) - Precision Scale HO-31046 (14" dia. brass)
- Front and rear headlight - Cal Scale 190-202
- Front Headlight bracket - Cal Scale 190-246
- Air equalizing reservoir - Precision Scale HO-3404
- Front number plate - Cal Scale 190-245
- Poling pole - Precision Scale HO-31571
- Rerail frog - Precision Scale HO-3110 or Cary 13-183
- Air Hoses – Kadee 438
- Headlight Lens - M.V. Products L185
- Various sizes of brass wire, brass sheet, etc.

* Cal Scale 190-375 classification lamps are closer in appearance to the classification lamps used by the YV but they are caboose markers with the mounting pin at a 45° angle for mounting on a rear caboose corner and thus can't be easily used.
** The Cary train indicator boards are much larger than the ones used by the YV but I couldn't find any other choices.

Cab Removal
1. The cab is removed via the two obvious screws beneath the running boards.

Boiler Removal and/or Cylinder Change
1. If you need to replace the cylinders and or running board air tanks, first remove the screw that is directly under the smokestack/cylinders. (There are a lot of

different size screws on the engine and the parts list doesn't help identify them. I suggest putting each different screw or sets of screws in a small, labeled plastic bag for safekeeping during disassembly.) Then remove the two screws at the rear of the frame, one on each side, directly in front of the brake cylinders under the cab. These screws are slightly hidden and not that obvious. There is a long plastic "arm" which apparently replicates the reverse lever on the right side of the engine under the running board that needs to be detached. (It can be discarded, even if you aren't changing the cylinders, since the YV engines didn't have the same long arm.) It has a press fit into the crosshead guide on the front end; just pull it out and then pull out the rear end. Finally, there is a pipe that is fitted into a hole in the front of the firebox on the right side that needs to be removed. I also cut off the signal line and the air hose that fit into the piston valve assembly and extend to the front pilot; I replaced these later with more correctly sized brass wire. The boiler can now be removed. Note the plastic tape that protects the wiring from touching the inside of the boiler; this will need to be replaced when you reassemble everything. The long air tanks will also come free when you do this; they can be discarded or replaced since they aren't prototype for the YV engines. The rest of the work to replace the cylinders is obvious from this point on.

Locomotive Modifications

1. Remove the following existing parts from the locomotive if you intend to replace them with brass castings: bell, whistle, generator (but not the mounting frame), headlight and bracket, classification lamsps, safety valves, single air pump, running board air tanks if so equipped, and front number plate. Note: if you want to salvage the LED in the headlight, carefully remove the smokebox front by prying it out with a thin screwdriver inserted in the joint between the smokebox front and the smokebox and then pull the wires out from the headlight first. If you are going to use an LED in the replacement headlight, mark which wire goes to the anode and which to the cathode of the LED before pulling the wires off the LED.
2. Different Spectrum models have different smoke box fronts; one has a circular handrail and the other a horizontal handrail. I ended up with one of each and used the circular one on my No. 22 and the other on my No. 23. For the No. 22, I removed the lower one-half of the handrail. For the No. 23, I completely removed the horizontal handrail. Fill the holes left from the removal of the classification lamps and handrail posts and install the replacement front number plate. Hint – Rather than use putty to fill these holes since the holes are so close to the rivets, I drilled out the holes with a #73 (.024") bit and glued in pieces of .025" round styrene rod (Evergreen #219) in the resulting holes. Once dry, I cut the excess rod off flush with the smokebox front for a seamless repair. Install the headlight bracket and headlight on the top of the smokebox front.
3. Fill the holes in the boiler left from removal of the headlight and sand smooth.
4. Either install the replacement bell in the original hole or fill that hole and install the replacement bell in the correct location between the steam dome and the sand box; this will require drilling a new hole in the metal boiler for the bell. I followed the latter course.
5. Either install the replacement whistle in the original hole or fill that hole and drill a new hole in the steam dome for the new whistle on the centerline of the boiler

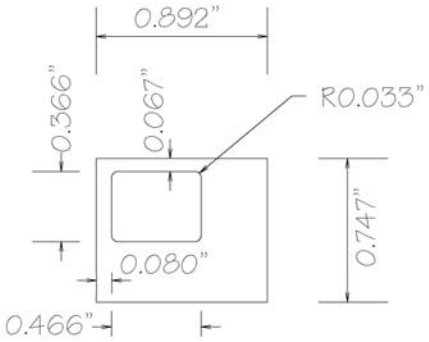
per the YV engines which is what I did. Note that the steam dome is plastic but it fits over a cast metal extension from the boiler (as shown in the Bachmann parts illustration). Since I removed the boiler from the frame, it was an easy task to remove the plastic dome, drill a new hole in it, and glue the whistle in place with CA. Keep in mind that the metal boiler extension means that the whistle “pipe” must not extend too far into the plastic dome.

6. Install the replacement safety valves in the steam dome. The Bachmann models ignore the fact that the rounded dome we see on top of the boiler is only a set of metal coverings and sheet metal and that the actual safety valves are affixed to the boiler and therefore should appear to be inset into the visible dome. I drilled into the plastic steam dome on my engines and glued a safety valve casting from an old brass engine to replicate this feature.
7. Install the replacement generator.
8. Add a pair of air pumps and plumb per the prototype photos and the information included with the castings. For the No. 23, I had to develop a way to have the pumps removable since the boiler can’t be reinstalled or removed if the pumps are mounted permanently on the pilot deck. The pilot deck has a sloped top surface which required that I first bent a piece of sheet brass to the angle needed to compensate for this slope. I soldered a piece of brass angle to this angled piece and then the pumps were then soldered to this angle plate and the piping added. This assembly is held in place by a 1-72 screw threaded into a hole in the bottom of this plate and through a clearance hole in the pilot deck.
9. Add the long driver brake reservoir on the fireman’s side of the locomotive under the running board. (See prototype photos.) Unfortunately, this reservoir blocks access to the screws that hold the cab in place. You therefore can’t permanently install this tank since you need to maintain access to those screws. I therefore mounted the reservoir with a screw so that it can be installed after the cab is in place. I first ground off the flat portions of the end castings since the prototype reservoir was held in place with bands around the tank. I then drilled a hole for the drain valve and glued it in place with CA and glued the ends in place, with the ground-off sides toward the rear. I then soldered a brass tab (bent in an L shape) to the inside rear end of the tank and drilled a clear hole for a 1-72 screw in this bracket. The bottom of the running board (under the cab) was drilled and tapped for a 1-72 screw; this allows the reservoir to be screwed to the bottom of the running board and then, by loosing the screw, swung out of the way to access the screws for attaching the cab. Finally, add some bands around the reservoir (I used .005" styrene) and .015" brass wire on the forward end to represent the air brake line leading to the tank. This line tucks up under the running board, runs forward, and then runs under the boiler to the opposite side.
10. Remove the two air tanks from under the running board on the engineer’s side of the locomotive under the cab and then grind or file off the front raised pad (just in front of the hole for the screw which attaches the cab to the running board). Then install the air equalizing reservoir where this pad was removed. Piping for this reservoir is limited to a 3/8" I.D. pipe which leads directly up to the brake valve in the cab. Model this pipe with .008" brass wire.
11. Add a bell rope and whistle rope; I used .006" brass wire for these ropes.

12. Note that the correct pilot is the one that has the boiler tubes extending to the top of the pilot beam. Although this has a press fit, I choose to bond it in place with CA to make sure that it would stay in place.
13. Add the new front air brake hose and signal hose to the pilot.

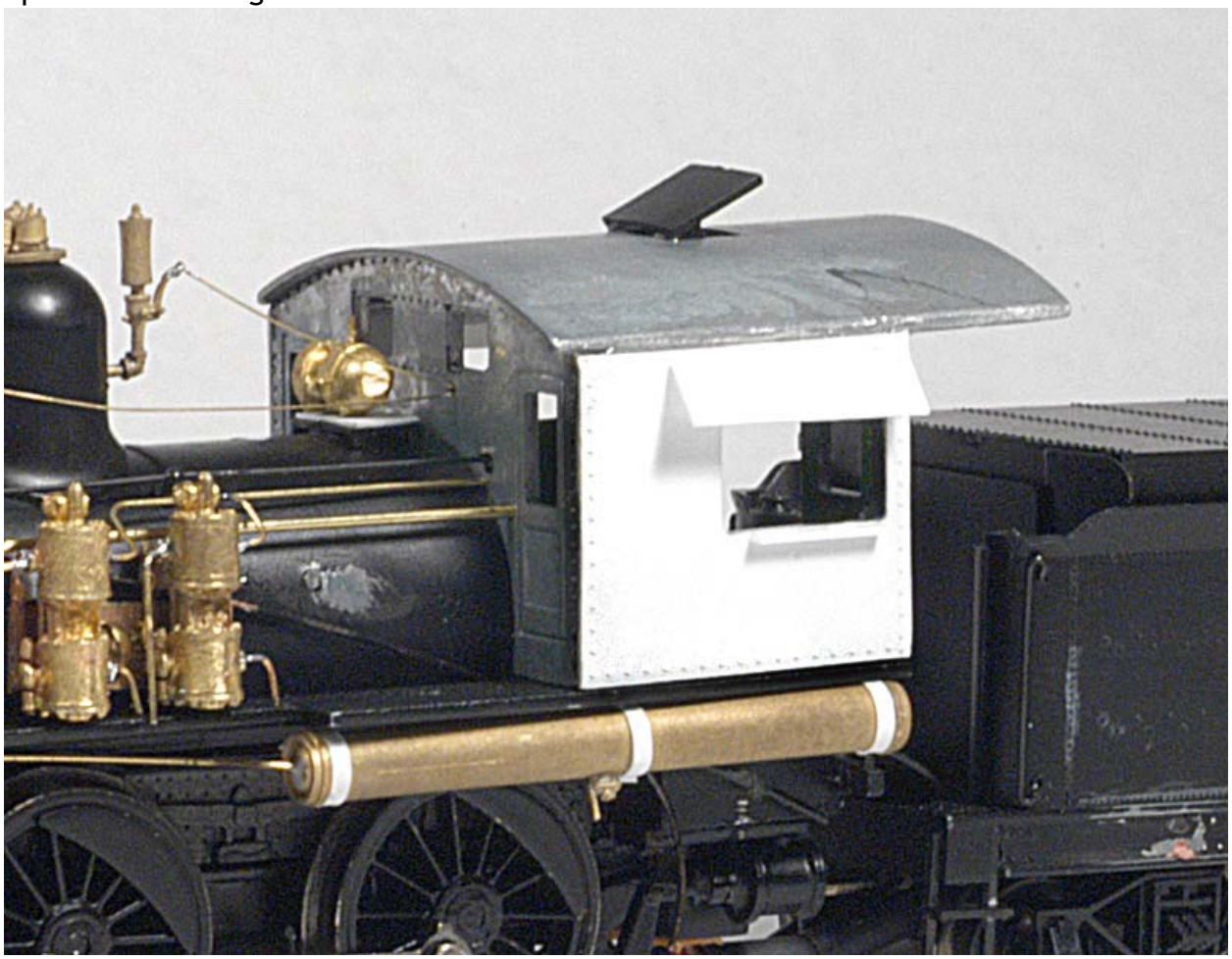
Going Beyond the Basics

1. I choose to reduce height of smoke stack to more closely resemble the YV stacks. There is a screw in the bottom of the smoke stack that allows it to be attached to the smokebox (as shown in the Bachmann parts illustration). While it is a Phillips screw, a very small regular screwdriver will work to let the smoke stack be "screwed" out. The top of the smoke stack has a ring so you need to cut off the bottom portion of the stack to shorten it. Unfortunately, there is a lip on the bottom of the stack which fits into the flange on the boiler; this lip is cut off when the stack is shortened which results in a poor joint at this point. To compensate, I turned a piece of brass rod to the inside diameter of the shortened stack and drilled it for a long 1-72 screw. The supplied self-tapping screw was discarded and the hole in the boiler redrilled to accept the 1-72 screw. I carefully cut off about 12" scale inches from the bottom of the stack. The brass rod was bonded inside the stack with CA (cyanoacrylate adhesive) and a nut used to secure the shortened stack to the boiler via the 1-72 screw. The brass rod thus reinforces the joint between the stack and the boiler and compensates for the lack of the original lip.
2. While one can simply remove the window muntins to make the cab closer in appearance to the prototypes, I choose to make replacement cab sides from .010" styrene and bond them to the cab sides. The factory-applied paint on the entire cab was removed and all rivets filed off of the sides of the cab. I also filed off the triangular fillets between the sides and the cab roof. The small sunshade and armrests were also filed off and the center post between the two existing windows removed. The openings in the cast cab were opened up as needed using a milling machine (a Dremel tool also works) and styrene sides fabricated. Here is my template for the cab sides:



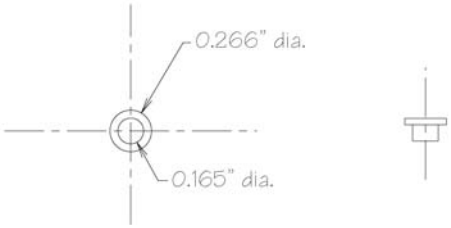
I made a simple jig to use in my drill press to accurately drill the four corner holes since I was building both the 22 and the 23 at the same time but these holes could be drilled manually as long as the layout for them is square. Once the holes were drilled, I used a straightedge to cut between the holes. Trying to cut tangent to the holes was an obvious solution but didn't work; instead I cut short on all four sides of the opening and finished off the openings with a flat jewelers file. I used one which lacked teeth on one edge; that allowed me to file right at the holes without accidentally filing the adjacent side. Rivets were added to the edges of

the sides using a NWSL Riveter although mine has been rebuilt using a compound X/Y slide. The resulting sides were bonded to the cast cab with CA and the joint between the top of the sides and the cab roof filed smooth to minimize the fact that the cab roof no longer projected over the sides. Since the sides were fabricated from .010" styrene, the openings are vulnerable to damage since the styrene openings are larger than the openings in the cast cab. Styrene strip and .040" flat styrene were therefore added on the insides of the .010" styrene between the inside limits of the windows and the metal window opening to reinforce this area. Styrene armrests and shades were then added. Here is a close-up of the resulting cab:



3. The model comes with spoked pilot wheels but the prototype had solid pilot wheels. I purchased some replacement pilot wheels from Precision Scale but they were the wrong diameter and the axles were of a larger diameter and therefore unusable. The solution therefore seemed to be to cut styrene discs to cover the spokes to convert them to solid wheels. My first attempt was to measure the sizes needed to cover the spokes, draft them in CAD, and use these as cutting templates. However, the tolerances of laser printing made it difficult to print accurate templates on my printer to use in cutting the discs. My next attempt was to use drafting dividers to cut the styrene circles. But this also didn't work as the center hole expanded during use, making the resulting circles non-concentric. I then came up with the idea of drilling a hole in some .010" styrene to

accommodate the “hub” and to turn a “tool” to use to cut the outside diameter. The first step was to drill some No. 18 holes in pieces of .010" styrene for the hub. One method would be to start out with a small drill and slowly increase the size of the holes using increasingly larger drills to eliminate the tendency for thin styrene to climb the drill bit, warping the hole in the process. Instead, I first clamped a piece of .060" styrene on my drill press table and drilled through this styrene. I then used this .060" styrene as a “receiver” to drill through some pieces of .010" styrene; this approach keeps the .010" styrene from distorting during the drilling operation. This hole is the inside hole for the “donut-shaped” styrene discs needed to cover the spokes. I then made a cutting “tool” from brass to the following dimensions:



The thickness of the two sections isn’t that critical, only the outside diameters. To use this tool, insert the 0.165" end of the brass tool through the No. 18 hole in one of the pieces of .010" styrene and then in the No. 18 hole in the .060" styrene…that allows the larger (0.266") diameter portion to be flat to the .010" styrene and also gives you a surface to cut against. Now use a Xacto knife with a new No. 11 blade to carve around the larger 0.266" diameter of the tool. The result will be a “donut-shaped” styrene disc (with a 0.165" hole and a 0.266" outside diameter) that drops into the spoked wheels to cover the spokes. Glue the discs in place with CA. You might want to then use some slightly thicker CA to make a fillet around the outside perimeter. Here is what the discs look like after being glued in place:

4. If you want to model the No. 23 after 1938, you'll need to cut back the length of the smokebox but that can be easily done. The smokebox door can be carefully pried off. That provides access to a pair of screws inside which hold the plastic smokebox to the metal boiler casting. Remove the smokebox. I used dial calipers set at 0.250" to scribe a line around the smokebox which results in a line just in front of the castings for the smokebox stays. I then used a Zona saw to cut off the front of the smokebox just short of the scribe line and finished up with a large file.

Tender

1. Remove the following parts: truck chains and hangers including eye bolts on the trucks; coal or wood loads; rear foot board and supports; rear full-width handrail; and poling pole.
2. Fill the holes resulting from the removal of these details.
3. I removed the factory water fill and made a new water hatch from 3/16" brass tubing with a styrene lid and glued it in place.
4. I added grab irons on the rear beam per the prototype photos; note that the rear beam is metal which might dissuade you if you don't have a precision drill press.
5. Add a new derail on the right side and a poling pole to the left side of the side sills. I fabricated hangers from DA #2528 brass flat bar for both of them, soldered the pieces to the hangers, and glued the hangers to the inside of the side sills with CA.
6. Add an air brake hose and signal hose to the right of the rear coupler.

Going Beyond the Basics

1. I reduced the height of the oil tank by 0.125" by first scribing around the tank with calipers and then cutting the excess off with a Zona saw. The cut was then cleaned up with a large file and the reduced-height tank glued to the tender. (If you are replacing the decoder, make sure that it will fit in the decreased space before reducing the height of the oil tank; see notes in the following section.)
2. The top tender flare on the top of the stock tender extends from the front end to the rear of the oil tender. However, on the YV tenders, this flare extended completely around the tender. I spent considerable time trying to develop a pattern in CAD to replicate this feature and extend the stock flare the rest of the way around the tender but was unsuccessful.

Decoder

1. I initially replaced the Bachmann decoder with one of the new Soundtraxx model TSU-750 Micro Tsunami decoders. However, after installing it and running the engine, I discovered that the engine was overloading the decoder since, after running for a couple of minutes, the decoder overheated and shut down. I therefore removed this smaller decoder and replaced it with a TSU-1000 Tsunami decoder. This larger decoder will fit in the tender although I didn't install any headlights in my engine and therefore didn't need to find room for the extra wires for lighting. I cut all of the excess wires about ¼" long with each one slightly longer than the one next to it. I wrapped these wires around one side of the decoder and taped them to the decoder with electrical tape. This got them out of the way and insured that they won't be able to create a short circuit. I'm not sure

that there is enough room in the tender (at least with the reduced-height oil tank that I have) for connecting all of these extra wires.

Note that Bachmann uses red wire for the right rail pickup and also uses red wire for the + side of the motor. Before you unsolder the wires from the Bachmann decoder, mark the red wire from the decoder for the motor (it is connected to the center of the circuit board) with grey paint to differentiate it from the other red wire. In addition, the both tender trucks use black wires to connect to the Bachmann circuit board but the rear truck is a left rail pickup and should be connected with the red wire for the right rail pickup from the engine; the front truck is a left rail pickup and is correct to be black. The Bachmann decoder to Soundtraxx decoder wiring color scheme is as follows:

Bachmann red and rear tender black wires = Soundtraxx red right rail pickup
Bachmann black and front tender wires = Soundtraxx black left rail pickup
Bachmann brown wire = Soundtraxx orange motor +
Bachmann red wire = Soundtraxx gray motor -
Bachmann yellow wire = Soundtraxx blue function common
Bachmann orange wire = Soundtraxx white headlight

I used a Model SP-28R-08 round 1.1" speaker from Litchfield Station. The speaker was glued over the stock opening in the floor of the tender and I then cut and glued pieces of .040" styrene adjacent to the edges of the speaker to cover all of the floor holes not covered by the speaker. I also cut off the “posts” molded into the floor that held the stock decoder in place. After soldering the decoder wires to the appropriate Bachmann wires, I shoved the decoder into the top of the tender/oil tank and taped it and the capacitor in place with electrical tape. Next, I plugged the wires between the tender and the locomotive into the connectors in the locomotive and determined how much slack would be needed; I pulled the excess into the tender and used a piece of electrical tape to hold them generally in place. I then put the tender onto the tender frame and screwed it in place.

Ready for Paint

On the following page are the locomotives ready for painting and lettering:

Paint and Lettering

1. If you need to remove factory lettering, I found that some very old Polly S Easy-Lift-Off that I had on hand worked so other decal softening products should also work.
2. I first painted the inside of the cab with Floquil Light Green. I then primed the brass and new parts with Floquil Primer. After the cab was dry, I masked the green paint in order to paint the cab exterior.
3. The first step for painting the engine black was to disassemble the boiler and frame and remove the motor assembly. I unsoldered the motor wires from the circuit board; the reddish stranded wire goes to the fireman side of the circuit board and the motor brush on the fireman's side and the wire with the orange tinge goes to the motor brush on the engineer's side and the adjacent spot of the circuit board. I then removed the two screws that hold this assembly in place (one

under the cylinders and one at the rear). Next, I masked the wheels on the pilot truck, the drivers, and the tender trucks. I also masked the tender truck axles. I then painted everything with a Floquil Engine Black lightened with some Reefer White. Rolling the drivers/frame assembly let me get paint behind the spokes without the need to disassemble the rest of the frame/drivers. I tried to keep overspray from the whistle, bells, safety valves, and front number board. Once the boiler was dry to the touch, I used lacquer thinner to clean up these brass fittings.

4. When this was dry, I masked the cab and air brushed the front windows Floquil Caboose Red and the awnings a dirty canvas color. The armrests, poling pole, derail, and front number plate were brush painted.
5. Next, I air brushed a gloss coat of Future on areas to receive decals: the sides and rear of the tender and the sides of the cab. The decals are available from my website.
6. After reassembling the engine except for adding the cab, I touched up the black paint, and, after letting the Future dry overnight, applied the decals. I also added gold decals to the front number plate for the locomotive number. This was followed by an application of Dullcoat.
7. Glass was added to the front cab windows using .005" clear styrene set in place with Microscale Mirco Kristal Klear. I also used this “glue” to add glass to the classification lamsps and to glue the headlight lens in place. A replacement crew was installed, and the cab reinstalled.
8. Light weathering was then added and the masking tape removed from the wheels to finish up the project. Even though the wheels and tires were protected with tape, I still had to use lacquer thinner to clean the threads. I also had to clean the tender truck axles and the backs of the drivers where the pickup wipers contact the backside of the drivers.

Resulting Locomotives

Here are the final locomotives:

Granted, the Ma & Pa engines are not perfect stand-ins for YV No.s 22 and 23. The most noticeable difference is the boiler…the Ma & Pa engines have a straight boiler whereas the YV engines had a boiler that transitioned from the smokebox to a larger diameter at the cab. In addition, the YV tenders had the top flare extend completely around the tender while the Ma & Pa engines have a flare that stops at the rear end of the oil tank. But, by changing a number of other factors including the number of air pumps, cab appearance, placement of details such as the bell and whistle, as well as upgrading parts, a reasonable stand-in can be built. They are good enough until I have time to build these models from scratch!