Build a train elevator

A compact, automatic device that transfers trains between layout levels

By Steve Harris • Photos by the author

When I built my HOn3 Rio Grande Southern layout a few years ago, I included a helix to connect the upper and lower decks. The helix worked fine, but it was difficult to clean the rails, and my slow-moving HOn3 locomotives took up to seven minutes to negotiate the seven loops of track within the helix. Plus, my track plan (published in the November 2004 *Model Railroader)* had the helix right in the middle of the mainline run.

A visit to my friend Dick Roberts' HO scale layout provided the inspiration for my train elevator. Dick had built a reliable train elevator using a modified garage door opener with a system of pulleys and drawer guides to move the platform. [See *Model Railroad Planning 2001. – Ed.*] For my version, I borrowed some of Dick's ideas and enlisted the expertise and considerable mechanical skills of another friend, Joe D'Elia, the proprietor of A-Line and Proto Power West.

The challenges

We faced a number of challenges. The mechanism had to move the platform slowly and smoothly to avoid derailing the lightweight HOn3 equipment. It had to be fully automatic and reliable, since dropping a brass locomotive would be a disaster (as I later found out during the "debugging" stage).

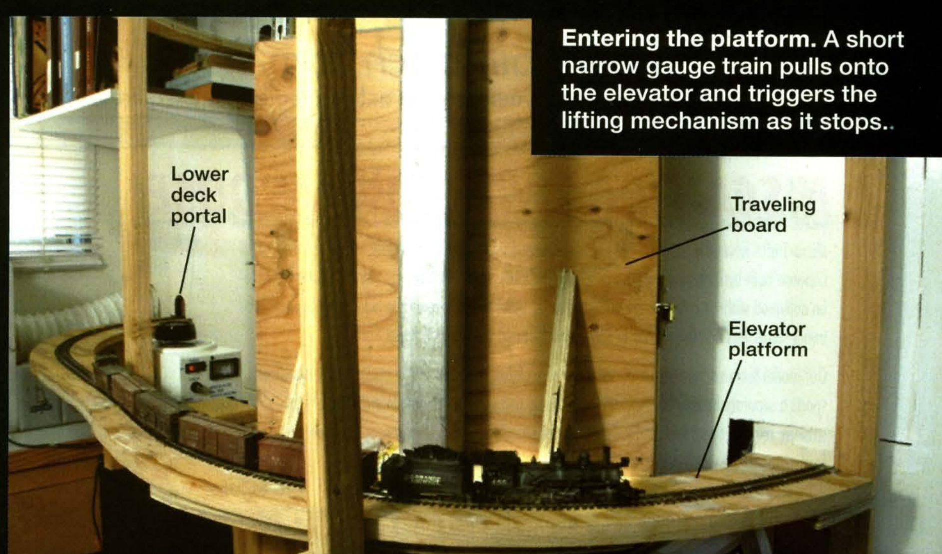
In addition, the entire elevator had to fit within the upper deck's 24" radius reversing loop that I had added around the outside top of the original helix. This meant the elevator platform had to be curved, and could be only about 35" long. Narrow gauge steam locomotives have limited pulling power, and short trains are normal on my layout, so this wasn't a problem.

The garage door opener

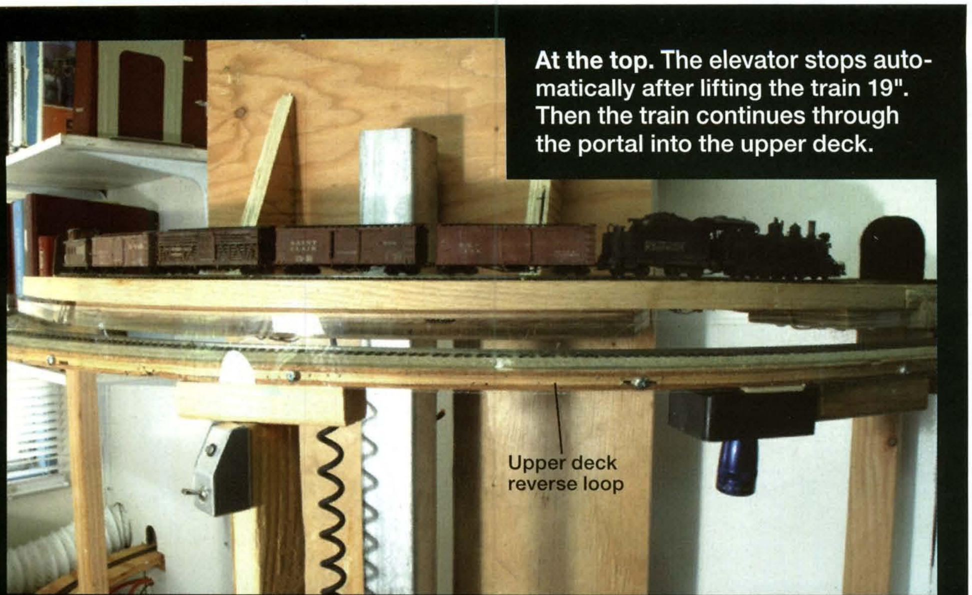
A modified screw-driven garage door mechanism operates my elevator (see **fig. 1**), and it has many useful features. It includes an AC motor with a reversing circuit, a threaded drive screw with a moveable carriage, and a shaft to guide the screw. In addition, it has adjustable stops built in at the top and bottom of its travel. The mechanism's only disadvantage is that it runs too fast for a train elevator.

At this point, my friend Dave Balser suggested that we use a variable AC transformer called a Variac, shown in **figs. 2** and **3** on page 62, to slow the motor. However, we found that the door

Train elevator. Author Steve Harris added this train elevator to move HOn3 trains between the levels of his double-deck layout in less time than they formerly took to traverse a helix.



Entering the platform. A short narrow gauge train pulls onto the elevator and triggers the lifting mechanism as it stops..



At the top. The elevator stops automatically after lifting the train 19". Then the train continues through the portal into the upper deck.

During the lift an electrical interlock cuts power to the platform track to prevent any inadvertent movement of the locomotive.

opener's electronic circuits for both the motor control and the stop detection were combined on one circuit board. When we used the Variac to lower the input voltage, the detection circuit wouldn't work.

Fortunately, another friend, Phil Hermsmeyer, is an electronics engineer. Phil figured out how to separate these two circuits so we could use the Variac to power the motor with reduced voltage while leaving the full 120 volts available for the detection circuit.

Testing the concept

Joe and I built a prototype mechanism on my workbench using plywood, a pair of high quality drawer guides, the garage door opener, and the Variac. For the purposes of the prototype, we mounted a vertical stationary backboard on the workbench. We then mounted the door opener head that contains the motor and electronics on a horizontal board secured at a right angle to the backboard.

The horizontal elevator platform that would transport the trains was fastened at a right angle to a second smaller vertical board. This assembly was then attached to the drawer guides mounted on the stationary backboard, as shown in **fig. 1**.

We used a hacksaw to cut the drive screw and shaft to size, then assembled all the parts. The elevator platform was fastened to the traveling carriage on the screw drive with L brackets. Finally, we added a counterweight and pulley system to smooth the motion and allow slower speeds.

We found that the adjustable stops in the opener head allowed us to adjust the elevator so that it would stop at both ends where we wanted it. The Variac allowed us to start the motor and run the mechanism with as little as 50 volts. At that voltage, the mechanism drove the screw slowly and smoothly enough that our elevator could safely transport an HOn3 train.

The Variac proved to be a good choice. During initial operation, the elevator sometimes moves too slowly and doesn't always complete its vertical movement all the way to the top. I can increase the voltage as necessary, and then turn it back down as the mechanism warms up.

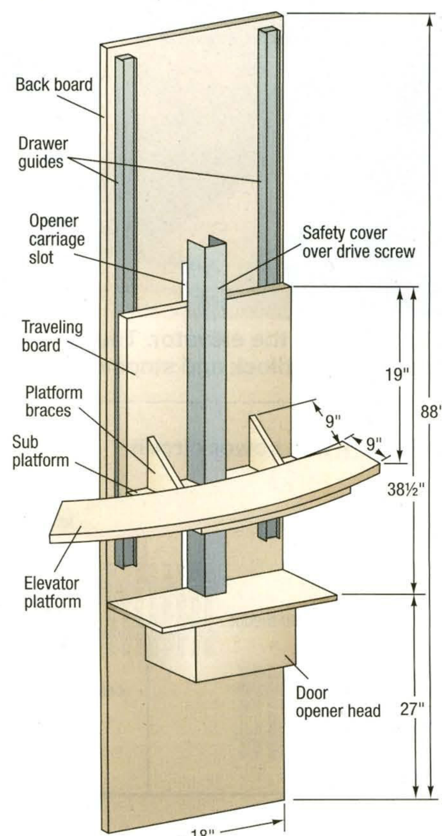
After proving that we could build a workable elevator on the workbench, we proceeded to tear out the front half of the helix and build an elevator in its place. I left the back half of the helix in place as seen in **fig. 2** because it supports some of the finished scenery in other parts of my railroad. The elevator was also tucked inside the upper deck reverse loop.

Automatic operation

Once we had the elevator installed and working mechanically, I tackled the design and installation of its automatic controls. I wanted a train approaching from either the top or bottom to stop and call the elevator. See **fig. 3.** This initiates the sequence of events shown in the three photos in the middle of these pages. After the elevator arrived, the train would proceed onto the platform (lower photo), and stop again while the elevator moved up or down (middle photo). Once the elevator stops (top photo), the train moves off the platform and passes through the portal into the layout to resume its run. All of this was to happen automatically without operator assistance. I achieved this goal using limit switches, optical sensors, relays, and timer circuits.

The initial problem was to make the locomotive stop at appropriate times and places. This was resolved by isolating sections of track to make control blocks in the main line. These isolated sections were installed in both the top

Fig. 1 Train elevator construction



Illustrations by Jay Smith

Fig. 2 Tight space. The elevator replaced the original helix inside of the upper deck's reverse loop (top). The remains of the helix help support some scenery.

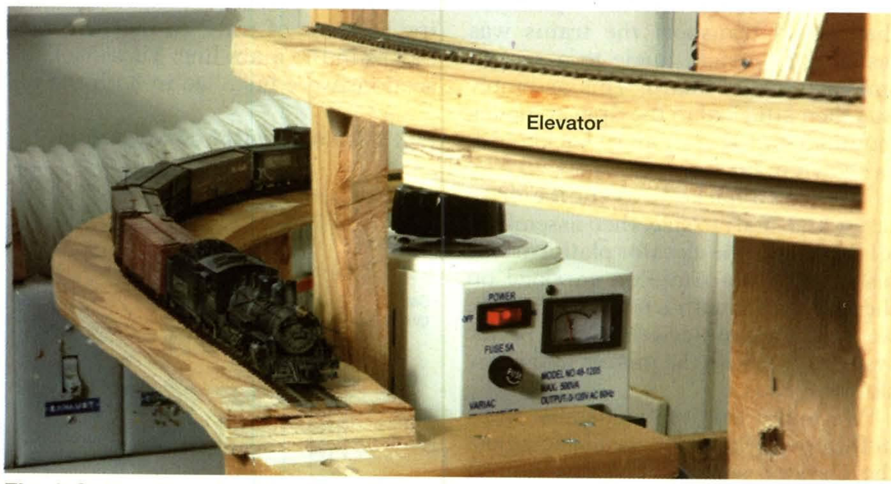
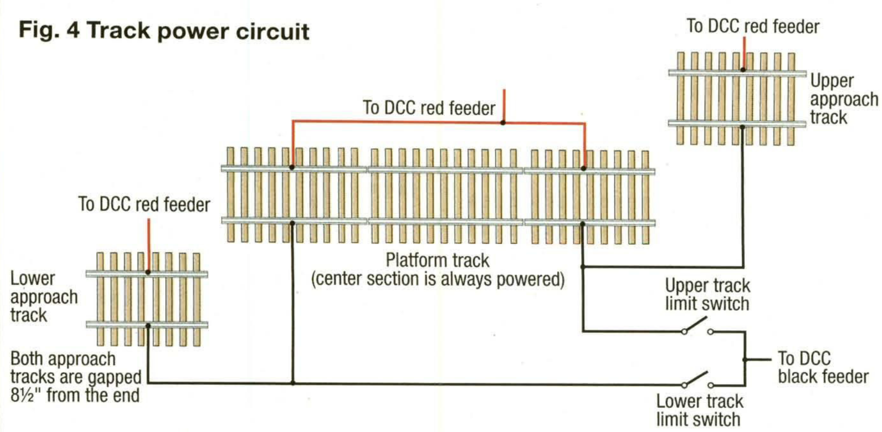


Fig. 3 Calling the elevator. The platform is up as a train slowly approaches the lower control block and stops over the sensor that calls the elevator.

Fig. 4 Track power circuit



and bottom approaches and on both ends of the elevator platform.

The track power wiring diagram in **fig. 4** shows how I use these sections, which are controlled by limit switches at the top and bottom of the platform travel. Thus, the lower approach block and the left platform block are energized by the closing of the lower limit switch when the elevator reaches its bottom limit. The upper approach block and the right platform block are controlled by the upper limit switch.

If the elevator is in the down position and a locomotive runs into the lower approach track, the lower limit switch will be closed, powering the lower approach block and the left platform block, but not the right platform block. This allows the locomotive to move slowly onto the platform until it reaches the unpowered right platform block. If the platform is in the up position when a locomotive enters the lower approach block, the locomotive will stop in the unpowered block until the elevator arrives and closes the limit switch.

Safety interlocks

A momentary push-button switch normally activates the door opener, but I used Circuitron optical sensors (which activate a circuit when they're shaded from light) to initiate my elevator's movement. The sensors trigger a Circuitron detection circuit with a relay that starts the elevator cycle.

I placed these sensors in positions where locomotives would stop in the control blocks on each approach track, and a few inches from each end of the elevator platform. Because different locomotives stop in slightly different places, it took several tries to find the optimum position for these sensors.

I also installed separate safety sensors at the ends of the elevator and wired them through relays that prevent movement if any sensor is covered. These sensors protect any train that's stopped across the gap at either end of the platform.

To prevent false triggering, I added limit switches wired in series with the sensor relays. See **fig. 5**. When the elevator is up, only the upper approach and left platform sensors can activate the elevator motor. Conversely, when it's down, only the lower approach and right platform sensors will trigger the control system.

I use a tapered dowel pin that slips into a hole to align each end of elevator as it reaches the end of its travel as seen in **figs. 6** and **7**. I also soldered all of the rail ends to brass tabs, which are cemented to the roadbed. This way the rails can't move out of alignment. See **fig. 8** on page 64.

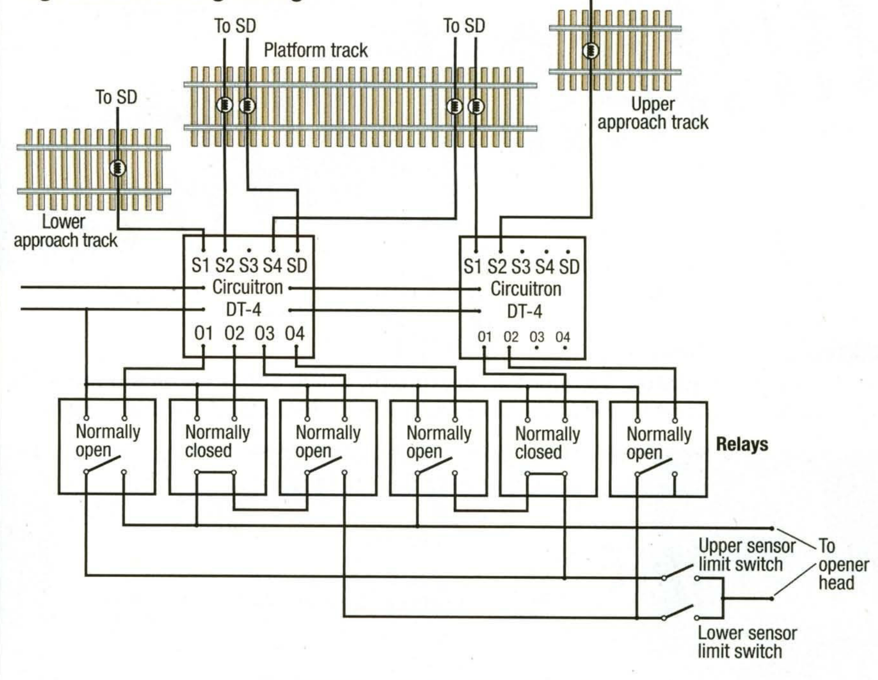
We installed a simple counterweight system to help smooth the platform's motion. A short cord runs from a hole in the top center of the traveling backboard, up and over a couple of pulleys, and down behind the backboard to a quart plastic bottle filled with weight. My counterweight is a bit lighter than the elevator so the empty platform will move with little effort.

The elevator is located in my shop, which is well lit with multiple windows and florescent lights. To my dismay, I discovered that people walking near the elevator created moving shadows that occasionally activated the elevator, even if a train was moving on or off the platform! This derailed one of my brass locomotives, which fell to the floor. To prevent any future problems, I mounted a pair of bright lamps directly above the platform that override the ambient room lighting. See **fig. 10** on page 64.

Timer circuit

To further protect my trains, I installed a timer circuit, triggered by sensors at the ends of each approach track and by a pair of limit switches that close when the platform reaches either end of its travel. See **figs. 4** and **9**. The timer is activated by the limit switch after the elevator platform arrives or when a locomotive crosses onto the platform, covering the sensor. This timer then opens the elevator sensor circuit for 16 seconds, giving the trains

Fig. 5 Interlocking wiring



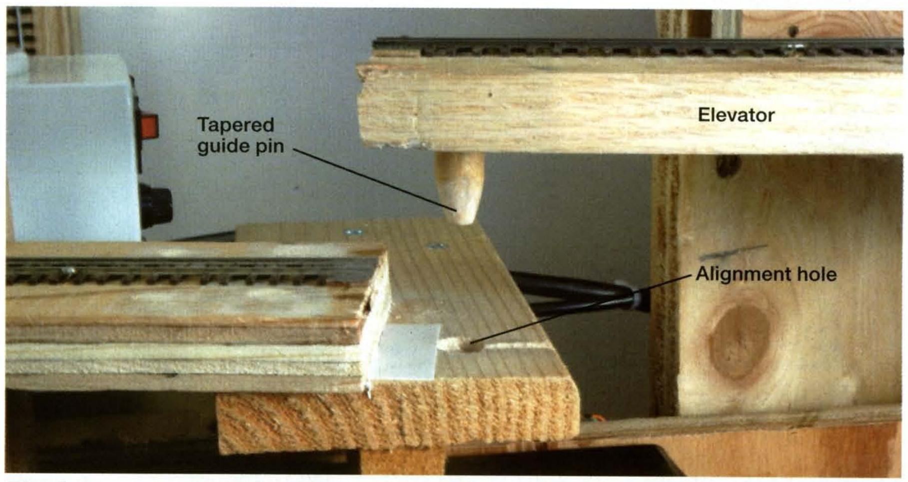


Fig. 6 Lower level alignment. A close-up view shows the platform's tapered pin that drops into a hole in the lower approach to guide the elevator into alignment.

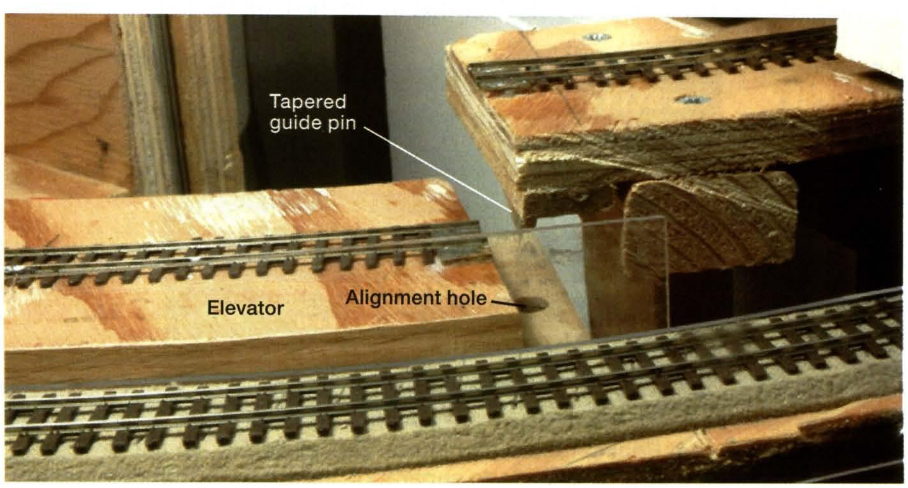


Fig. 7 Upper level alignment. A second tapered pin is mounted beneath the upper approach to engage and align the elevator with the upper level track.

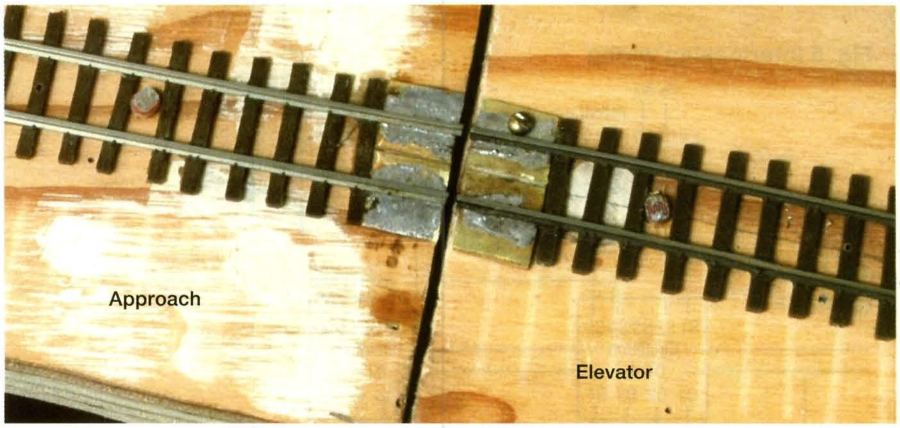


Fig. 8 Alignment plates. To maintain alignment, Steve soldered all the rail ends to brass plates glued to the ends of the approach blocks and elevator platform.

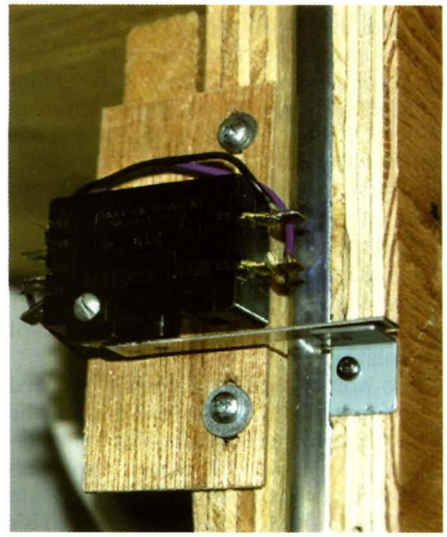


Fig. 9 Limit switch. Limit switches activate the delay timer and complete the circuits to the appropriate platform sensors. They're used to prevent false activations of the elevator.

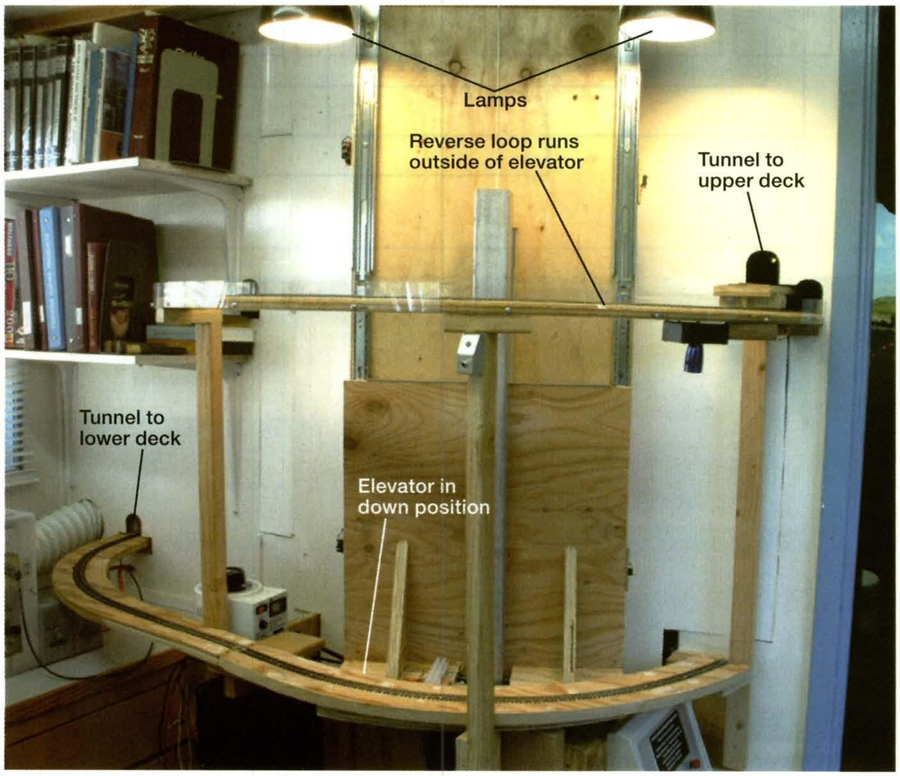


Fig. 10 Safety lamps. This pair of bright lights overrides the room lighting to prevent false activations of the elevator that might damage the trains.

Recognition plaque. Real railroads don't have train elevators, so this device is officially designated as a "D'Elia grade separation equalizer." Upon completion, a dedication ceremony was held where Steve unveiled this plaque to thank the friends who had been instrumental in the elevator's design and construction.

plenty of time to move on or off the elevator platform safely.

The payoff

Visitors are fascinated by the train elevator and often wait to see it travel between the decks, so the layout sometimes winds up playing second fiddle. My operators love it because the elevator has solved the problem of travel time from one level to the next. All the engineer has to do is run the train into the elevator and then wait for it to release the train on the other deck.

It now takes a little over a minute for a train to travel from one level to the other. Most of this time is used by my slow-moving locomotives hauling trains on and off the platform. This is a great improvement over the seven minutes it formerly took to run through the helix, and it's a lot more fun to watch. **MR**

Steve Harris has been modeling the Rio Grande Southern RR in HOn3 since 1978 and has been building his layout in an office trailer since 1993. His narrow gauge layout was featured in the November 2004 and April 2008 issues of Model Railroader, *and his article "Weathering your Structures" appeared in the November 2003 MR. He has also published numerous articles in the* Narrow Gauge and Short Line Gazette. *Steve is retired from the television advertising business and lives with his wife, Susie, near San Diego.*

More on our Web site

A video demonstration of Steve's train elevator in action can be found on our Web site at www.ModelRailroader.com.