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COLUMNS

NEWS and EDITORIAL

How to model
Working miniature cranes
Part 1

BY DR. GEOFF BUNZA
Photos by the author

1. Animated Athearn DCC crane.

Put these animated cranes to work on your layout ...

THE 250-TON CRANE I DESCRIBED IN THE August 2012 *Model Railroad Hobbyist* (model-railroad-hobbyist.com/magazine/mrh-2012-08-aug) whetted my appetite for additional animated cranes. Cranes make a great interest-grabber on any layout or module, particularly for a club or show. There are many prototypes available to choose from, either older, truck-mounted cranes or newer self-propelled cranes on caterpillar treads.

Cranes are a great place to start putting animation to work on a layout. They open possibilities for movement, lighting, and even sound to enhance a scene.

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I will detail how to build four low-cost animated cranes with simple hand tools most modelers have. I'll start with a truck-mounted crane that uses two DC motors, then I will do a multi-featured DCC controlled truck-mounted crane model with three motors and lights.

After that, I'll do two mobile crane projects with cranes on caterpillar treads and show how you can put them on your layout using two different control methods: one with in-the-layout wire-guided control, and the other using wireless remote control, ending with a special "moving" animation.

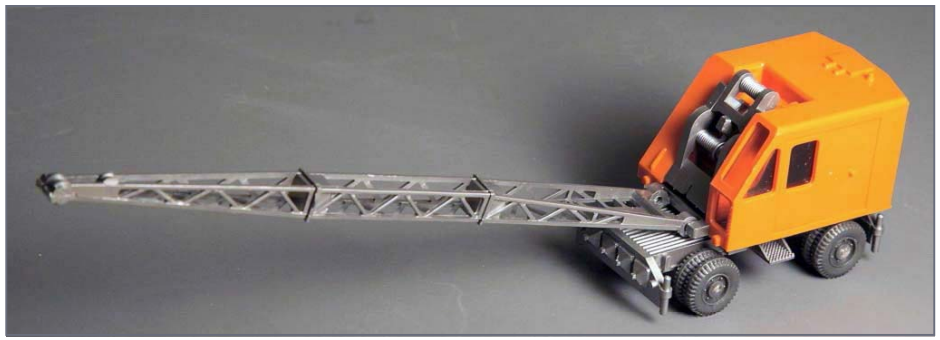
Gathering the resources

mounted on a 6x6 frame built by White, Corbitt, and Brockway, for the U.S. Army, and shipped all over the world. I used a similar approach for modeling the truck-mounted cranes I build here.

2. Military truck crane.

Commercial cranes obtained as military surplus were often heavily modified, and of course re-lettered and repainted. These saw service in many places for decades.

3. Herpa/Roco trucks M-923, M-54 and M-35A2 left to right used for this project.



4. Original Wiking wheeled crane used to make the truck crane.

5. Original Wiking crane with caterpillar treads.

Building a truck crane (Crane #18)

For the first crane, we'll start with a Roco model of an M-35, M-35A2, M-54, or an M-923 depending on the era you are modeling. The model crane cab and boom in the models come from a Wiking wheeled or tracked tread crane. Together, they make quite a presentable truck-mounted crane. The Wiking crane cab has the distinct advantage of being a hollow shell, which allows for added mechanisms inside.

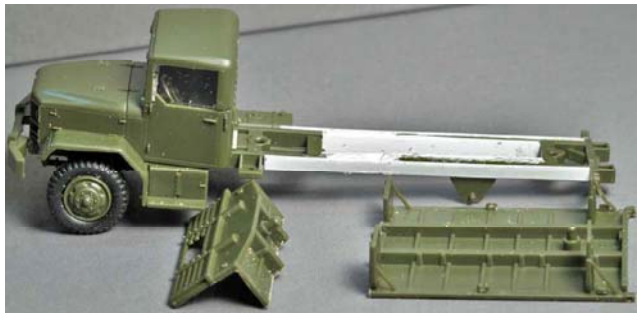
STEP 1: PREPARE THE TRUCK BED

First, disassemble the truck body and frame. Remove the chassis floor, then cut the floor so as to preserve the flaps around the rear wheel mount [6]. Next, use styrene strips 0.08" x 0.03" and glue to extend the chassis an additional length 0.45" [7]. I chose to attach the strips to the outer and

-

tinuous support. I have observed that over the many years these trucks were made, there seem to be small variations in the mounts, so check your dimensions and the mounting method for your particular model.

6. M-54 and M-35A2 trucks disassembled.

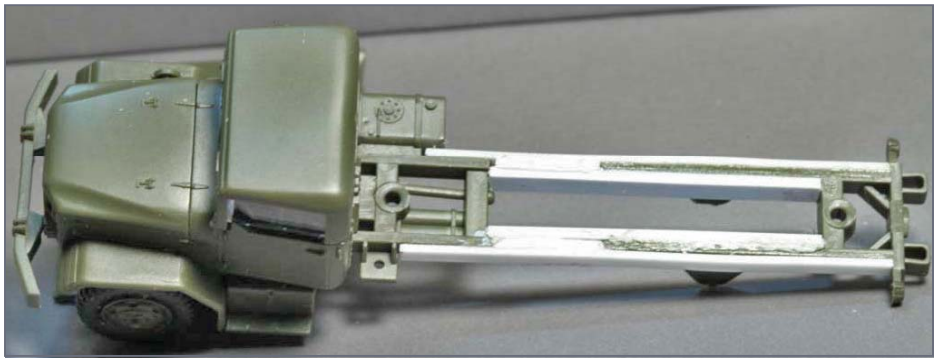


7. Starting to extend truck bed.

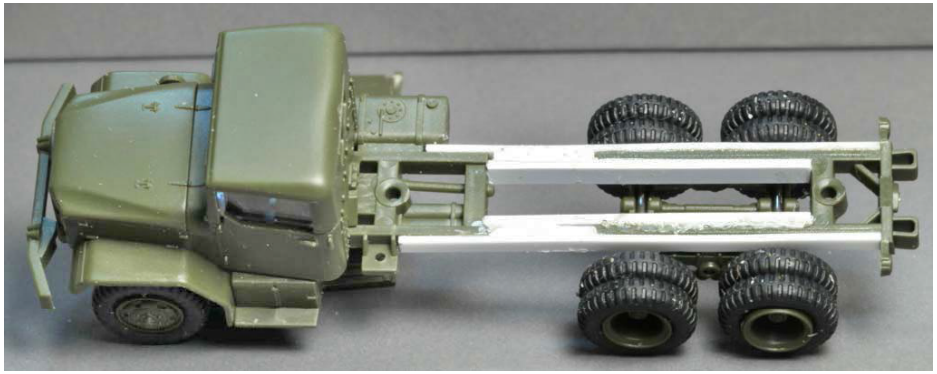
STEP 1: CONTINUED ...

Re-mount the flatbed parts and measure a small piece of 0.040" styrene (I used black styrene) and glue to the top of the bed in place, forming the basis of the new bed. After the glue dries,

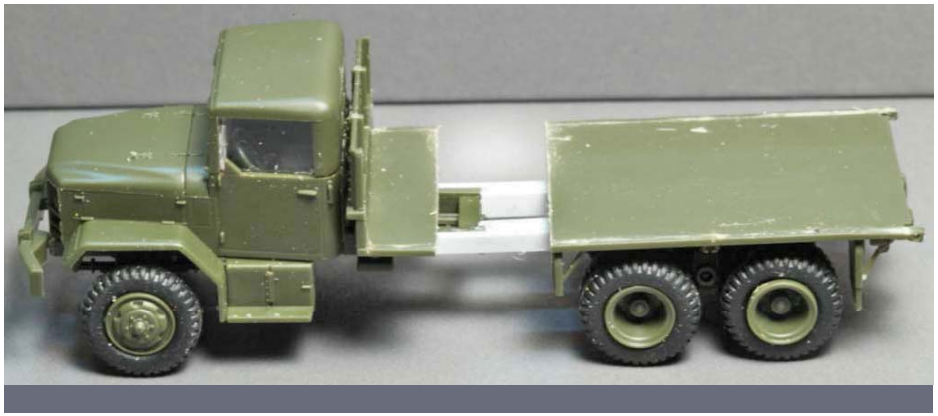
strips to make the width continuous when viewed from the bottom [7 – 10].



8. Truck frame extension.



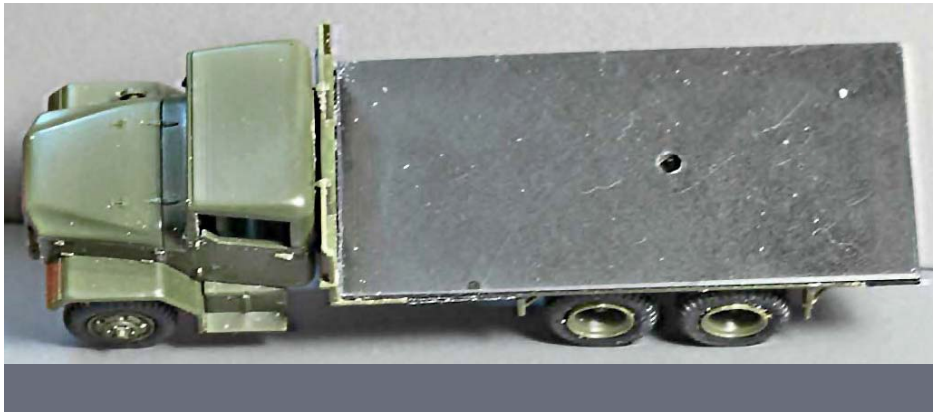
9. Truck frame extension with the wheels added.



10. The original flatbed separated.

Mount the new flatbed, and drill a #52 hole in the center of the

- vide the mounting point for the crane cab.

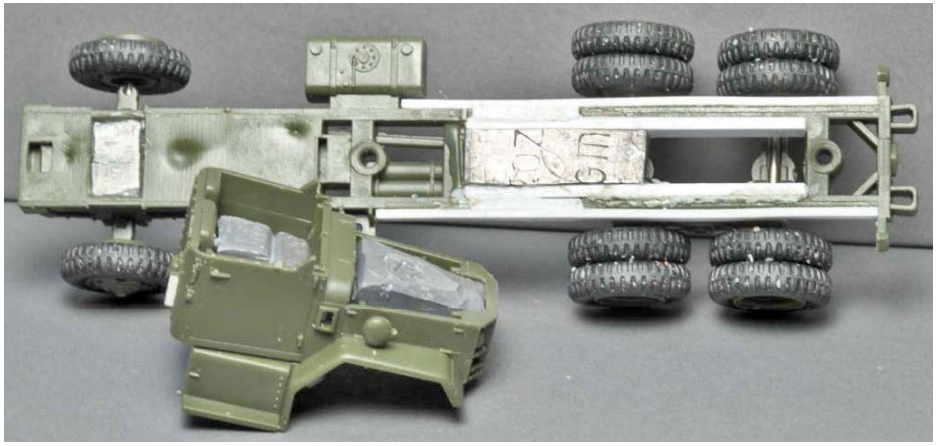


11. Flatbed extension with pivot hole drilled.

STEP 1: *CONTINUED...*

While focused on the chassis, disassemble the truck cab and fill in as many open, hidden spaces as possible with pieces of lead sheet, or lead shot, to weight the cab and chassis as far forward

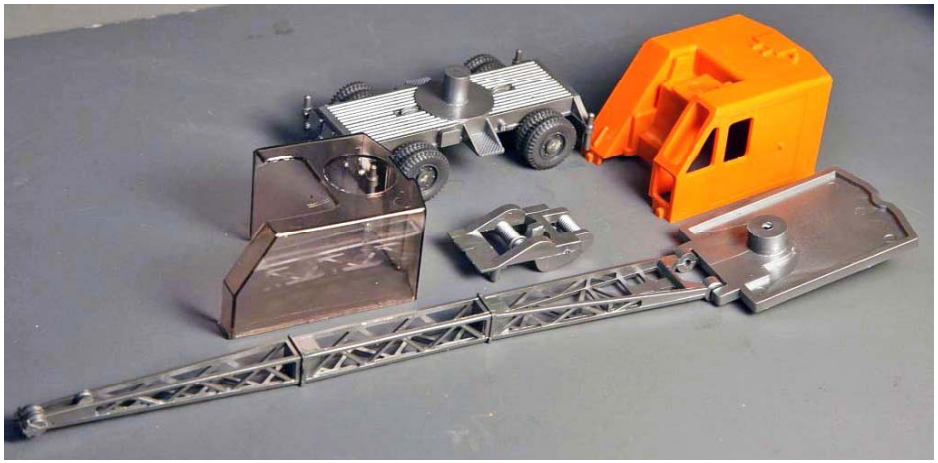
truck as you move the crane boom around. Finish the truck bed by cementing 1/16" Evergreen styrene channel around the edges of the bed. Miter the corners to give it a sturdy, professional look. Before gluing the channel edging, paint it with the trim color of your choice, leaving the back bare for gluing. I chose a yellow and black scheme for the company colors.



12. Weights added between the truck frame and in the cab body.

STEP 2: PREPARE THE CRANE CAB

Next disassemble the Wiking crane cab carefully from the base of the cab and remove the "glass" windows. Trim the window material to give more wiggle room inside the cab. Some models I have were glued in place and some were not. If you damage the window material, you can substitute clear styrene later. Preserve the cab and floor.



13. Wiking wheeled crane disassembled.

On the base of the cab, cut flat the internal hub, and widen the hole to 11/32". Next, fill in the floor with small pieces of 0.040" styrene. This creates a flat mounting surface for the cab motor and the spindle motor.

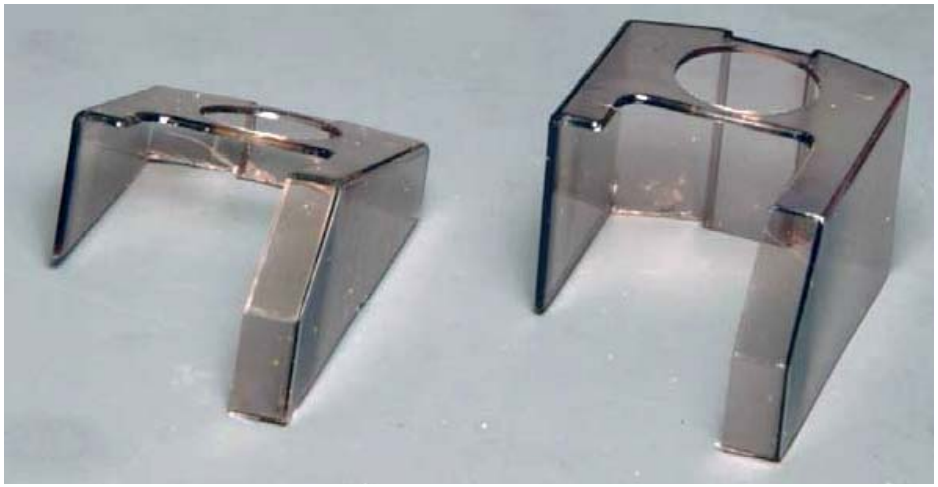
STEP 2:

CONTINUED...

Glue a small piece of 0.125" x 0.156" x 0.25" styrene to the inside of the cab where the motor would be, as a screw support to hold the cab to the floor. Drill and tap for a 0.25" 0-80 flathead screw from the floor bottom.

14. The original cab shell on the left and the modified cab shell on the right.

15. Hiding the front cut with the hoist drums.



16. Trimmed glass is on the left and the stock glass is on the right.

17. Parts for the cab-turntable drive and mounts.

STEP 3: MOUNT THE MOTOR DRIVES

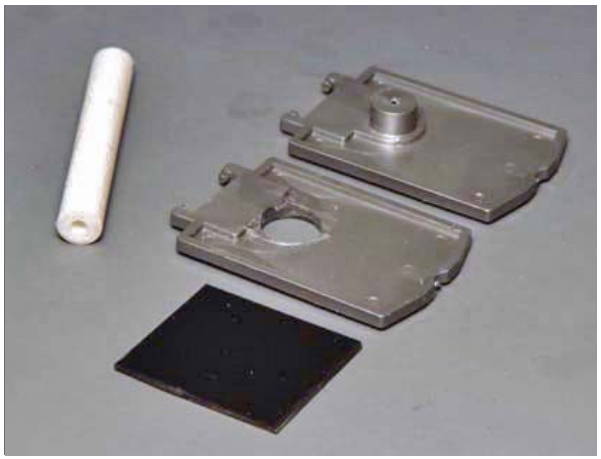
The 90-degree-drive geared motors are available from several vendors on eBay for less than $1.50. Search for "DC 3v 5V Worm Gear Motor" or try: eBay.com/itm/121230293476. The drives can be trimmed by cutting and filing the excess plastic from the cases. Small protrusions can also be filed off, but make sure that the corners remain intact, leaving two small mounting holes. Tap these two remaining mounting holes for a 0-80 thread.

I found the center drive hole, [24] to be perfect for threading with a 2-56 bottoming tap. In [24], you can see the cable hoist for the "boom cable" made from a 3/16" length of 3/16" tube sandwiched between two 5/16" disks cut from 0.010" sheet styrene, and held in place with a 2-56 screw.

After smoothing/flattening the final drive, make a bushing slightly smaller than its width. I made mine starting with 1/8" Evergreen #224 styrene tube, glued in a 3/16" Evergreen #226 styrene tube, glued in a 1/4" Evergreen #228 styrene tube, with a center clearance hole widened with a #43 drill [18]. Flatten the ends of the hub square.

18. Forming the drive hub from tube styrene.

Test the angle of the mount by screwing



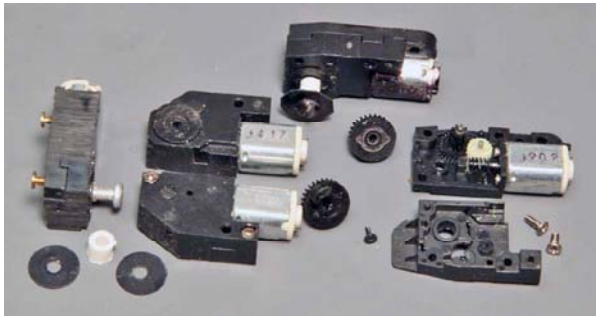
19. The new hub ready to be sized.

20. Gear motors.

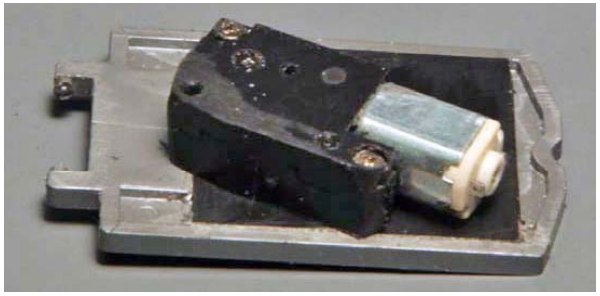
the drive housing to the flatbed with a 2-26 screw from the bottom of the bed, through the bushing you just made, into the tapped 2-56 hole in the motor drive. A plastic or nylon screw can be cut to exact length to make sure you have just the right length for a tight fit. Once leveled, glue the bushing to the motor drive with a tiny amount of ACC. Use the glue sparingly. Do not get any glue on the gear teeth or on the screw threads. This is only to make the assembly and disassembly screw will provide the strength for the connection.

STEP 3:

CONTINUED ...



21. Motor and drive parts.



22. Cab-turntable drive motor mounted.

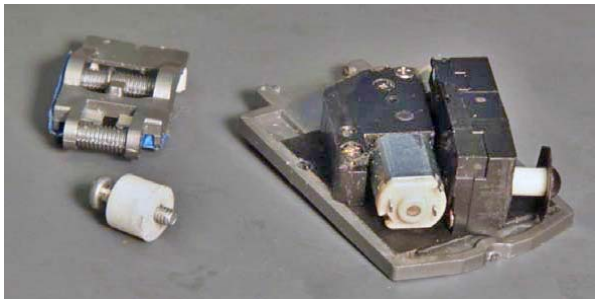
23. Cab turntable drive viewed from the bottom.

Position the bushing and level it, then attach the motor drive to the cab floor either with a 0-80 flathead screw from the bottom, or carefully glue it in place with a small amount of CA glue or epoxy. Next glue the hoist motor to a thin styrene strip and then screw the strip down to the floor next to the cab-drive. This was done for ease of future modification and maintenance.

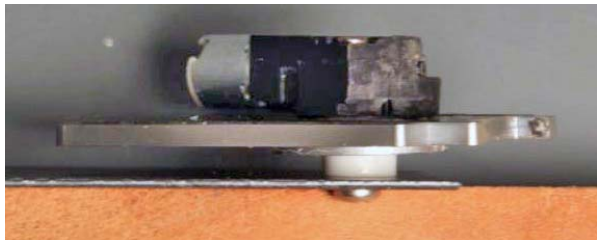
Next I attach very thin, VERY flexible wires to each motor. The ones used were in my stash, but you can get equivalent, 30 AWG, ultra-

STEP 3:

CONTINUED...



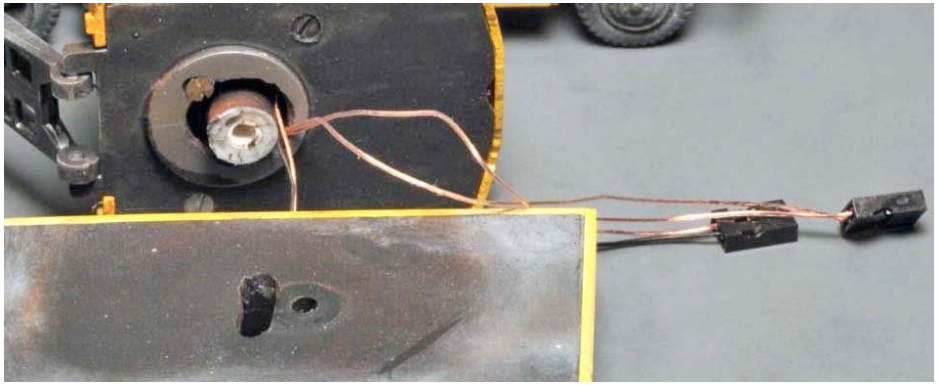
24. Cab turntable and cable drum motors.



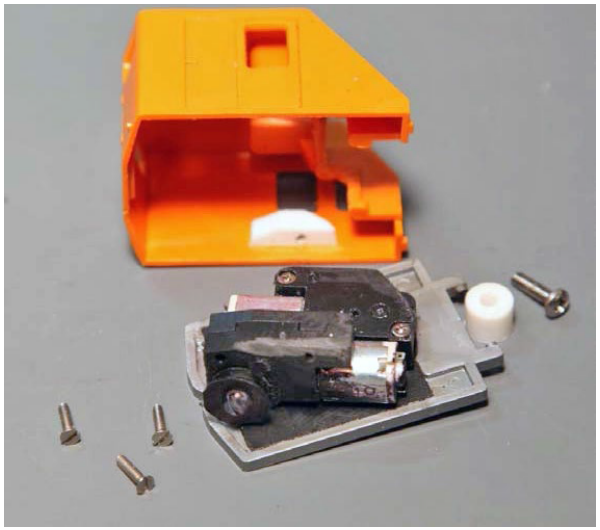
25. Crane cab turntable drive bushing test. I checked the hole to make sure it was centered and perpendicular to the drive.

Miniatronics Corp miniatronics.com. I use permanent markers to color the leads for later reference. You may find it easier to attach the wires before securing the motor drives.

It is my intent to face the crane toward the rear for operation. Once assembled, I attach the motors onto the cab floor. The hole on the bottom of the cab is enlarged toward the front of the truck. Clearance is needed for lots of movement with the wires. This allows or limits the maximum turn of the crane cab and easy clearance of the motor wires. The cab motor and the cable drum drive barely fit inside the cab, once angled properly. A small hole is drilled in the cab floor as close as possible to the drive hub for the motor wires. I route the wires down through the cab floor behind the cab-drive hub protruding below.



26. A shot of the crane cab bushing through crane bottom.



27. The motor drives have been mounted on cab floor.

STEP 3:

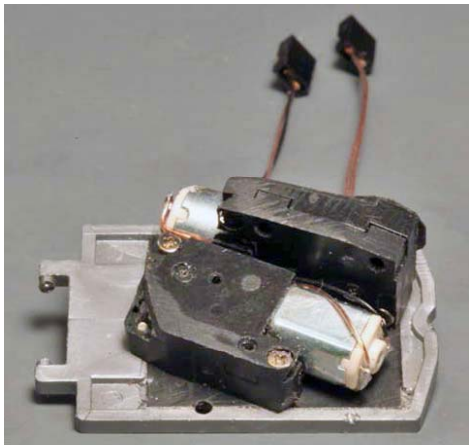
CONTINUED...

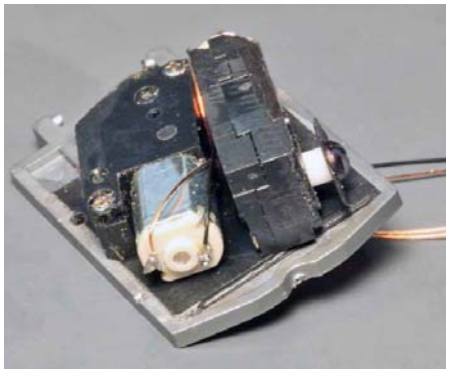
28. Cab turntable drive motor (left) and hoist motor (right).

This is a major construction simplification. It does limit the cab rotation, but still allows for an interesting animation.

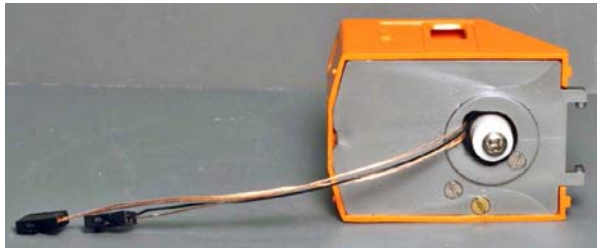
I attached some very thin synthetic black or brown thread to

can either be glued to the hoist or tightened between the hoist parts with the





29-30. Motor wire routing. Crane cab turntable drive bushing test. I checked the hole to make sure it was centered and perpendicular to the drive.



31. The motor leads from the cab pass through the body as near the center pin as possible.

32. Crane 18 with motor leads attached.

hoist screw. Wind the thread around the hoist drum, with about double the length to run the thread out to the end of the boom. I drilled a 1/32" clearance hole in the front of the cab to route the thread as high as reasonably possible for good appearance.

Then I attached the cab from the bottom of the flatbed with the 2-56 screw previously sized. Before attaching the boom to the cab base, I hide as many small bits of lead or metal weights as possible into the joints of the boom, before gluing it in place. This will place enough of a tug on the cable (thread) to keep it taut during operations – an important feature.

STEP 3:

CONTINUED...

33. Weights have been added to the boom to help stabilize it.

STEP 4: FINISHING THE CRANE

34. Crane 18 ready for operations. The cab rotates and the boom goes up and down.

To keep this crane simple, there are only two DC motors – one for cab rotation and one for boom movement. The hook is attached to the front of the boom, with a loop of thread for the hook cable, and then glued in place. The hook itself is the small hook (part number 17018) from an Athearn 250 ton Bucyrus crane. Each motor can be independently driven with 2-5 volts in any number of ways, including simple switches, pushbuttons, batteries, a wall power adapter, or even an old DC power pack.

I chose another simplification for this crane: not to provide a slip ring mechanism for the power to the motors. Experience with the Bucyrus 250 ton crane animation indicated that often no complete rotations were required. This saves much space and effort.

routed as close as possible to the hub for the cab drive, the cab rotates approximately 90 degrees (or more) to the left and right of center. I run the wires vertically below the truck,

STEP 4: CONTINUED ...

and lightly weighted the wires with a small piece of metal before they loop to connect to a controller – and it works!

The crane has markings for a fictitious company, Westside Machinery – WM – as crane number 18. Cranes sometimes get numbered for maintenance and inventory purposes. I secured a small welding hose and tanks to the front of the truck bed. The "Westside Machinery" tiger logo came from a Microscale #87-289 Structure Signs Decal Set.

STEP 5: BUILDING A SIMPLE MOTOR CONTROLLER

Since I designed crane #18 as a simple animation, I built an appropriately simple controller that connects to the crane motor lead wires. The next diagram [35] shows a two-AA-battery controller with an on/off switch (S3), two preset-table speed controls (R1 & R2), start-up booster capacitors to overcome friction (C1 & C2) and two small double-pole, double-throw center-off toggle switches (S1 & S2) to control each motor.

The motors run with very little power. The capacitors can be

capacitors are used to give the motor a jolt to kick-start them.

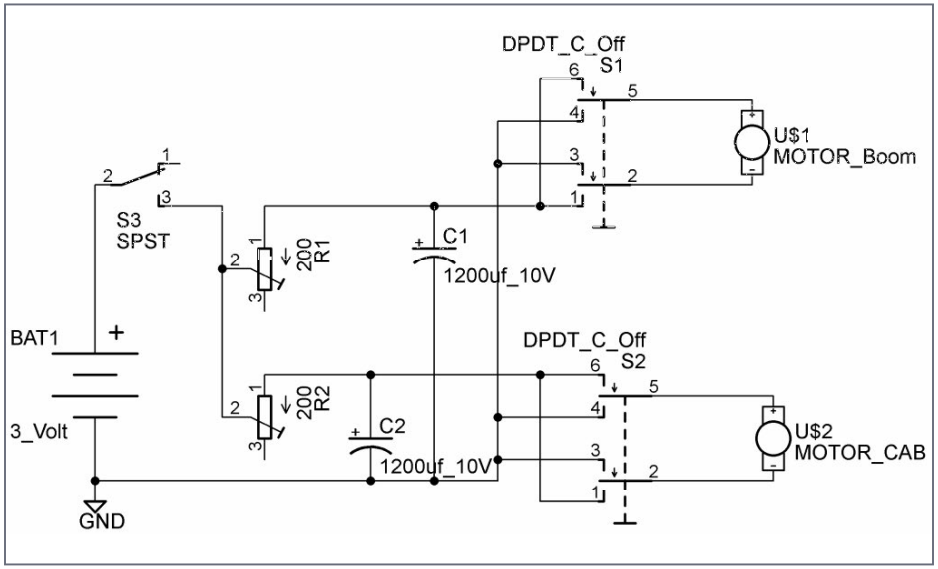
Here are some representative components for the project:

- 2 - Bourns Inc. 3296W-1-201LF 200 Ohm Trimmer Potentiometer, Digikey.com
- 2 - 910µfU 8V Capacitor Rubycon 8AX910M10X9, Digikey.com
- 2- DPDT CENTER-OFF MOMENTARY MINI-TOGGLE, AllElectronics.com
- or 2- DPDT ON-OFF-ON MINI TOGGLE, AllElectronics.com
- 1- SPDT MINI-TOGGLE SWITCH, AllElectronics.com
- 1- BATTERY HOLDER 2 AA CELLS, AllElectronics.com

STEP 5:

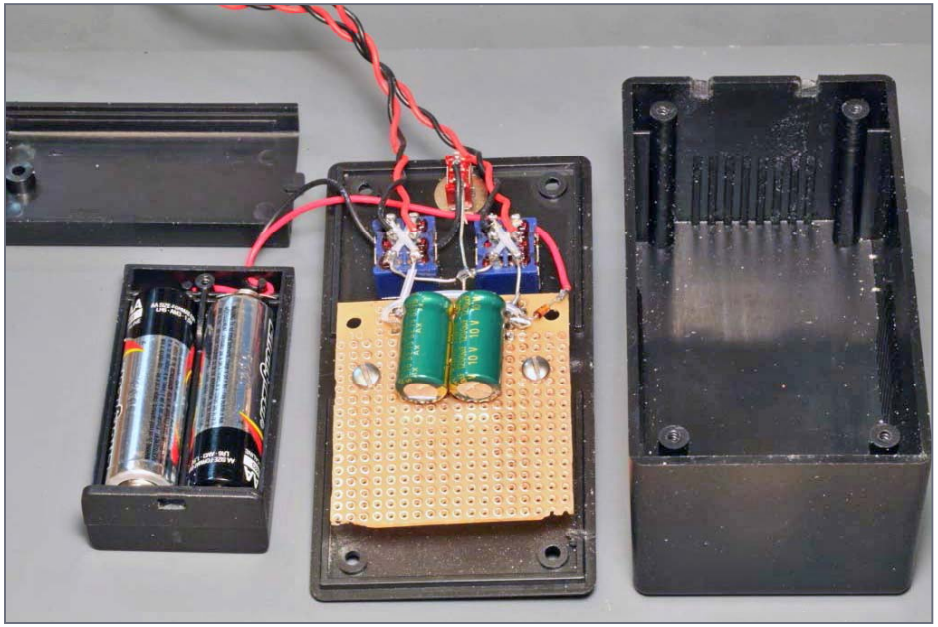
CONTINUED ...

- 1- ABS PROJECT BOX, 3.97" X 2.12" X 1.72", AllElectronics.com



35. DC controller battery-powered schematic.

36. DC battery-powered controller.



37. DC battery-powered controller open.

Once built, the two trimmer resistors can be adjusted to give a slow traveling speed for the cab and boom. Turn the power on with S3. Leave S1 and S2 at the center (OFF) positions ordinarily. Then switch S1 or S2 on to animate your crane in the direction you would like.

Building a DCC-controlled truck crane (Crane #19)

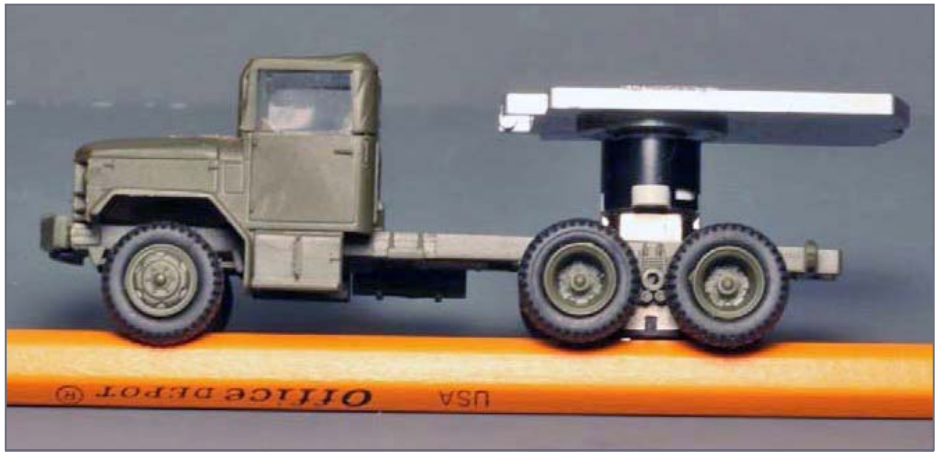
The next crane, #19, has cab rotation, boom movement, and independent hook movement all controlled with DCC. I am again making a truck-mounted crane, but it requires two motors in the cab to control the hook and boom motion, representing another approach for animation.

A third motor sits between the rear truck wheels to turn the cab. So this time, I am using three different motors with a planetary gear drive. Again, I found these on eBay from several vendors for less than $2.00 each. Search for "Small Planetary Gear Motor" or try: ebay.com/itm/181494571304.

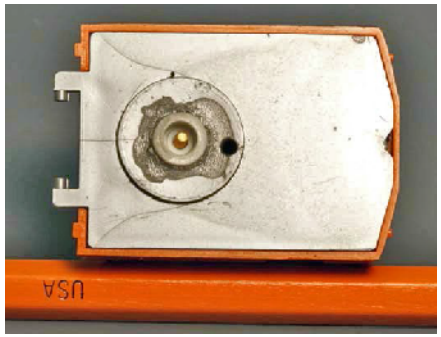
38. The planetary-gear drive motors for crane 19. The quarter gives you a good idea of how small these motors are.

Click here for reader comments

STEP 1: PREPARE THE CRANE CAB



39. Crane 19 with the turntable motor mounted between the axles.



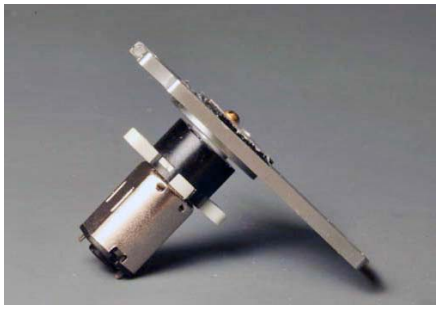
40. Crane 19 hub glued to the cab floor.

As with the previous crane, I fabricated the cab-drive hub with telescoping tubing, but drilled it with a 5/64" or #48 bit to a depth of about 0.08" at one end to fit over the shaft of the motor.

I flattened the cab floor and filled around the hole with 0.040" x 0.38" styrene strips level the floor. I then drilled and fitted the ¼" hub and glued it in place. Finally, I fitted the telescoping tubing into the

STEP 2: MOUNT THE HUB MOTOR

41. Hub cut and screwed to the motor shaft.

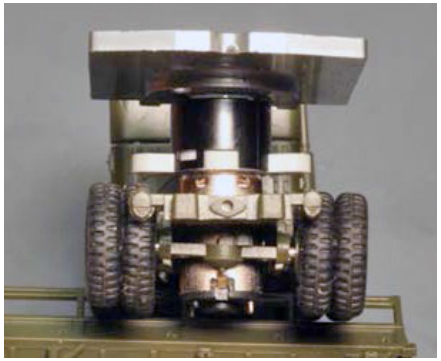


42. Hub spacing to cab floor.

I positioned the motor under the floor and set the hub spacing as close as possible to the floor while maintaining clearance as in [41]. I made sure to keep the tube perpendicular to the floor and glued it in place with a solvent glue for plastic.

After the glue dried, I cut the tube above the floor, even with the floor as shown in [42]. You need a 0-80 screw long enough to attach the hub to the cab-drive below. I cut the screw to fit, by measuring for length, then screwing on a 0-80 nut just below the length I needed. After shortening the screw, unscrew the nut and it will clear the screw threads.

Some motors have mounting ears on them, which can help with the cab motor mounting, but in this case they need to be cut off. I mounted two ear-less motors vertically, stacking one on top of the other. They are glued with ACC to a piece of 0.25" styrene channel with a side plate, and trimmed to fit



43. Turntable motor viewed from the end of the truck.

floor, after fitting each with two small disks to make up the cable drums.

The disk nearest to the motor is cut like a doughnut and glued to the drive, without gluing the whole gearbox shut! The outer disk is attached with a 0-80 screw into a shallow tapped hole in the end of the tiny protrusion after drilling the hole so it doesn't interfere with operations.

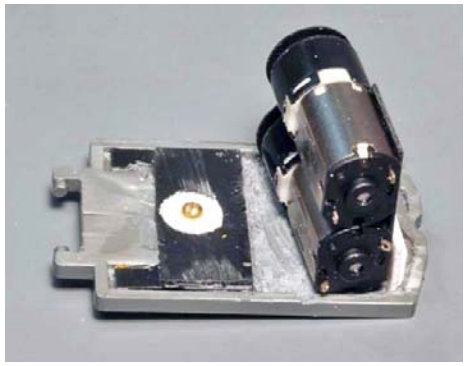
STEP 3: In-cab motors, lights, and decoder

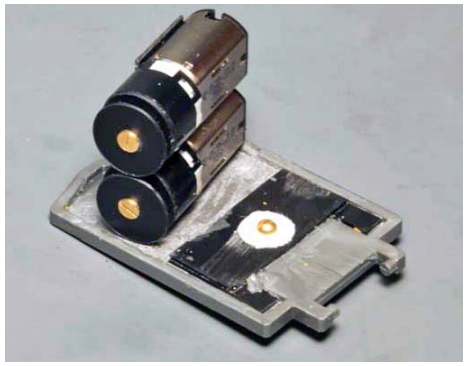
44. Hoist parts.

I equipped this crane with work lights front and rear. The LEDs could be wired in parallel, or they could use another decoder with more functions to control them independently. To control all this requires at least 6 wires into the cab. I elected not to do this.

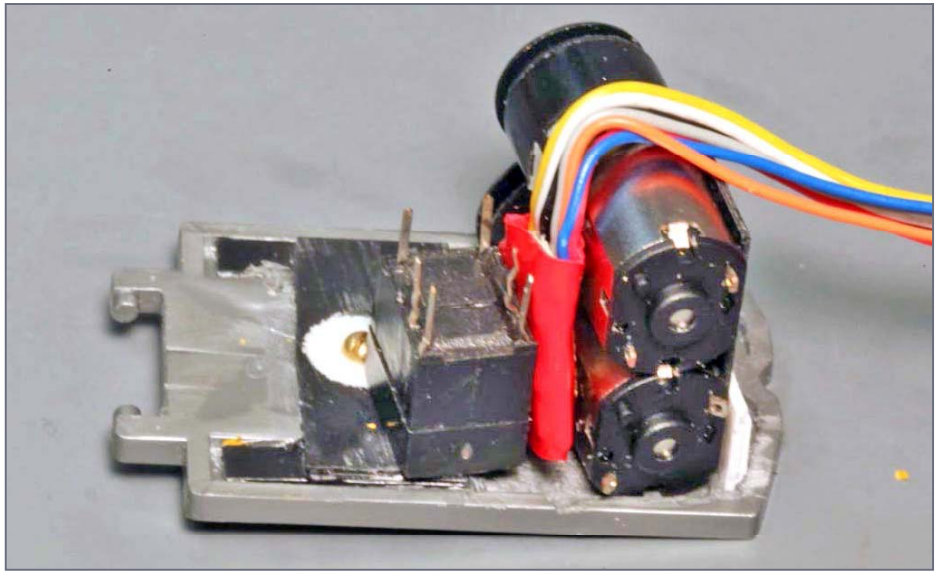
Instead, I used a DCC decoder (a Digitrax DZ123 or DZ126) with a tiny 12-volt single-pole single-throw relay to select which motor the decoder drives. This relay can be obtained from Allelectronics.com (RLY-616). Thus, I only needed two wires to run up into the cab!

Function 2 (F2) switches between the hook and the boom





45-46. Stacked hoist drives on the cab floor.



47. An SPDT relay and DZ126 decoder are installed on the cab floor next to the stacked drum drives.

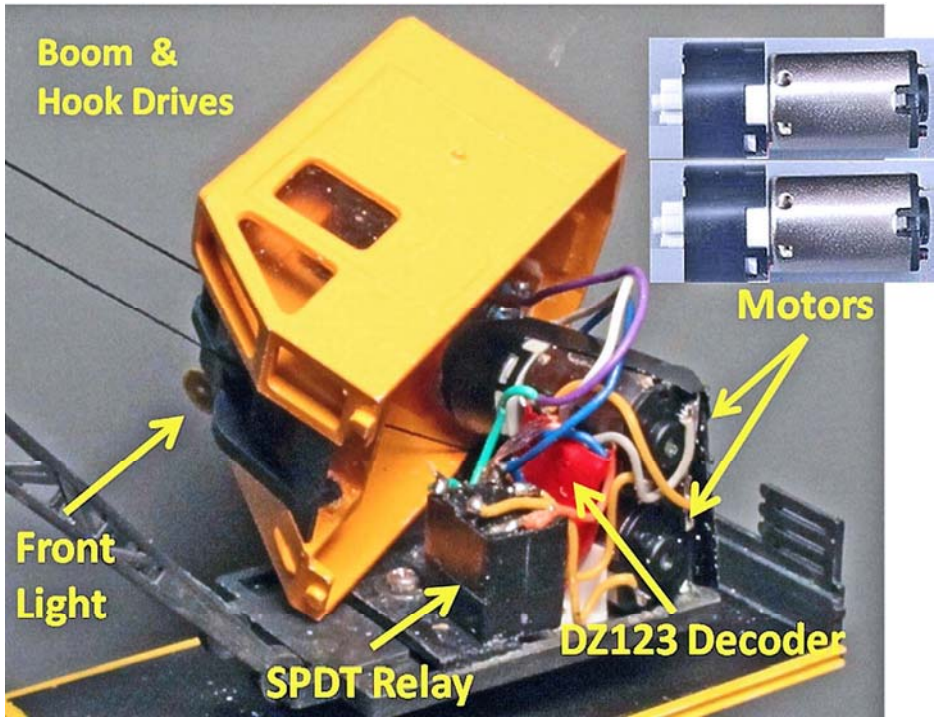
drive. You can remap the yellow function wire to F1, F2, or F3 as you like.

A second DZ123 controls the cab rotation using a second separately addressed decoder. Juggling the two addresses is not a problem for me, since I intend to have these controlled by a program and not via a hand throttle.

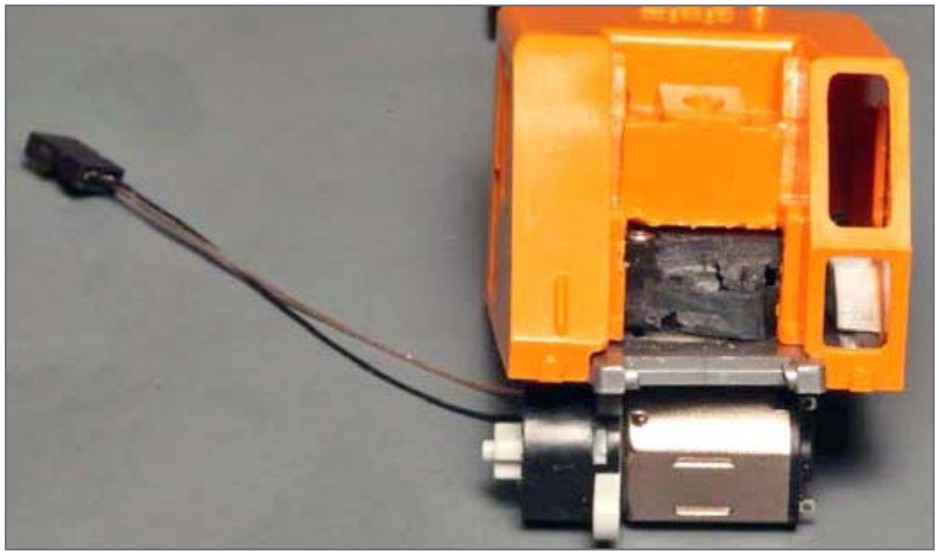
However, throttles like the Digitrax DT402 do allow independent control of two decoders simultaneously. Position the stacked drum motors, the decoder, and the relay as pictured

STEP 3:

CONTINUED...



48. Stacked boom and hook hoist motors with the DZ123 decoder and drive relay.



49. Wire lead extended for the DCC decoder.

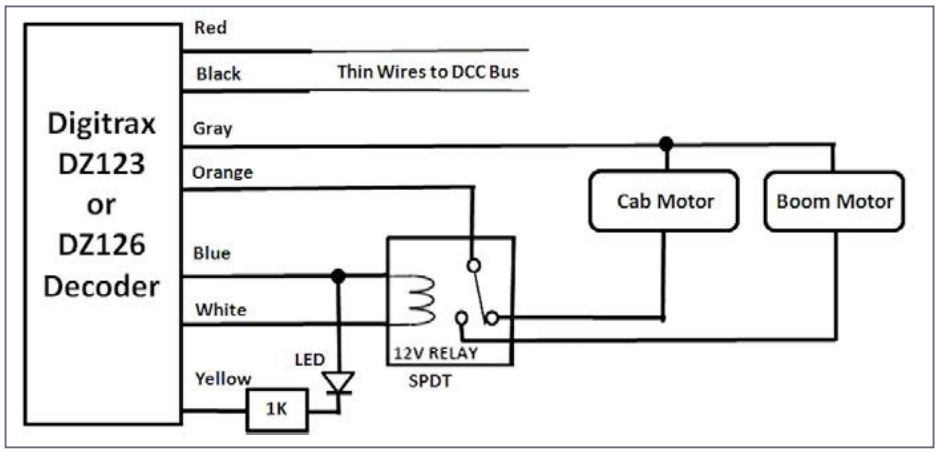
STEP 4: FINISH THE CRANE

50. Cab rotation drive that fits between the wheels.

Once the relay, motors, and decoder were wired, I painted and decorated the cab. I added glass and lights at this time. Once the cab was ready I screwed the cab motor drive to the cab hub bottom.

Next I prepared the truck chassis the same way as with the previous truck-mounted crane, except I located and drilled

hole should be centered between the rear truck wheels. I inserted the motor through the truck bed hole, and screwed the cab onto the motor



51. Cab decoder wiring diagram.

The red and black leads from the decoder should be attached or replaced by the same very fine flexible wire used before, and routed down alongside the drive hub. If the crane will operate toward the rear of the truck, place the holes for the wire toward the front of the truck. I made the holes large enough to allow maximum movement and minimize visibility. A keen observer will note that the hook on this crane has added weights on its sides. This is to add tension on the hook's cable/thread to enable smooth movement, since independent operation of the hook is possible.

I attached a second decoder to control the cab rotation. I programmed the decoders to have two sequential addresses and test the DCC control of the motors and lights. You should dramatically limit the upper speed/voltage settings of both motors as you like. Remember these are actually 6 volt motors.

STEP 4:

CONTINUED...

52. Finished truck crane 19.

WORKING CRANES | 37

52. Finished truck crane 19.

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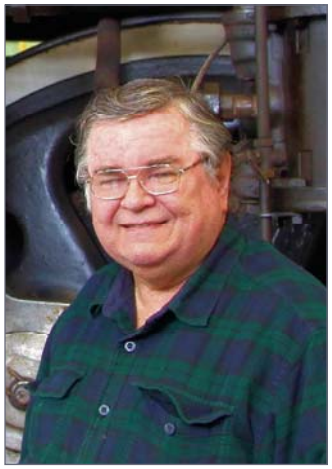
When talking to hobby vendors, please remember to mention MRH.

Dr. Geoff Bunza



Geoff Bunza started as a Model Railroader when he received a Mantua train set for Christmas, at age 6. Interest in the New York Central was cemented when riding on a NYC fan trip to Harmon on November, 1966 behind S-Motor 110. He fed his interests through college becoming a member of the Tech Model Railroad Club (TMRC) at MIT while getting his doctorate and three other degrees in Electrical Engineering.

He models the New York Central Railroad, the Great Northern Railway, and Maine narrow gauge in HOn30. Scale model animation in HO is one of his great interests.

Geoff has authored numerous articles on animation for *Model Railroad Hobbyist*, the *New York Central System Historical Society Modeler Magazine*, and *Railroad Model Craftsman.* He has presented clinics for the NMRA at Division, Regional and National meets, and the National Narrow Gauge Conventions.

He is blessed with his wife, Lin, in marriage for 36 years and their two terrific sons. He is a life member of the NMRA and holds an Extra Class amateur radio license. ■