East Penn Traction Club

HO SCALE TROLLEY MODIFICATIONS FOR IMPROVED PERFORMANCE

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10/22/2015

Why Modify?

- Many HO scale Ready-to-Run (RTR) models (particularly older brass imports) will not provide satisfactory performance for the serious trolley modeler.
  - Trolleys are not wired for overhead operation
    - If wired, not wired for pole reverse
  - Trolley poles do not pivot freely and have poor overhead contact and tracking
  - Trolley car will not negotiate prototype streetcar curves (6” radius)
  - Trolley has poor slow speed operation
    - Open frame motors
    - 4 wheel (alternate truck) pickup

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Example Trolley

- Typical Brass Import
  - Suydam Niles Freight Motor
    - 1960's vintage
    - Oregon Electric Prototype

Modifications To Be Performed

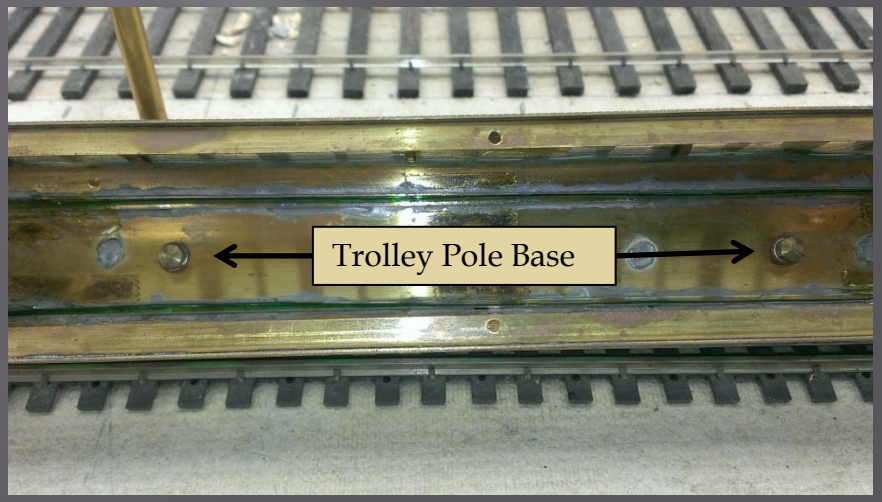
- Replace trolley pole bases with insulated bushing and brass pivot base
- Replace trolley poles with "pin base" trolley poles
- Wire trolley for pole reverse using 3 pin connectors for easy car disassembly.
- Modify power truck to increase angle of rotation and decrease minimum radius
- Add wipers to insulated wheels for 8 wheel pickup
- Replace open frame motor with can motor and flywheel assembly
- Add diodes to reduce the speed of this faster trolley into the "fleet speed" range

What we are NOT doing

- These modifications are for DC operation.
- Nothing in this clinic precludes installing a DCC decoder
  - Pole Reverse capability is lost with DCC
  - Diode installation not necessary with DCC
- The nuances of rewiring cars for DCC operation is covered in other clinics.
  - East Penn Clinic "DCC Clinic" by Dave Gairo
  - Trolleyville Schoolhouse Clinic "Digital Command Control and Overhead Trolley Wire Operation" by George Huckaby and John McWhirter

Pole Modifications

- Trolley Pole Bases
  - The trolley poles on many RTR trolleys come with a threaded base and are attached to the trolley through an insulated bushing (if the body is metal) and a solder lug for electrical connection and a nut.
    - Electrical connection to the pole is made by soldering a wire to the solder lug.
    - The mass and stiffness of this wire, no matter how small a gauge, can restrict the free swing of the pole and cause dewirements.
    - If the pole needs to be replaced or serviced, the car must be disassembled to undo the hardware to remove the pole.



Pole Modifications

- Trolley Pole Bases
  - Replace existing pole base structure with brass pivot capable of accepting "pin" based trolley poles
    - Insulated bushing and brass pivot
  - Expand trolley base hole to #27 Hole
  - Super glue insulated bushing into hole
    - Insure bushing is flush and level
  - Super glue brass pivot into bushing
    - Insure fully seated and perpendicular to roofline
    - Do not get super glue inside pivot
  - Solder electrical leads to outside of brass pivot

All new Bowser trolleys come with Brass pivot and pin based poles

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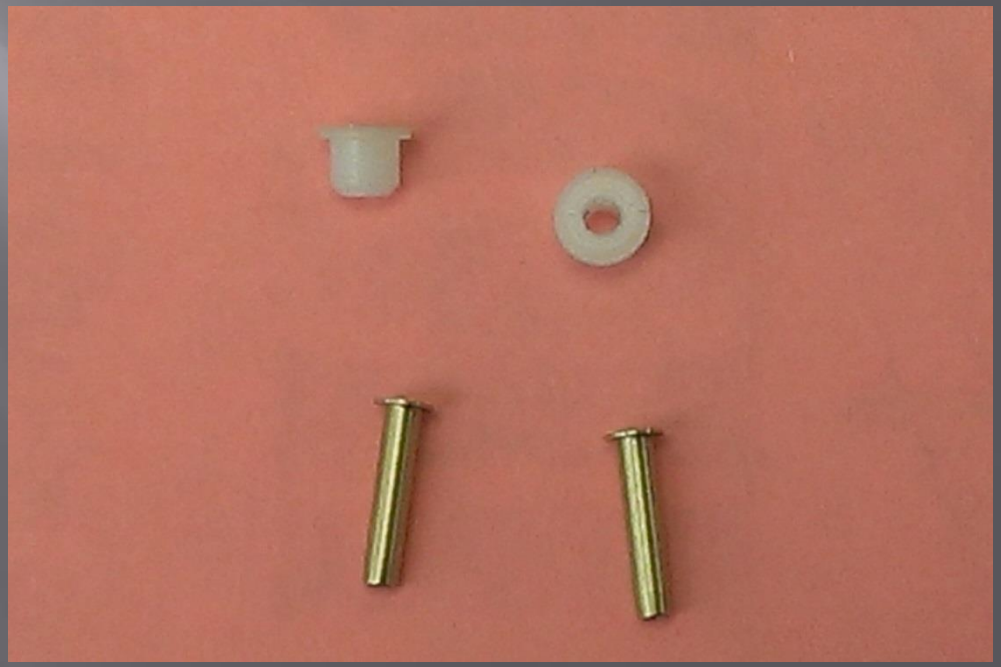
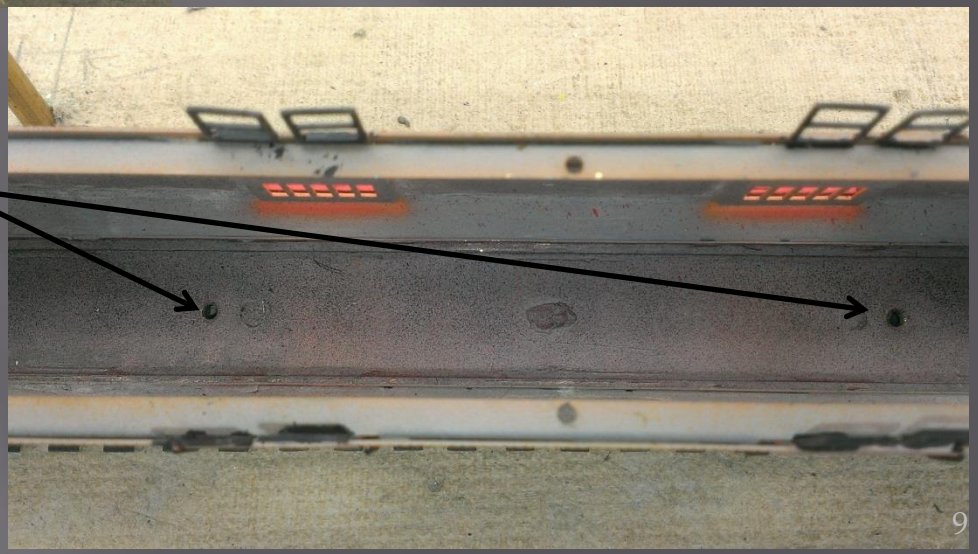
New Trolley Base Materials

- Materials
  - Available from Custom Traxx
    - Insulated Bushing
      - Part # SCTC-2
    - Brass Pivot
      - Part #SCTC-1 or
      - Bowser Part #12508



Original Trolley Poles Removed

Original Trolley Base Holes approx #46 or 0.081”



Trolley Base Holes Expanded

Open trolley base holes by going up 2 drill sizes at a time (i.e. #44, #42, #40..) to avoid damaging roofwalk.

Resized Holes #27 or 0.144”

Installing Insulated Bushings and Pivots

Insulated bushings glued in place.

Slide pivot partway into bushing, apply superglue, and push in all the way.

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Bushings and Pivots Installed

Pole Modifications

- Trolley Pole Shoes/Wheels
  - The trolley poles on many RTR trolleys come with a shoe or wheel that is un-prototypical in shape and size and provides poor performance
    - "Taco" shoe – a piece of metal wrapped around the pole and soldered
    - The solder connecting the shoe to the pole often comes in contact with the overhead making the overhead dirty and wearing the shoe/pole joint.

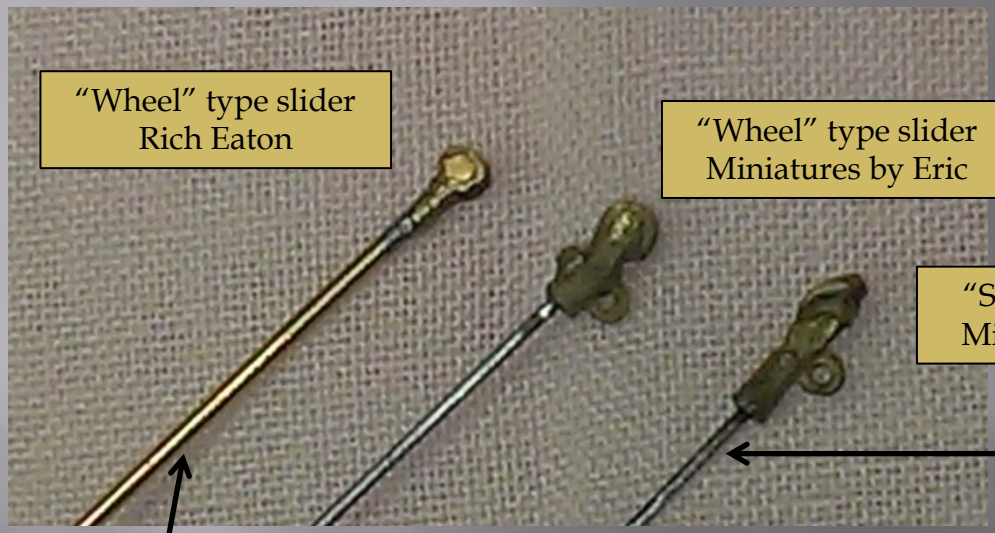
Pole Modifications

- Trolley Pole Springs
  - When using functioning overhead wire, the most unreliable connection in the propulsion circuit is between the trolley pole and the overhead.
    - Single point contact vs 8 wheel (hopefully) rail pickup
    - Strong upward pressure from the trolley pole is necessary to maintain reliable contact with the overhead
    - Many RTR trolley poles have moderate (at best) upward pressure and can easily lose springs further decreasing the upward pressure

Pole Modifications

- Trolley Pole Replacement
  - Replace existing trolley poles with "Miniatures by Eric" trolley poles
    - Very strong upward pressure
    - Does not lose springs
    - Poles feature simulated slider shoe or wheel castings
      - Solid casting
      - No solder contact with overhead
      - Longer wear.
    - Pin base
      - Freely rotates, tracks better, fewer dewirements
      - Easy removal for cleaning, adjusting
  - Rich Eaton also makes very fine poles with good upward pressure.
    - Better (smaller) wheel casting than Miniatures by Eric.
  - Pin New Bowser PCC (Form 11) pole is made from "Miniatures by Eric" design

After Market Pole Characterisitcs



"Wheel" type slider
Rich Eaton

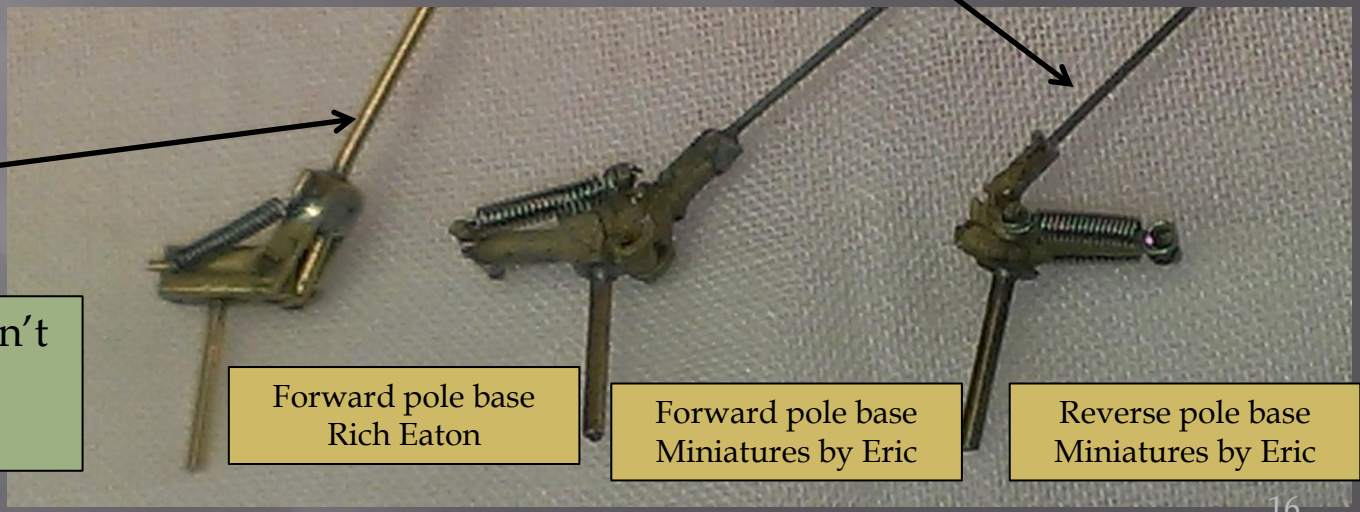
"Wheel" type slider
Miniatures by Eric

Cast sliders
No solder contact to overhead

"Shoe" type slider
Miniatures by Eric

Piano wire pole
Miniatures by Eric

Brass pole
Rich Eaton



Strong springs that don't fall off insure good overhead contact

Forward pole base
Rich Eaton

Forward pole base
Miniatures by Eric

Reverse pole base
Miniatures by Eric

Wiring Modifications

- Trolley Pole Reverse
  - The most obvious method to wire trolleys for overhead operation is to remove the positive wire from one of the trucks and attach it to both pole bases (if a double ended car)
    - Some cars come from the factory wired this way
  - To reverse the car the polarity of the wire and rail must be reversed
    - This is not feasible in a system where multiple cars are being run simultaneously from a single power source.

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Wiring Modifications

- Trolley Pole Reverse
  - For proper operation attach the positive lead from the motor to the "up" pole base for forward travel
  - Attach the negative motor lead to the "down" pole base
  - Attach a wire from the metal body to the metal frame or from both hold down hooks to the metal frame
  - Attach a wire from the metal frame to all pickup wheels.

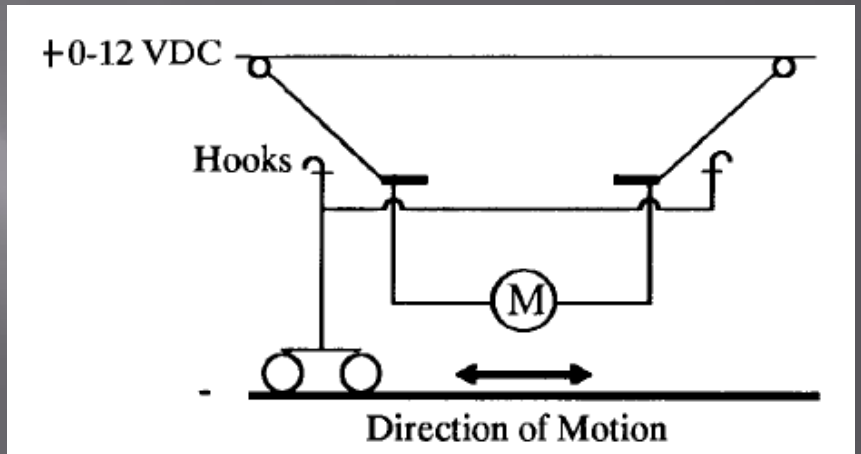


Figure 2 - Basic Pole Reverse Wiring

From East Penn clinic
"Model Trolley Car Wiring"
By Richard Kerr

Wiring Modifications

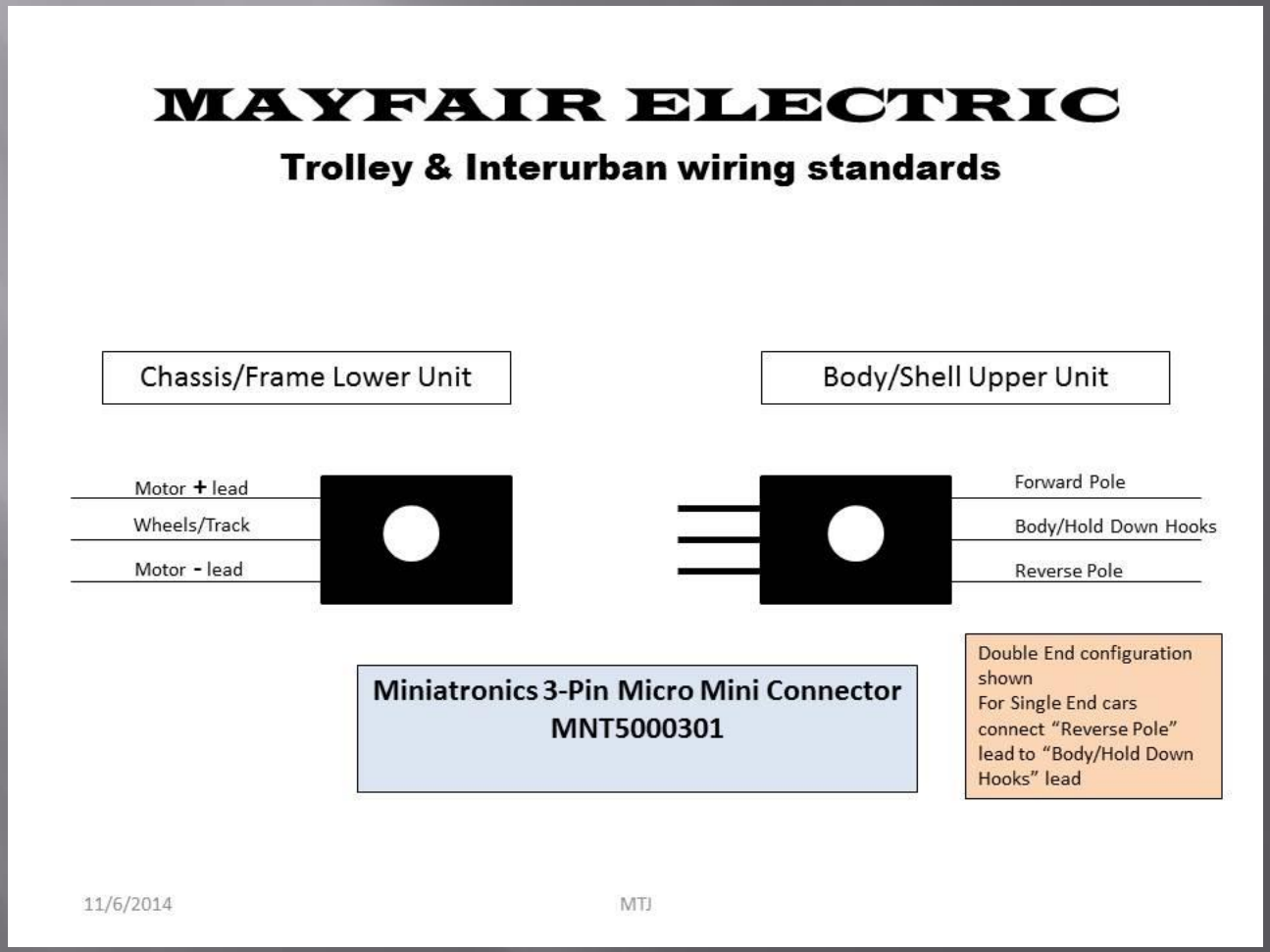
- Car Disassembly
  - If the leads from the trolley pole bases and body are hard wired to the frame and motor, it can be difficult to work on either portion of the trolley when disassembled.

Wiring Modifications

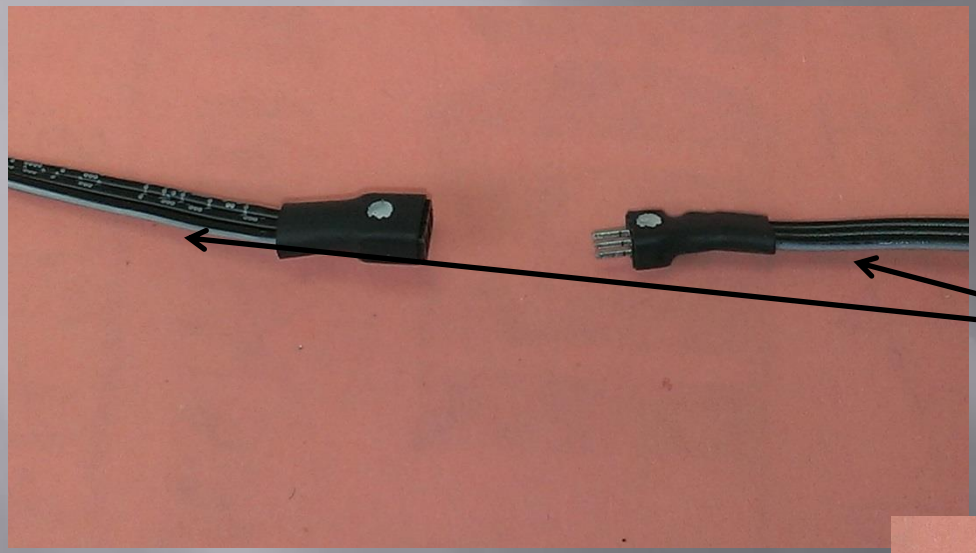
- Car Disassembly
  - Install Miniatronics micro-mini 3 pin connector
    - Standardized wiring
      - Allows interchange of bodies and frames if you have many cars of the same type/model.
      - Allows testing of power train without body using test tether.
    - Small design only slightly larger than wire itself.

Wiring Modifications

- Standard Wiring Diagram using 3 pin connector.

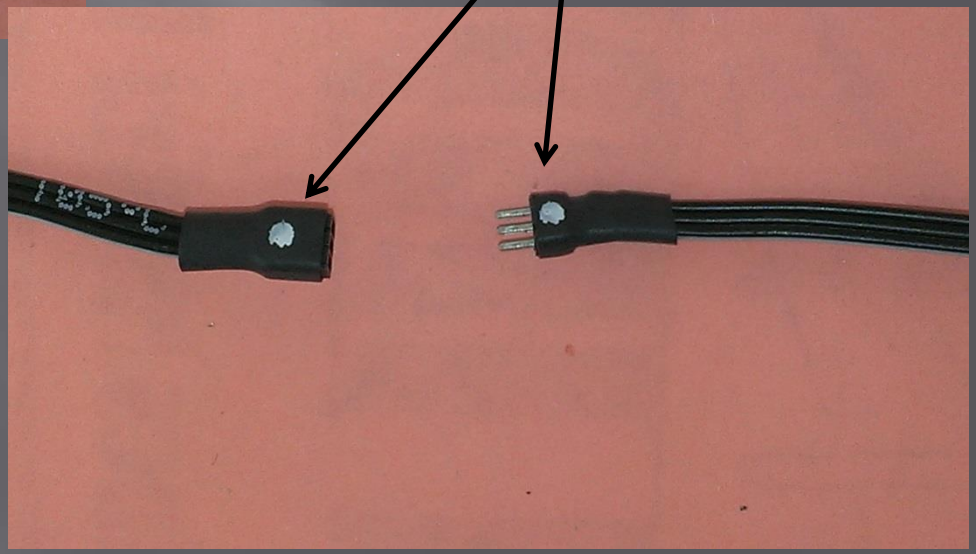


Miniatronics 3-pin Connector



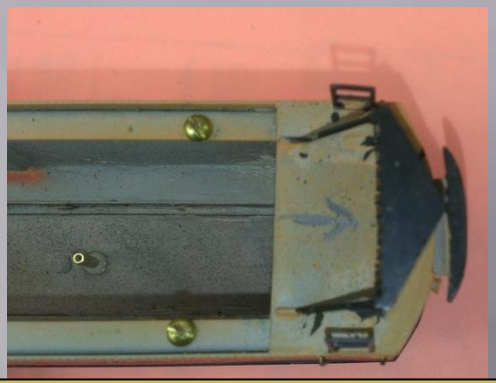
Male and Female connectors are NOT “keyed”

White dot and white stripe aid in pin/plug registration



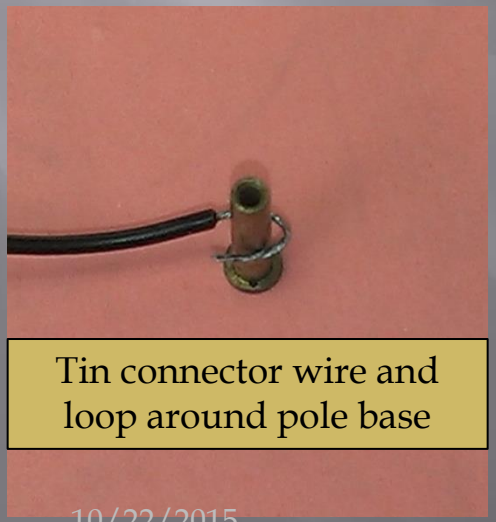
Worse case, if pugged in backward, trolley runs in reverse

Installing Connector Wires to Body

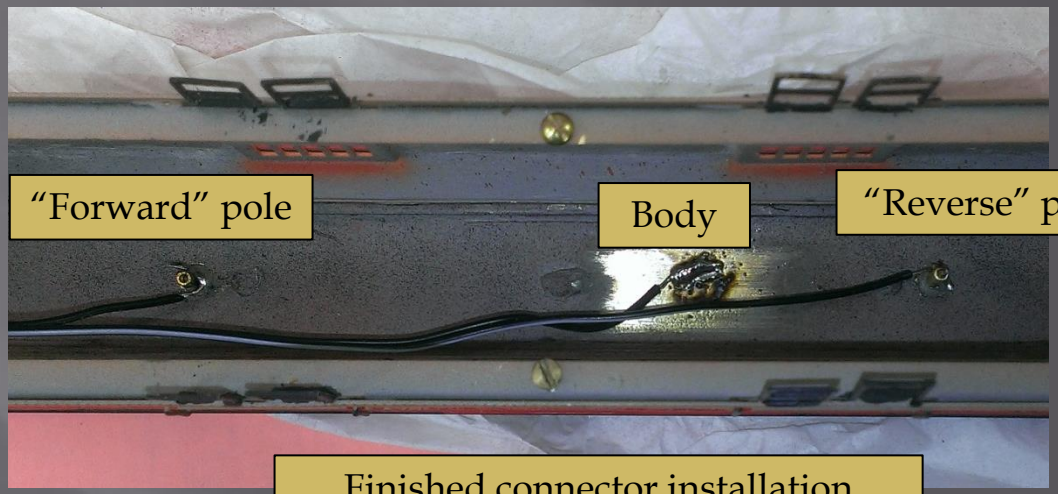


On double end cars, designate and mark one end as the front (forward)

If car is metal and painted or oxidized burnish an area on the underside of the roof to solder the body/frame wire



Tin connector wire and loop around pole base



Finished connector installation

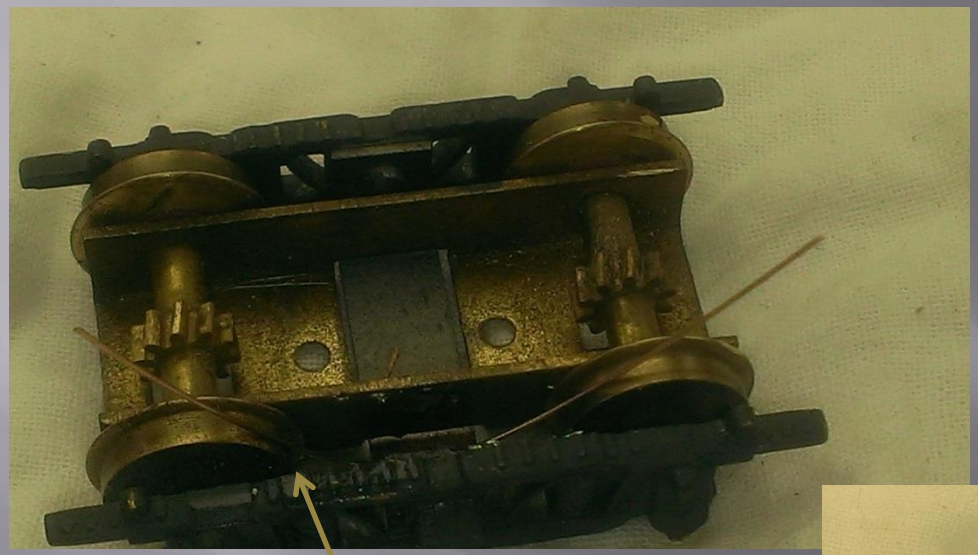
Wiring/Mechanical Modifications

- Rail Pickup
  - Many RTR trolleys (2 truck) come with 4 wheel pickup and wired for two rail operation.
    - Usually one truck picks up from one rail and the other truck from the other rail.
    - One wheel on each axle is insulated from the rest of the axle.
    - Additional wheel pickups can improve operation in dirty rail situations and improve the detection of the trolley in automatic train control systems.

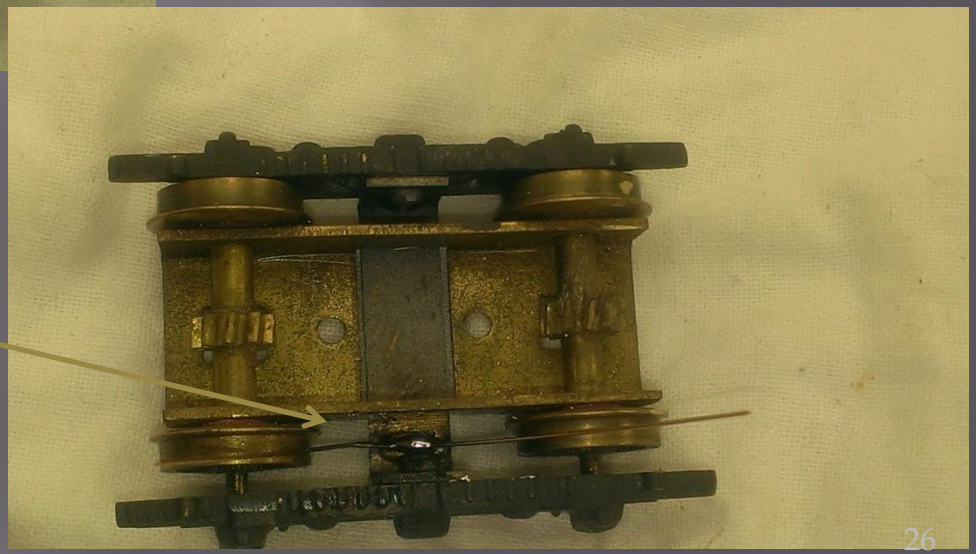
Wiring/Mechanical Modifications

- 8 Wheel Rail Pickup
  - Install wire wheel wipers on each truck.
    - 26 Gauge phosphor bronze overhead wire
    - Bend wire into “V” shape
    - Solder wire to truck frame so wire gently wipes the insulated wheel
      - Back of wheel for trailing truck
      - Wheel tread for power truck
    - Verify free wheel rotation

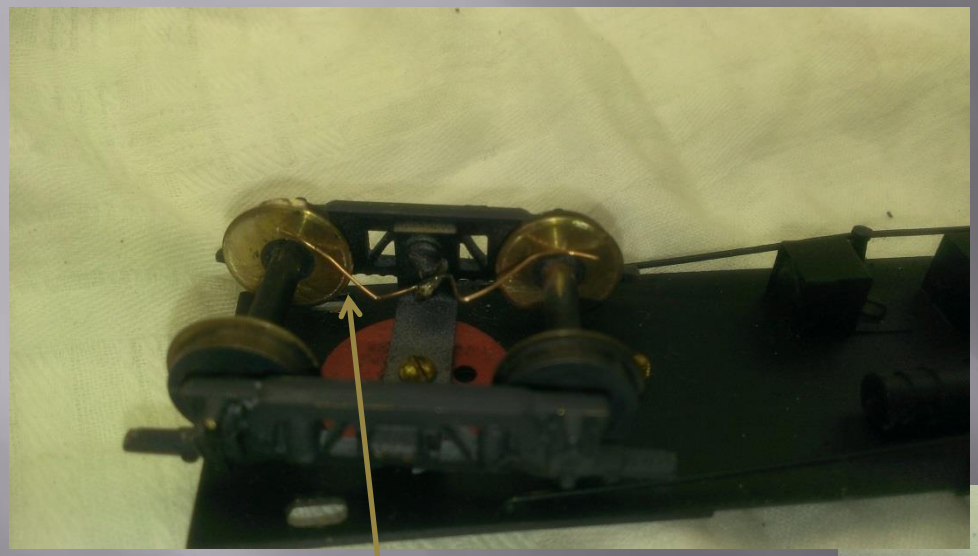
8 Wheel Rail Pickup

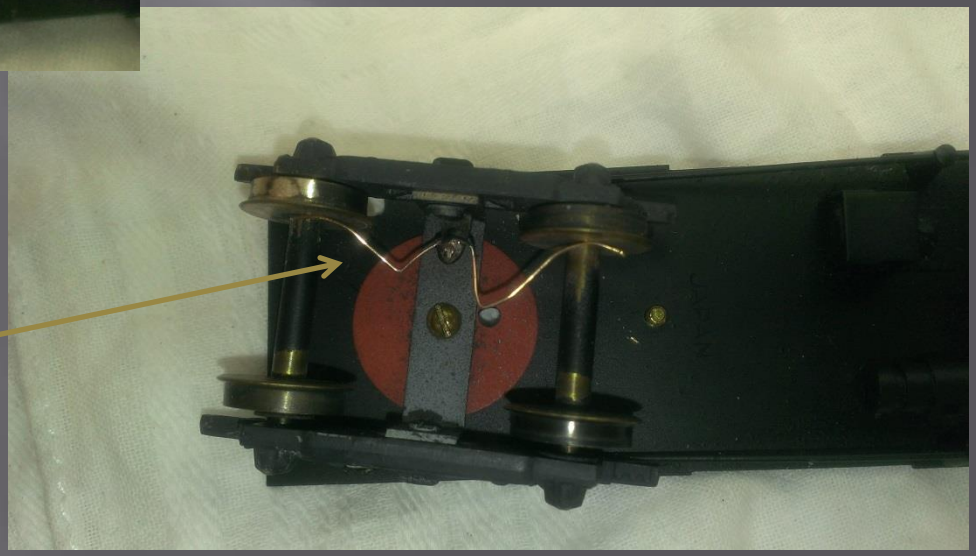


Phosphor Bronze wire soldered to frame of power truck wiping the tread of the insulated wheels



8 Wheel Rail Pickup





Phosphor Bronze wire soldered to frame of trailing truck wiping the back of the insulated wheels

Mechanical Modifications

- Turning Radius
  - The turning radius of many RTR is sufficient to negotiate a 9″ radius curve (65′ prototype radius).
  - The minimum radius of many layouts is 6″ (43′ prototype radius) and a lot closer to the 50′-37′ radius seen on city curves.
  - Most trolleys have a single power truck and a trailing truck.
  - Usually, unless blocked by steps or underbody detail, the trailing truck will swing through a large angular range
  - The power truck usually limits the minimum turning radius by one or more of the following features:
    - Power truck design
    - Through the floor mounting
    - Motor / Power Truck coupling

Mechanical Modifications

- Turning Radius
  - Remove trolley frame from body
  - Use a minimum radius test curve to verify car will not negotiate minimum curve
  - Determine limiting mechanical factor
  - Remediation depends on power train design
    - Gear Tower
    - Spring Belt

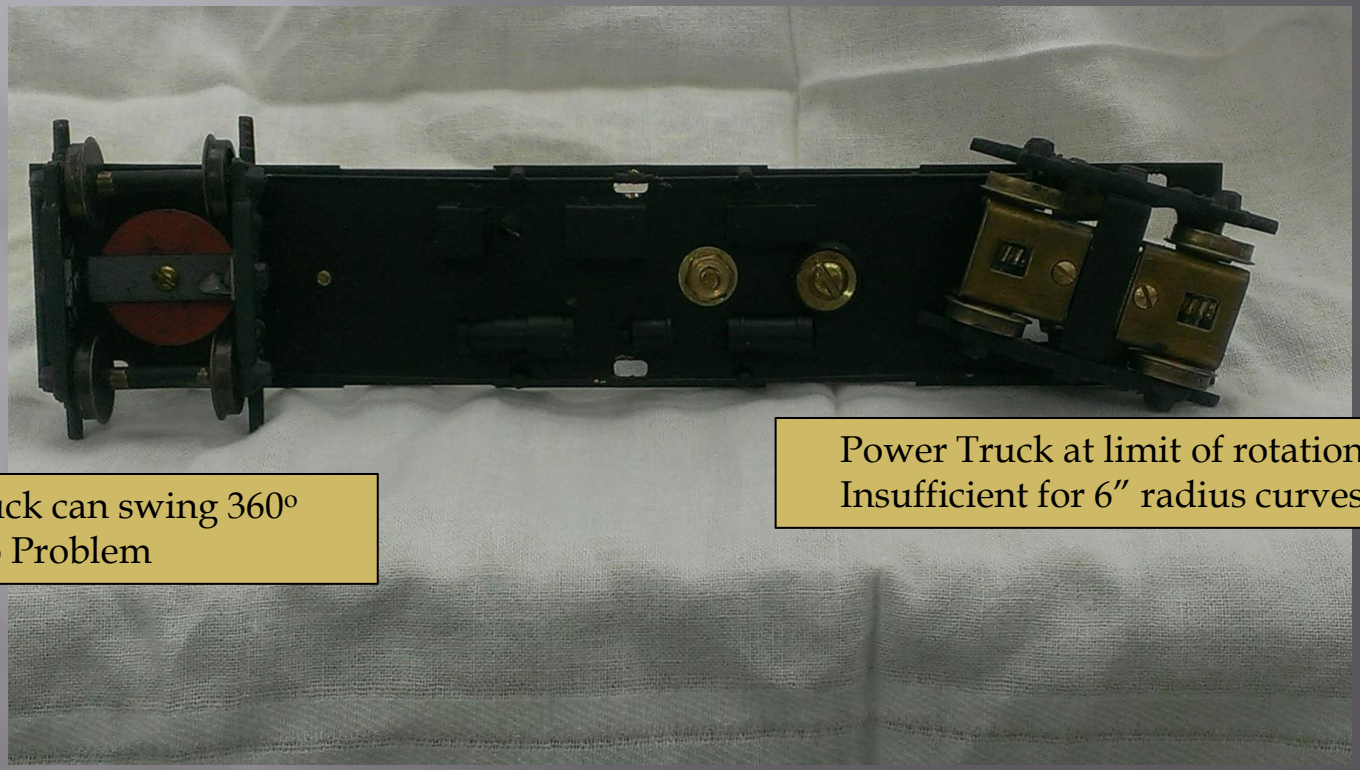
Mechanical Modifications

- Turning Radius (Gear Tower)
  - In "Gear Tower" power trains, the truck gear box or the opening in the floor for the truck and gear box limits the turning radius
    - Remove material from the corners of the truck gear box to allow truck to swing further
    - Remove material from the frame to expand the opening in the floor for the truck and gearbox
    - Sometimes a little of both of the above so as not to overly weaken the truck of the floor/frame.

Mechanical Modifications

- Turning Radius (Spring Belt)
  - Spring Belt drives usually have the largest angular swing of the power truck and therefore the best minimum radius performance and seldom need modification
  - Longer cars with larger truck to truck spacing sometimes need modification
    - Remove material from the corners of the truck frame near where it attaches to the frame above the lower spring belt pulley

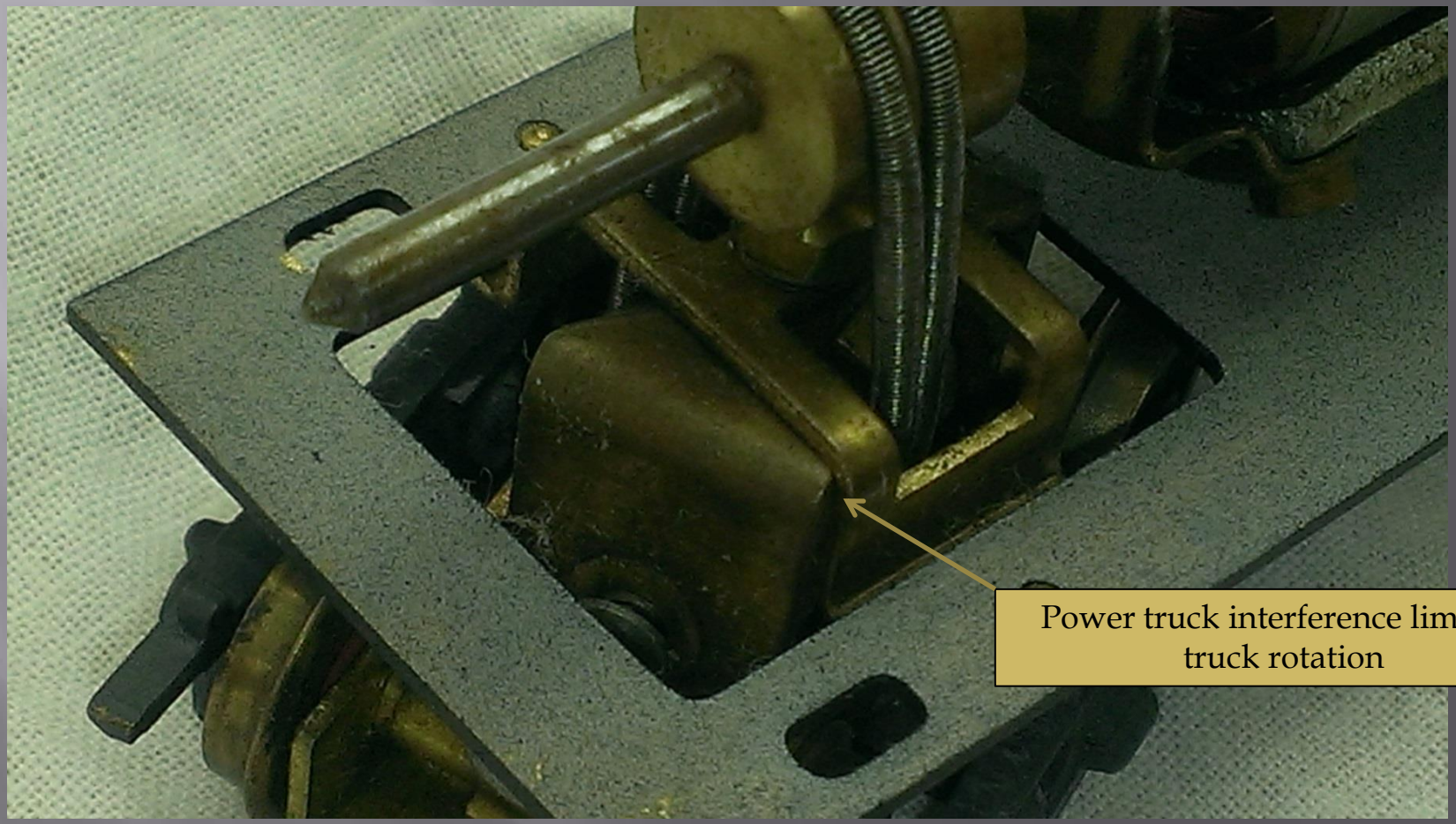
Turning Radius Modification



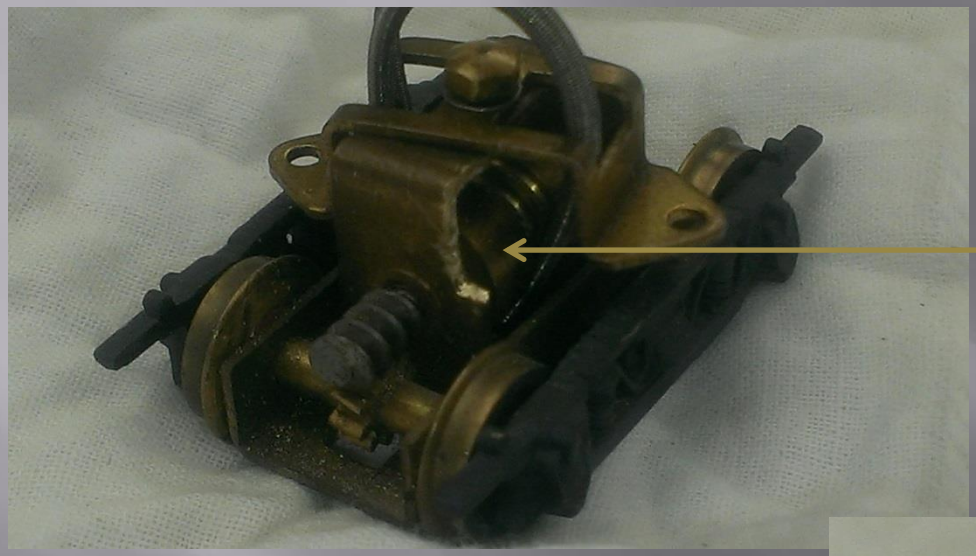
Trailing Truck can swing 360º
No Problem

Power Truck at limit of rotation
Insufficient for 6″ radius curves

Turning Radius Modification



Turning Radius Modification



Material removed from one side of truck structure

Turning Radius Modification

Material removed from all sides of truck structure

Mechanical Modifications

- Motor
  - Many RTR trolleys come with an open frame motor and no flywheel
    - Open frame motors draw much higher current than newer can motors
    - Open frame motors have poor slow speed characteristics
      - High "stop/start" voltage/speed
      - "Cogging" at minimum speeds
    - The lack of a flywheel exacerbates the slow speed issues of open frame motors and produces poor performance with dirty rail and wire.

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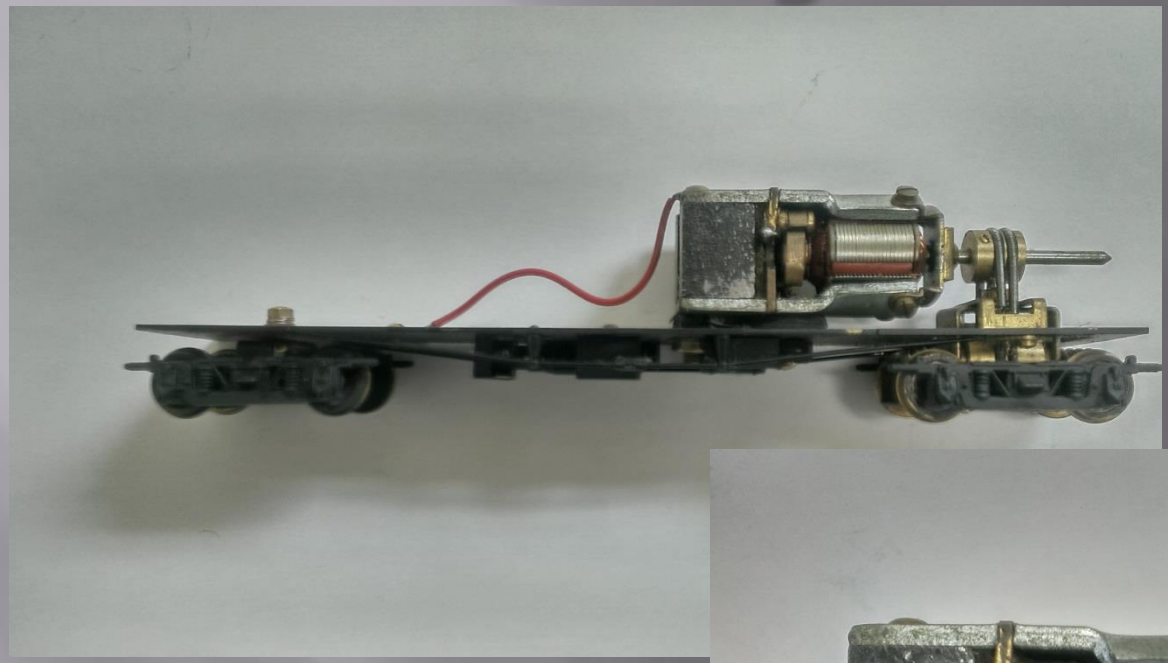
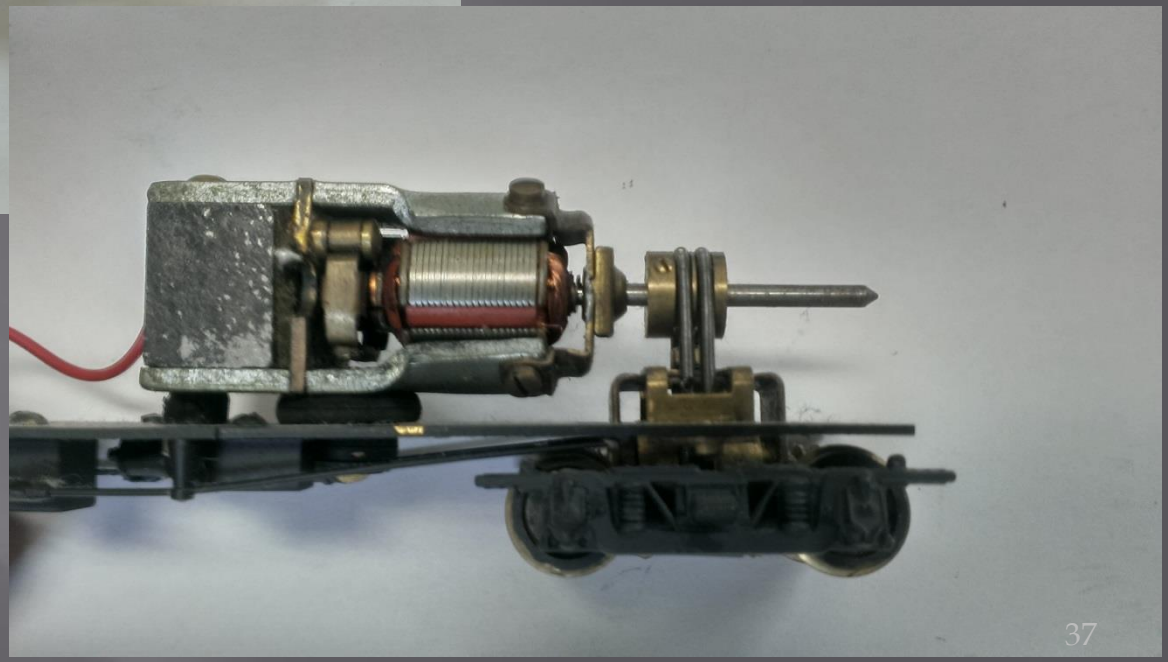
Existing Power Train



Typical Suydam Power Train

Open Frame motor with spring belt drive to one truck

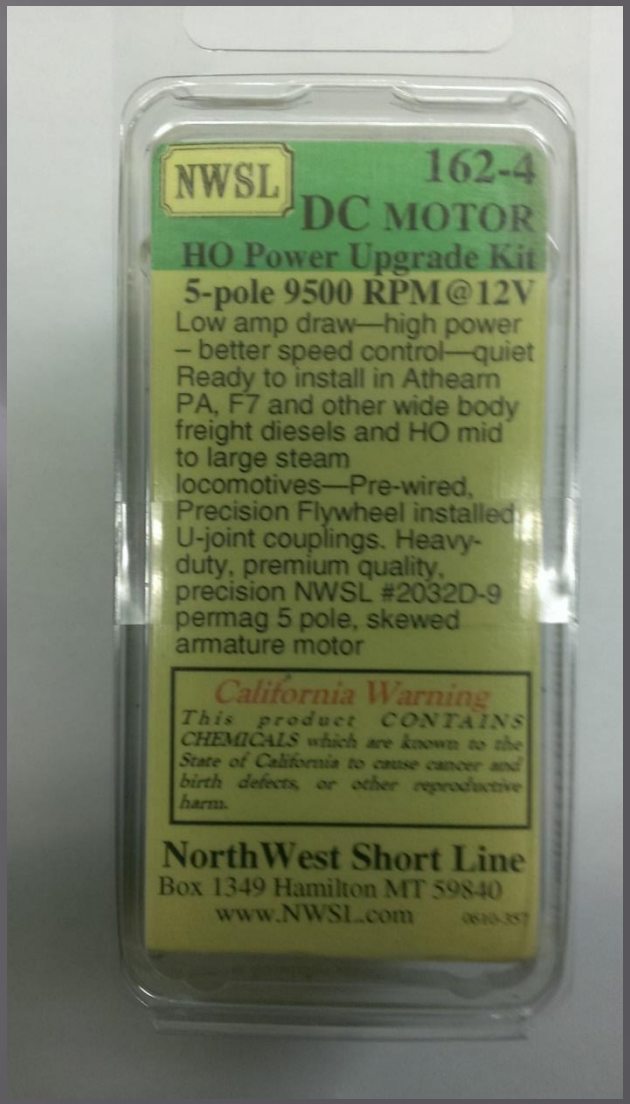


Four wheel pick-up

Insulated for two rail operation
Forward truck picks up from one rail
Rear truck from the other

Mechanical Modifications

- Motor
  - Replace Open Frame motor with can motor and flywheel assembly from North West Short Line (NWSL)
    - Two varieties
      - 1162-4 for "narrow" body
      - 162-4 "wide" body
      - Same motor, different flywheel diameter
  - Bowser "improved" drive train is also a very smooth, reliable candidate



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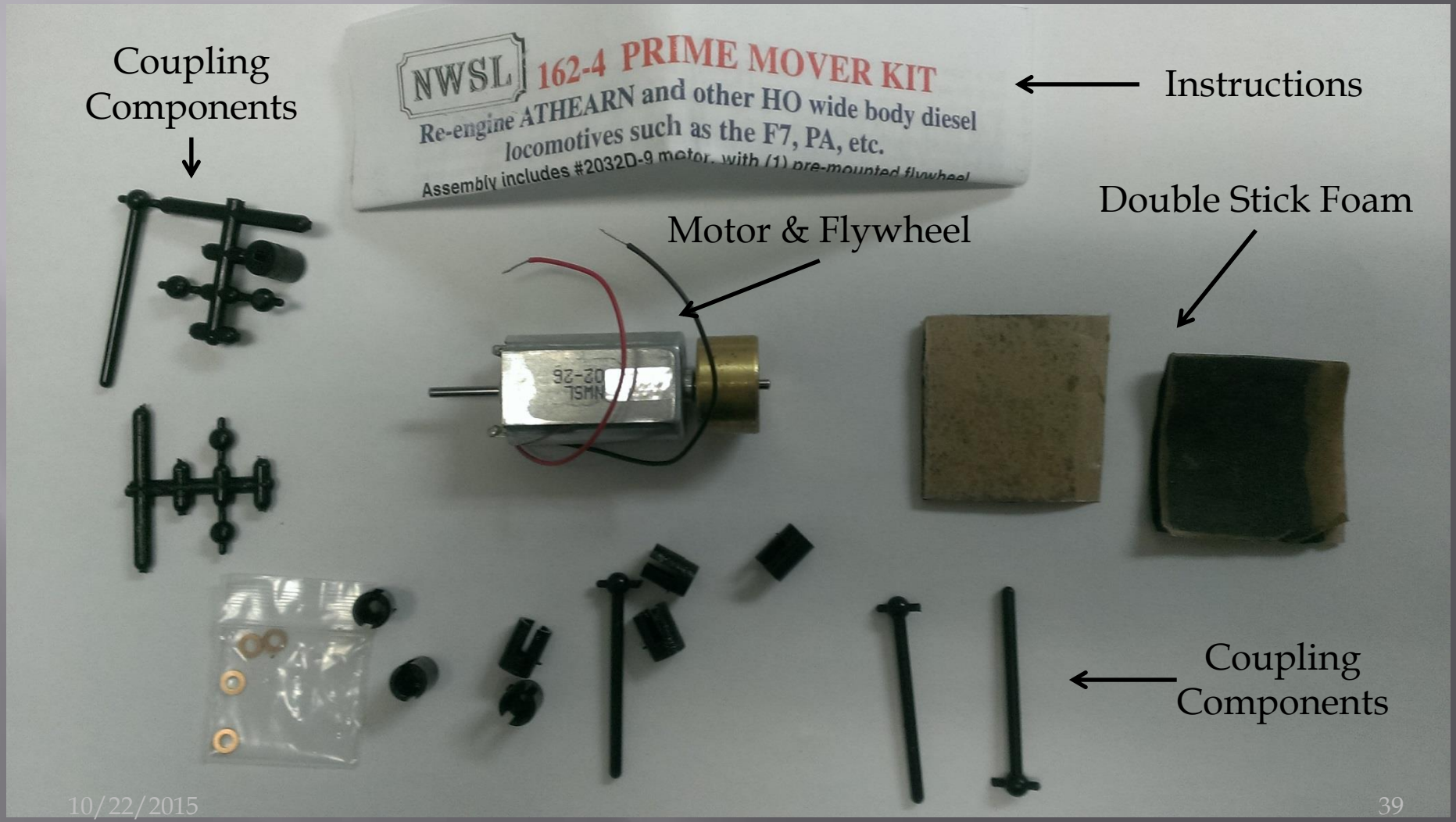
What's In the Box



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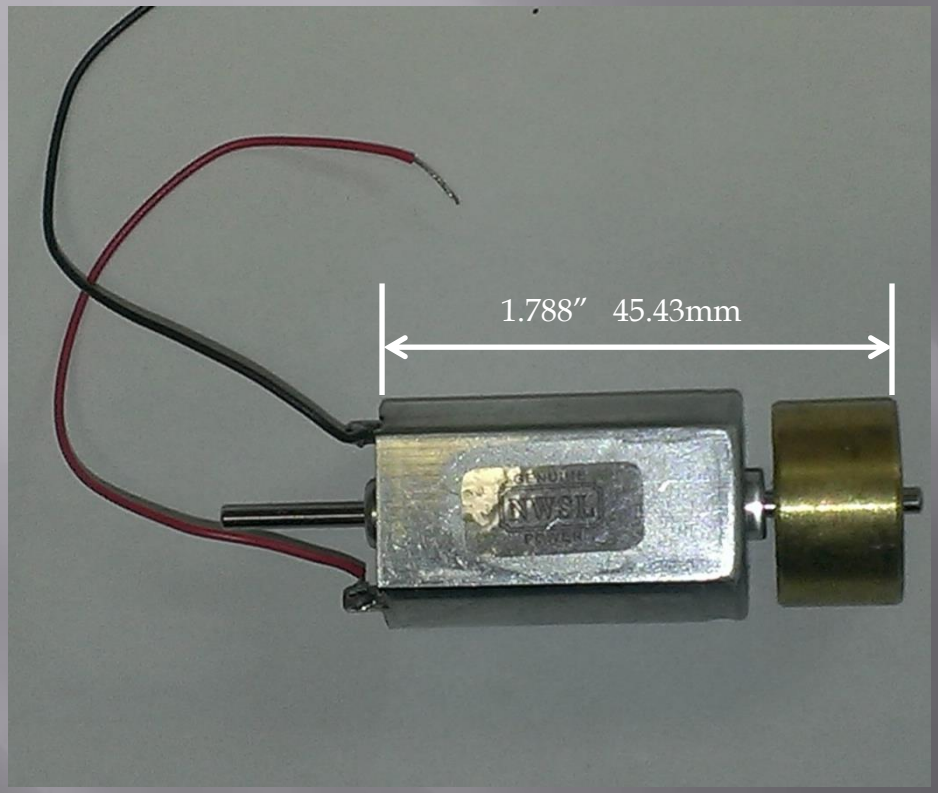
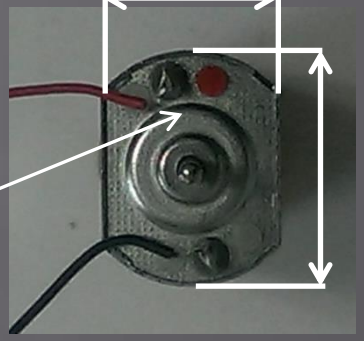
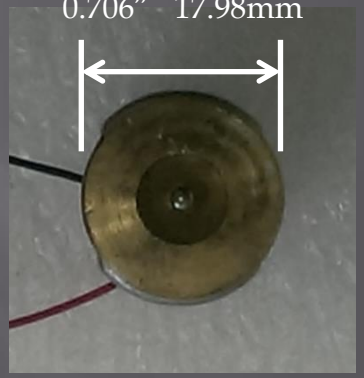
Motor Detail



Red dot marks positive terminal





NWSL 2032D-9 motor with flywheel
9500 RPM @ 12VDC

(dimensions as measured, not spec'd)

Mechanical Modifications

- Motor Replacement (Gear Tower)
  - Most gear tower drives are connected to the motor through a ball and socket universal
  - Remove Open Frame motor
  - Remove the socket from the Open Frame motor shaft
    - Set screw
  - Open Frame Motor shaft is 2.4mm diameter
  - Can Motor shaft if 2.0mm diameter
  - Install brass sleeve on Can Motor shaft to increase diameter
    - Secure with locktite
  - Install socket on Can Motor shaft

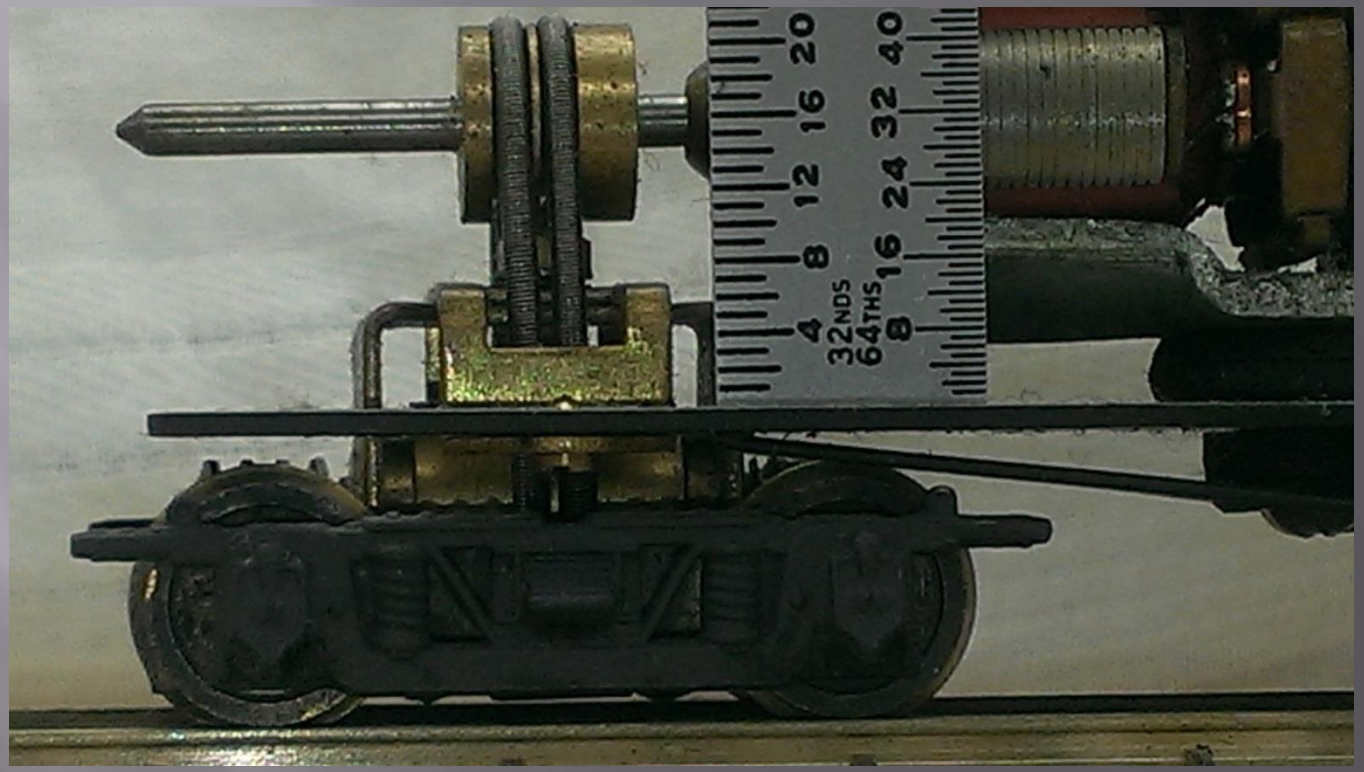
Mechanical Modifications

- Motor Replacement (Gear Tower)
  - Position Can Motor and connect socket with ball
    - Test for minimum radius
    - Ball "spokes" should not bottom out in socket slots
  - Verify vertical/horizontal alignment of motor shaft and ball shaft
    - Use shim if necessary
  - Use double stick tape/foam to temporarily mount motor and install body to insure no interference from the body roof/sides/trolley bases.
  - If OK attach Motor assembly to frame using DEVCON flexible adhesive and any shim required.
  - After 24 hour curing, finish attaching wires to motor.

Mechanical Modifications

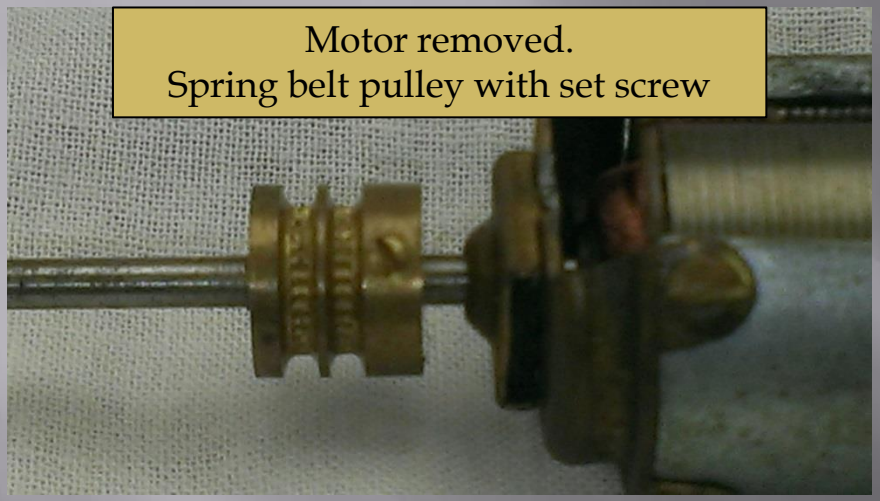
- Motor Replacement (Spring Belt Drive)
  - Most Spring Belt Drives are connected to the motor through a pulley on the motor shaft
  - Note position and height of motor shaft prior to removal
  - Remove Open Frame motor
  - Remove the pulley from the Open Frame motor shaft
    - Set screw
  - Open Frame Motor shaft is 2.4mm diameter
  - Can Motor shaft if 2.0mm diameter
  - Install brass sleeve on Can Motor shaft to increase diameter
    - Secure with locktite
  - Install pulley on Can Motor shaft

Spring Belt Drive Motor Replacement



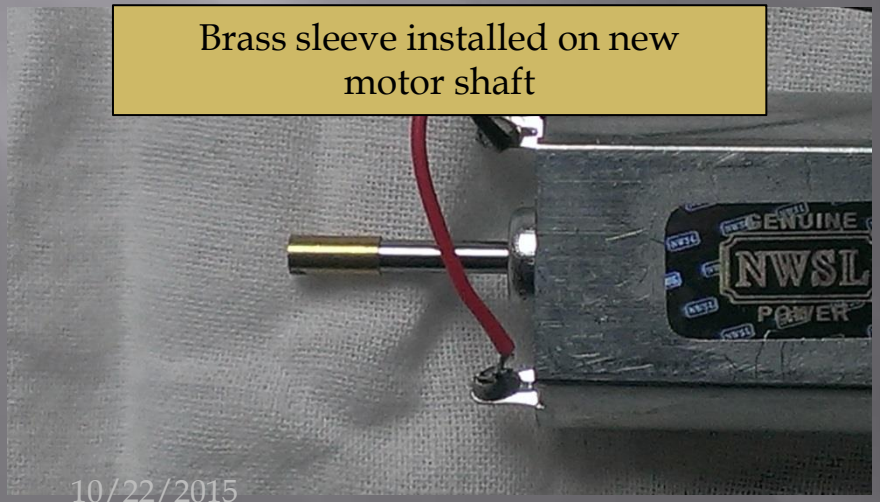
Measuring position of old motor and shaft height prior to removal.
Shaft center line is 0.5″ above car floor.
New shaft must be at the same height to assure proper spring belt tension.

Spring Belt Drive Motor Replacement

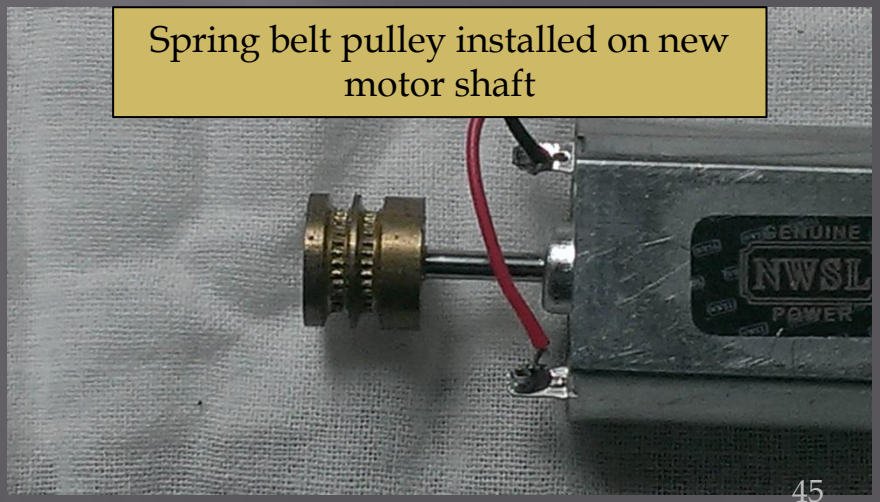


Motor removed.
Spring belt pulley with set screw

Brass sleeves to increase new motor shaft diameter to fit spring belt pulley



Brass sleeve installed on new motor shaft

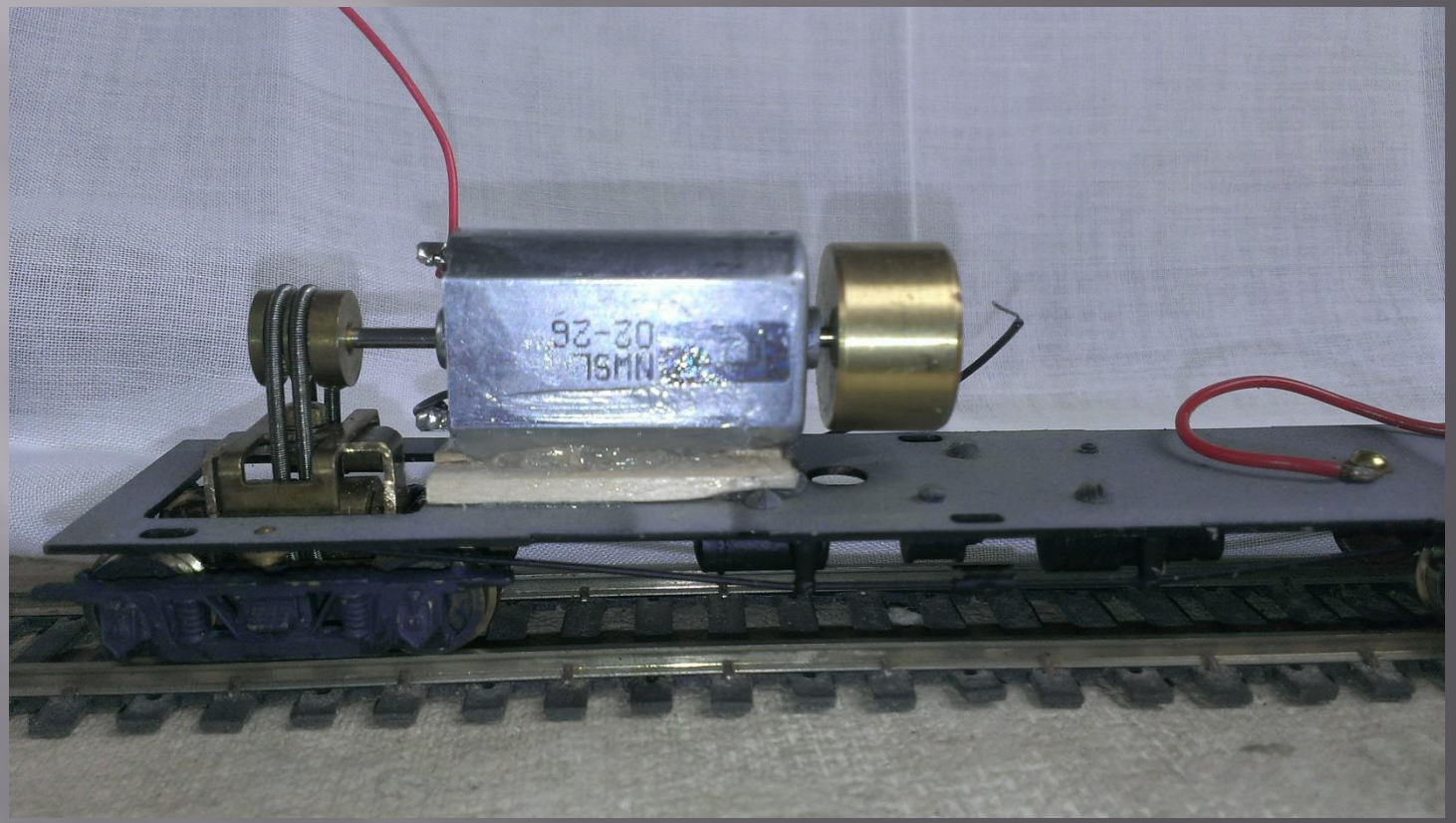


Spring belt pulley installed on new motor shaft

Mechanical Modifications

- Motor Replacement (Spring Belt Drive)
  - Place Can Motor in position noted before Open Frame Motor removal
  - Attach belts to pulley
    - Turn flywheel and verify wheels turn and belts do not slip
  - Verify vertical/horizontal alignment of motor shaft
    - Use shim if necessary
  - Remove belts from motor shaft pulley
  - Use double stick tape/foam to temporarily mount motor and install body to insure no interference from the body roof/sides/trolley bases.
  - If OK attach Motor assembly to frame using DEVCON flexible adhesive and any shim required.
  - After 24 hour curing
    - Attach spring belts to motor shaft pulley
    - Finish attaching wires to motor.

Spring Belt Drive Motor Replacement



New motor with flywheel installed using silicone adhesive

Speed Modifications

- When running multiple trolleys with one throttle, it is desirable that all the trolleys operate roughly at the same speed for a given voltage.
- If the speed of the finished trolley is too fast, diodes can be placed in series with the motor to provide a voltage drop to lower the speed of the trolley for a given throttle setting.

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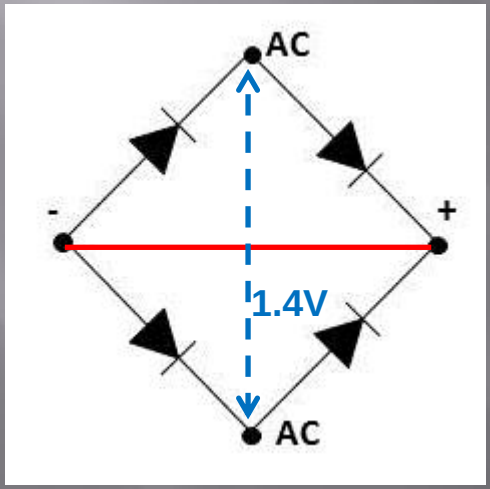
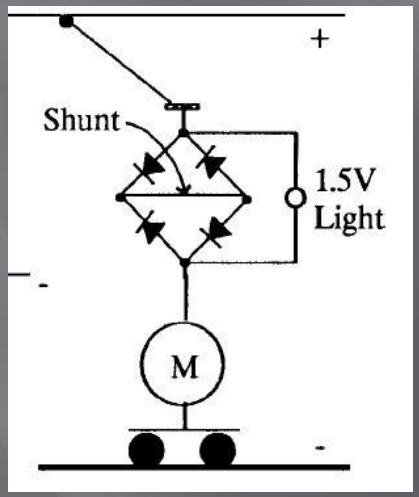
Speed Modifications

- Modified full wave bridge rectifiers can provide a bi-directional voltage drop in 1.4V increments
  - Jumper between + and – terminals
  - Connect AC terminals in series with motor and connector on either the positive or negative side
  - Can be used for constant interior lighting

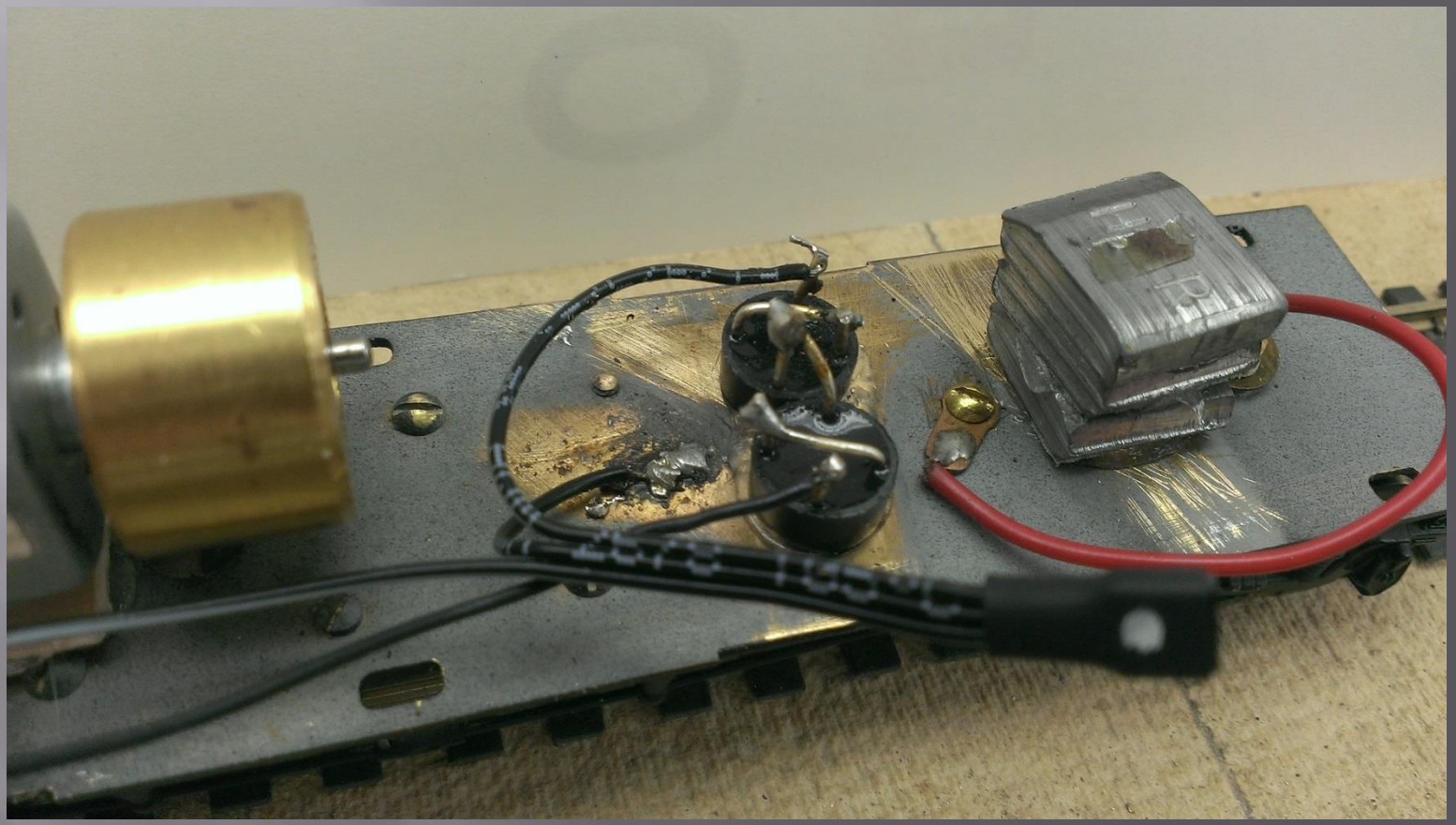




From East Penn clinic
"Model Trolley Car Wiring"
By Richard Kerr

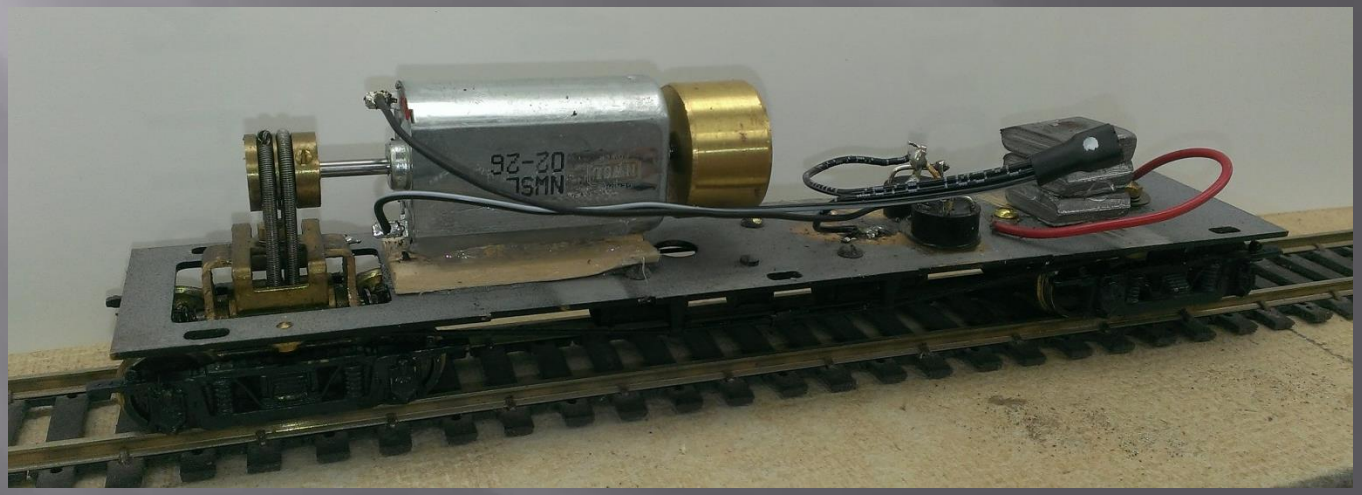
Bridge Rectifier with + and – terminals shunted

Speed Modifications



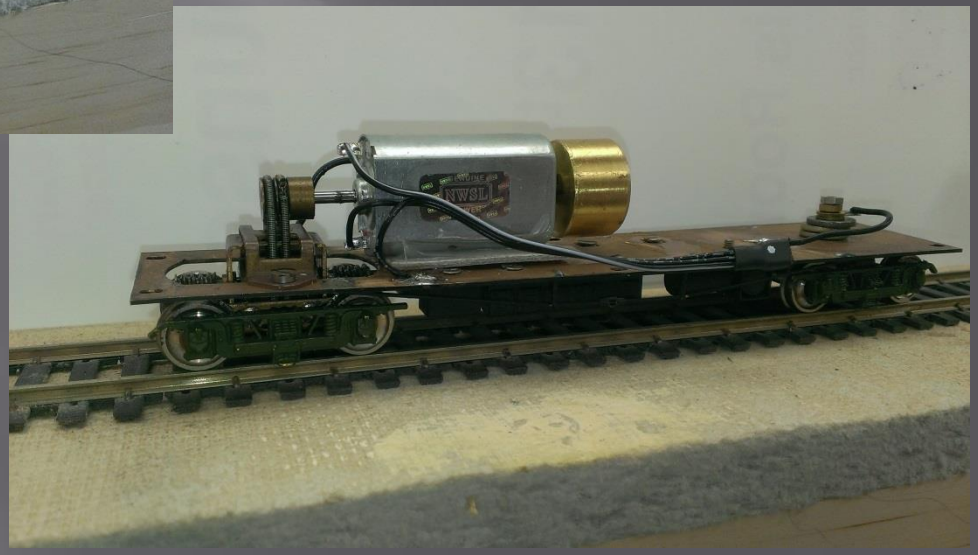
Two bridge rectifiers installed on project trolley along with additional weight over trailing truck

Finished Car



Other Installations

Suydam
Sacramento Northern
Niles Coach

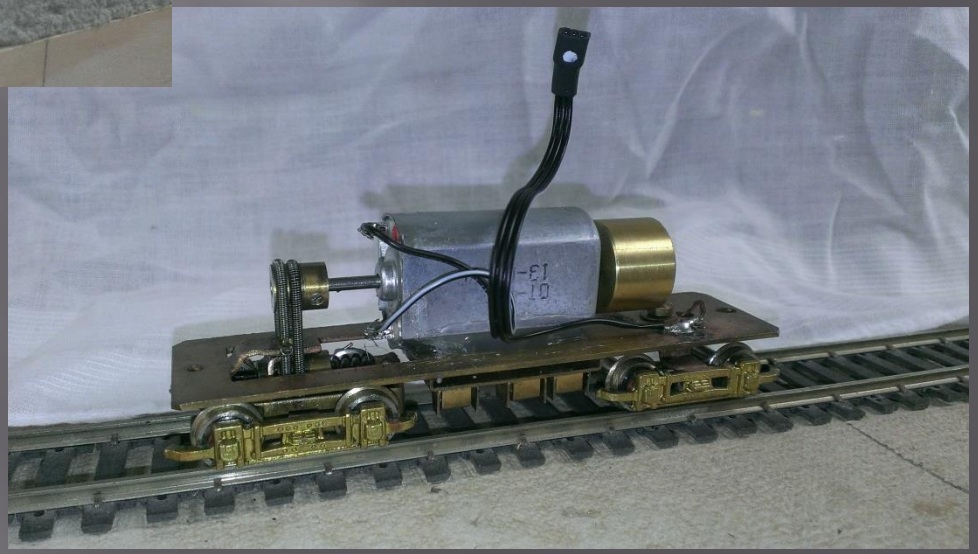


Other Installations

NWSL
Brill Master Unit

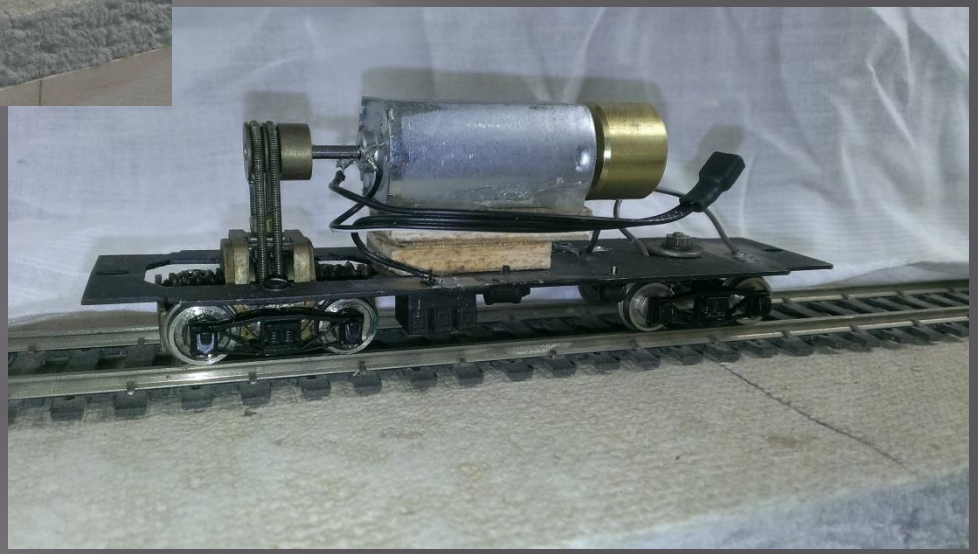
Other Installations

Ken Kidder
Double Truck Birney



Other Installations

Fairfield Interurban



East Penn Traction Club

Costs

- Insulating Bushings:
  - Customtraxx #SCTC-2 — $ 1.25 (pr)
- Brass Pivot:
  - Customtraxx # SCTC-1 or Bowser #12508 — $ 1.50 (pr)
- Miniatronics Connector:
  - #MNT5000301 — $14.26 (ea)
- Trolley Poles:
  - Miniatures by Eric — $29.95 (pr)
    (including SCTC-1, SCTC-2) — $32.00 (pr)
  - Bowser PCC (Form 11) Bowser #12600 — $14.00 (ea)
    (includes brass pivot)
- Brass Sleeves:
  - Customtraxx #12053 — $ 5.95 (4 pk)
- Flywheel Cement
  - Customtraxx #20010 — $ 4.25 (ea)
- Motor/Flywheel:
  - NWSL #162-4 — $52.95 (ea)
  - NWSL #1162-4 (narrow flywheel) — $49.95 (ea)

Other Repowering Options

- Bowser mechanisms
  - Includes motor, power and trailing truck, mounts and couplings — $47.50 (ea)
    - 26", 28", 30", 33" wheels
  - No Flywheel
  - Flywheel retrofit Kit — $ 8.50 (ea)
- A-Line motors — $47.00 (ea)
  - Flywheels — $10.95 (2 pk)
  - Couplings — $ 7.95 (ea)

Acknowledgements

- The author wishes to acknowledge inputs from the following sources:
  - Trolleyville "Schoolhouse" Clinics
    - George Huckaby
  - East Penn Traction Club Clinics
    - Bob Dietrich
    - Rich Kerr
    - Dave Gairo
    - Charles Long

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