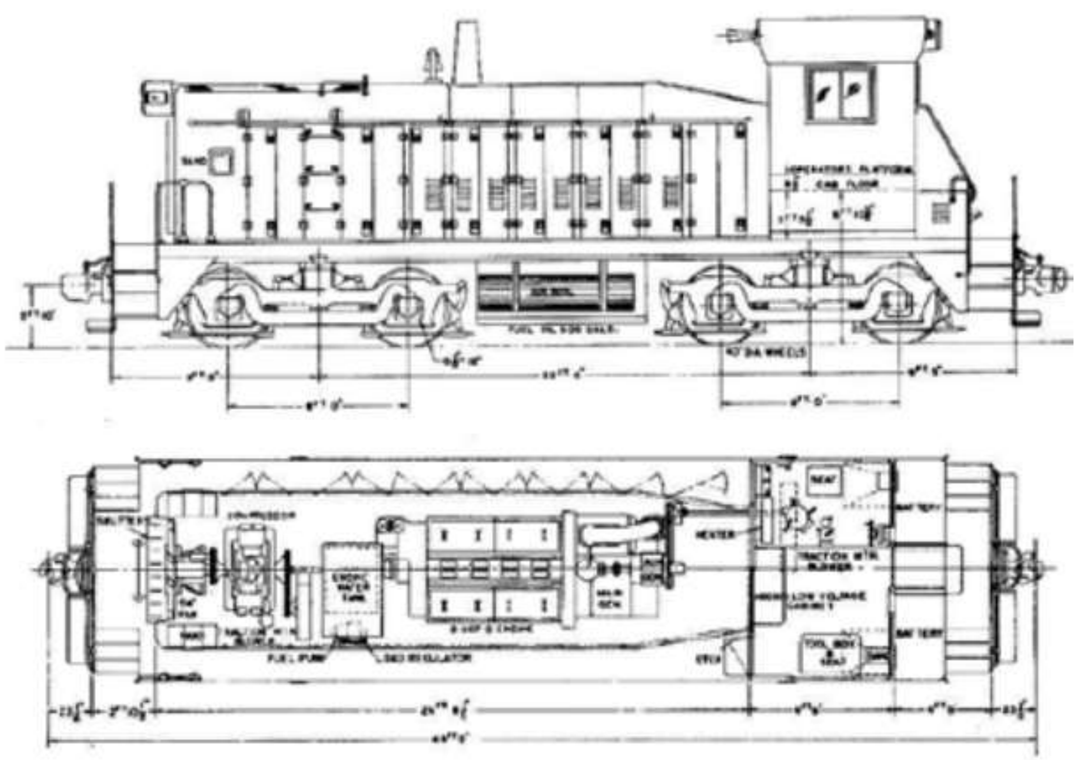
Transition on the Montour Railroad

By Bob Ciminel - Montour Railroad Historical Society

The Montour Railroad went through many transitions in its 100-plus-year lifetime. In 1901, it transitioned from the Imperial Coal Company to become a subsidiary of the Pittsburgh Coal Company. Then, in 1946, it transitioned from the newly-formed Pittsburgh Consolidation Coal Company to become a jointly-owned subsidiary of the Pennsylvania Railroad and the Pittsburgh & Lake Erie Railroad. In 1975, with the demise of the Penn Central, it became a wholly-owned subsidiary of the P&LE.

There were many other transitions on the Montour, such as the transition from a passenger and freight line to a freight-only line in 1928, and the transition from steam to diesel in the early 1950s. But there was one transition that occurred multiple times every day and night when the railroad was in operation. These took place within the electrical cabinets of the Montour's SW-9 diesel locomotives as they moved their carloads of coal on the main track and branches between Montour Junction and Mifflin Junction.

The power plant of the SW-9 diesel-electric locomotive was a 1,200 horsepower General Motors Electro-Motive Division Model 12-567B 12-cylinder diesel engine driving a 600-volt, 848-kilowatt generator. The generator furnished electrical power to a Model D27 traction motor on each of the locomotive's four axles. The traction motors then supplied mechanical power to the wheels to move the locomotive along the rails.



Schematic diagram of an SW-9 Locomotive

When starting out, electricity from the generator was routed to the four traction motors in series (#1 to #2 to #3 to #4), keeping the 1,400 amp current from the generator at a level that prevented the motors from overheating as the locomotive applied its maximum tractive effort to move the train.

As the locomotive speed increased, the traction motors began generating an opposing voltage (an electric motor is essentially a generator running in reverse) called back electromotive force or back emf. If allowed to continue, this opposing voltage would eventually equal the voltage applied by the generator and the traction motors would be unable to generate additional torque to continue increasing the train's speed. On the Montour's SW-9s, this point would occur at about 7 mph and was called the transition point, or the point where the locomotive needed to shift from low gear to high gear.

On the SW-9, transition was automatically initiated by the locomotive's control system, unless the engineer chose to do it manually. Various relays and switches would actuate and realign the electrical power going to the traction motors into a configuration known as series-parallel (#1 to #2 and #3 to #4). This would divide the 600 volts among two sets of motors, reducing the back voltage and allowing the motors to continue producing torque and increasing their speed.

The Montour SW-9s were delivered with a 62:15 gear ratio on the traction motors (the wheels would make one revolution for every four revolutions of the traction motor). With this gear ratio, forward transition (series to series-parallel) would occur automatically at 7.5 mph and the engineer would initiate backward transitions (series-parallel to series) at 9.5 mph. Automatic forward transition could be cancelled using a forestalling switch in the locomotive and was frequently used by Montour engineers to prevent jerking when operating multiple locomotives to prevent couplers from breaking on heavily loaded trains.

Former Montour employee Gene P. Schaeffer describes how manual transition was used in the 1970-80 time frames (edited for clarity):

"You could also take the transition lever, advance it like the gear shift in an automatic transmission, then throttle the locomotives out to #8 (the throttle had eight notches, which increased engine rpm and generator output) and let them do it on their own, but I think the big reason in doing it manually was to control the power surge when it transitioned.

Running light you could let them do it themselves without worry about tearing the train in half, but with loads or a lot of empties, always a big chance of breaking a knuckle with the power surge.

That is the way Jack Harvard taught me to do it and some of the reasons.

Also with 3 or 4 units, you wanted all of them to transition at the same time. When in series-parallel, if you were dragging a hill with tonnage. At a certain point normally you had to make reverse transition so you gradually back down on the throttle, then around

#3 or #4 you made reverse transition at where you thought reverse transitioning would equal back out to being in series, so it was a smooth reverse transition in regards to reapplying horsepower. When you made reverse transition, again you had to be careful with tonnage as you almost always had a moment or two when you lost power, and for that brief moment the train was drifting. Then you had to reapply power slowly so not to have a slack run out and break a knuckle with tonnage but you had to do it quickly so as not to lose momentum and really have a concern with slack."

When the Montour ran its Mikado steam engines, it was not necessary to transition, but they did have the equivalent of a gear shift. It was called a reverser lever that controlled how much steam was admitted into the cylinders. But that is a topic for another newsletter.

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