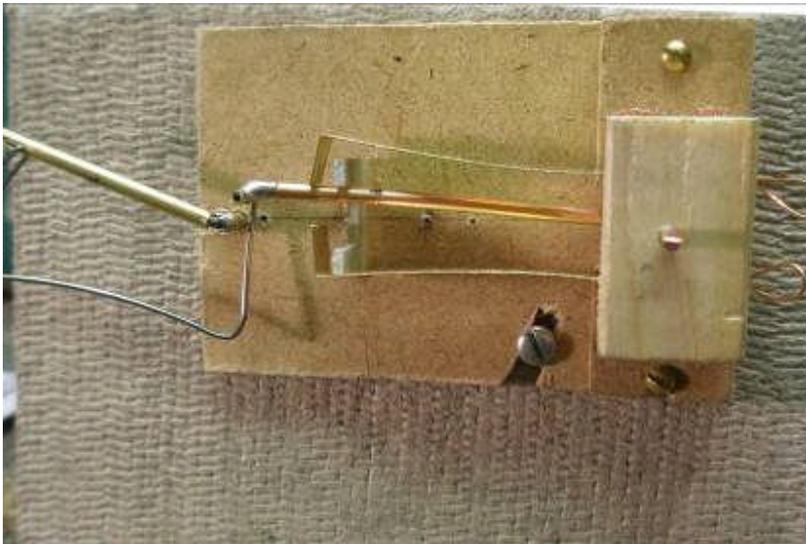


The U Toggle Turnout

By Robert Frey

Since the beginning of model trains, there have been many articles and illustration on the subject of adding electrical contacts to model train turnouts. Being a retired professional engineer, I have been interested in this subject to make my own electrical contacts for my HO turnouts. This all started when I picked up a small piece of 14 Gauge, bare copper wire (commonly used in home wiring) with a 90 bend. Holding the wire by my fingers in one hand, it was easy to rotate it with one finger of my other hand. The rotation of this bare wire could easily operate electrical contacts. But this is as far as it went.

Several years ago while adding some more turnouts to my layout, I again had the need to add electrical contacts to the new turnouts. This time, thinking if a spring was added to the end of a bare wire and the other end attached to a crank, then the motion of the crank would move the wire and operate my electrical contacts. Over the years there have been illustrations published that show how to take a bent music wire at the turnout and add a crank under the layout. I built some and found that operating the Turnout, would operate the electrical contacts. But I also found that pushing or pulling on the bare wire would toggle the points of the turnout.



Picture 1 The end of bare copper wire connected by a "U" shaped spring to a crank. The rotation of this crank operates the point of the turnout above.



Picture 2 The "U" Toggle assembly is easy to take out and put back into place. Note that when the wire is in the center, both electrical contacts are not closed.

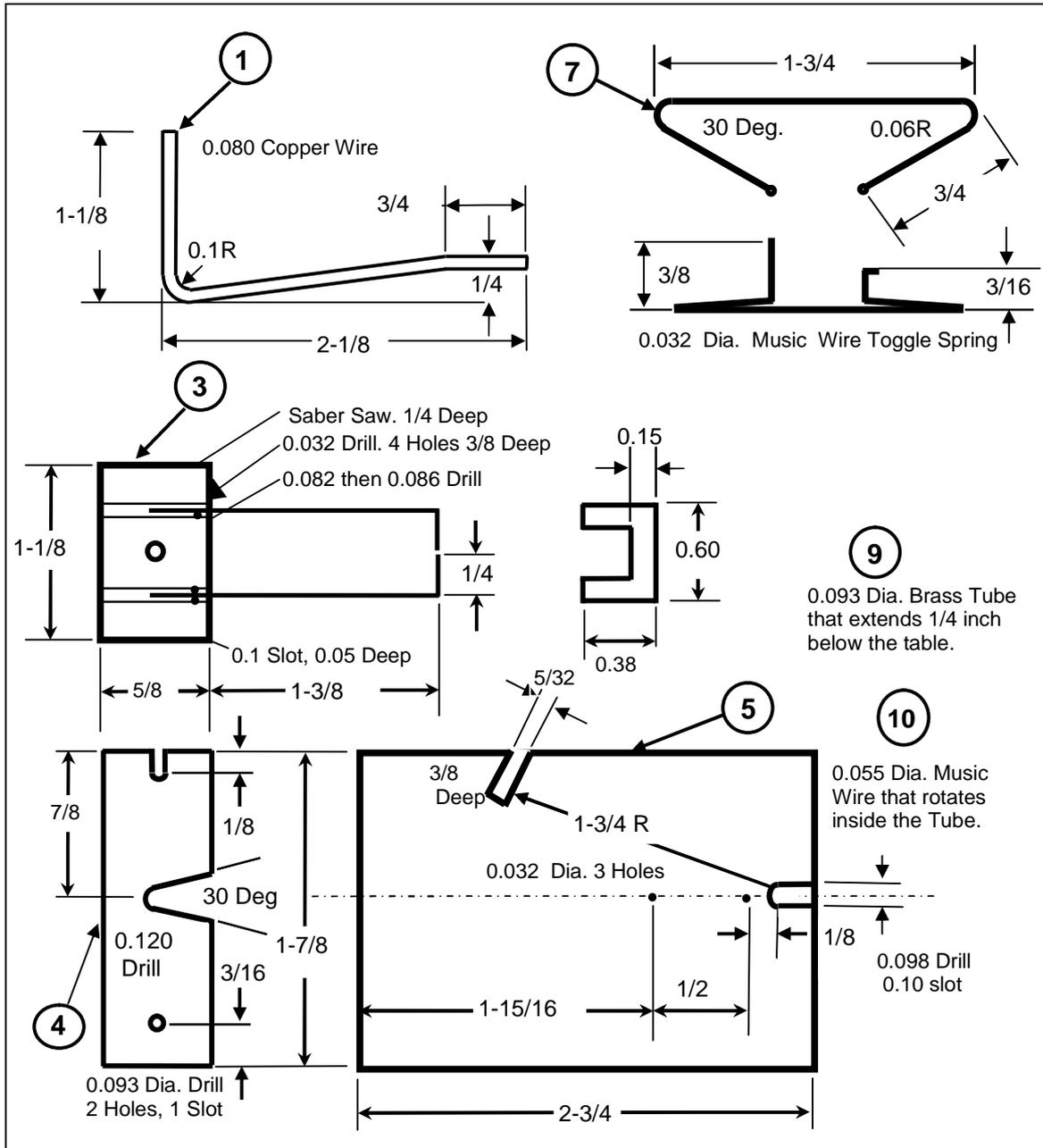
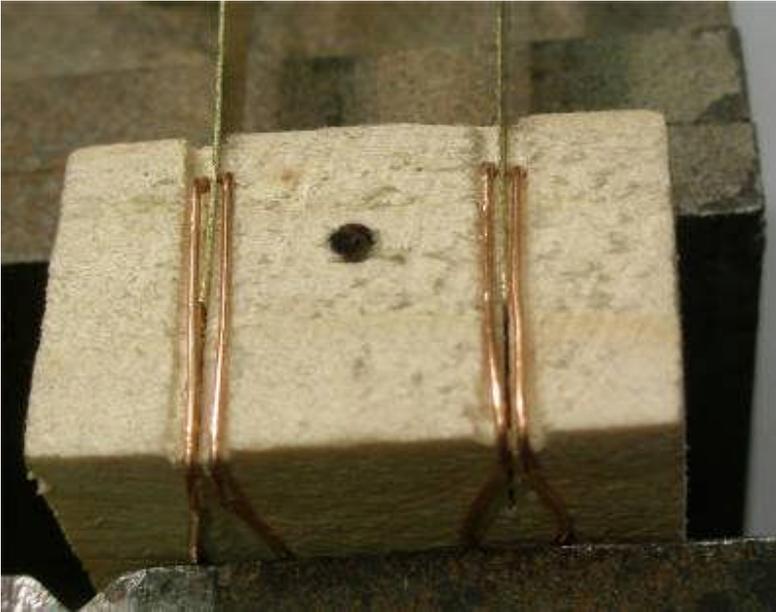


Figure 3 Dimension of Parts

- #1 COPPER WIRE: 14 AWG Solid Copper Wire 3-1/2" long, bent around a 0.200 dia. Drill.
- #2 END TUBE: K&S Engineering #1497, 1/16 x .014 Sq. Brass Tube. www.ksmetals.com/retail.htm
- #3 CONTACTS: K&S Engineering #251 Brass .010 x 4 x 10". Cut 1/4" wide x 4", cut to 2" long.
BLOCK: 1 x2 Wood strip cut in half to 1-1/8" deep. Makes two 5/8" x 3/4" x 1-18' long BLOCKS.
- #4 WIRE SPACER: 1/8" Hard board smooth both sides, 5/8 x 1-7/8" Long.
- #5 BASE: 1/8" Hard board smooth both sides, 1-7/8" x 2-3/4" Long.
- #6 INSULATOR: 1/16" Tk. Circuit Board. Three 0.080 Dia., holes helps remove the center material.
- #7 U SPRING: 0.032 Dia. Music Wire. Bend 0.120" Dia. at 1-3/4 Dimension. Sharp bends at 3/8" & 3/16" hook.
- #8 EXTENSION: K&S Engineering #1268 3/32 x .014" Tk. RD. Brass Tube 1-1/4" long with a slot.
- #9 PIVOT TUBE: 3/32 x .014: Tk, RD Brass Tube. Length is top of table to bottom of table plus 1/4".
- #10 CRANK WIRE: 0.055" Dia. Music Wire with one 90 degree bend. (See text)

CONTACTS and Insulator BLOCK

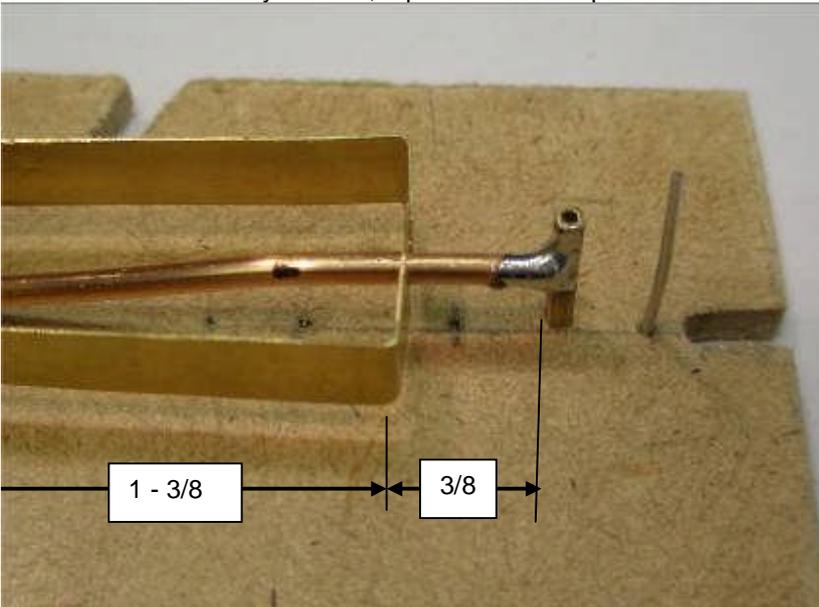
Cut a 1/4" deep slot in the wood BLOCK with a thin saber saw blade. Insert two 1/4" x .010" x 2" CONTACTS one-half way into the slots. With a hack saw blade, cut on both sides, to about 0,05 deep, Drill four 1/32" Dia. Holes 3/8" deep. Take two pieces of 22 gauge bare wire, (each 2-1/2 long), fold in half, and make a 90 Deg. bend 1/4" from the ends. Put the 1/4" ends into the drilled holes. Push the CONTACTS flush to the BLOCK. Make a 90 Deg. bend 1/4" from the end, and slide the CONTACTS to a distance of 1-3/8 for the BLOCK. (See Picture 4.) Solder the wires to the CONTACTS and sand the surface flat. Glue Item #4 to the sanded surface, (WALTERS GOO) with the hole for the wire exposed. (The slot of Item #4 is on the same side as the slot of Item #5.)



Picture 4 Attaching some loop wires to the CONTACTS

Solder WIRE #1 to END POST#2

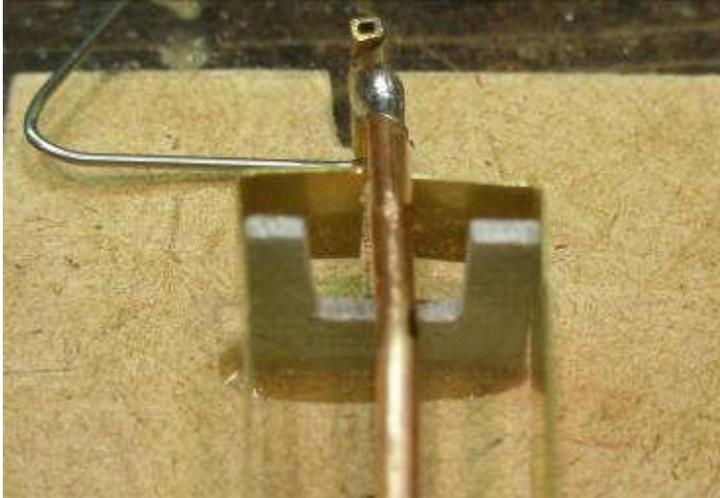
After bending a 2-1/2" long copper wire around a 0.199 drill, cut to 1-1/8" by 2-1/8 with a 1/4" offset. In Item #5 put a 1/32 Dia. wire near the 0.1 slot. Put the 7/16" long SQ Tube over the wire. Re-bend the copper wire so that it is in the center of the CONTACTS. Solder the SQ Tube to the end of the copper wire. Drill two 0.045 Dia holes in the BASE located by Item #4, tap the holes and put two #2 screws 1/4" long.



Picture 5 Cut the copper wire to 3/8" from CONTACTS surface before soldering.

INSULATOR #6 to BASE #5

Put a 1/32 Dia. wire 1/4" long in the hole behind the contacts. Put some 5 minutes epoxy on the bottom of INSULATOR #6 and glue to the BASE #5 near the contacts as located by the wire. Center the INSULATOR as shown in Picture 6.



Picture 6 INSULATOR, WIRE, END TUBE, and Notch are all in line. If both CONTACTS touch the wire, then grind a small amount of material off of the ends of the CONTACTS.

U SPRING #7 and EXTENSION #8

Make the U SPRING as shown in Figure 3 with 0.032 Music wire. Start with the 1-3/4 length and make two 30 Deg. bends with about a 0.06" radius. Remove the two #2 screws to add the U SPRING to the bottom of the tube in Picture 5. The other end of the U SPRING attaches to the slot in EXTENSION #8.

Figure 7

TURNOUT CRANK

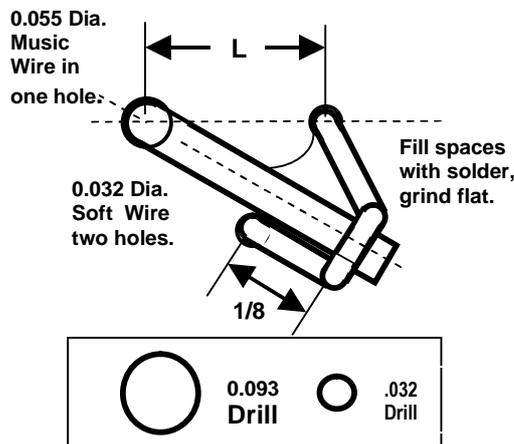
How far the points of the Turnout move is "Throw".

$L = 2 \times \text{"Throw"}$

Figure 8

Drilling Template

Two holes,
Dim. **L** apart.

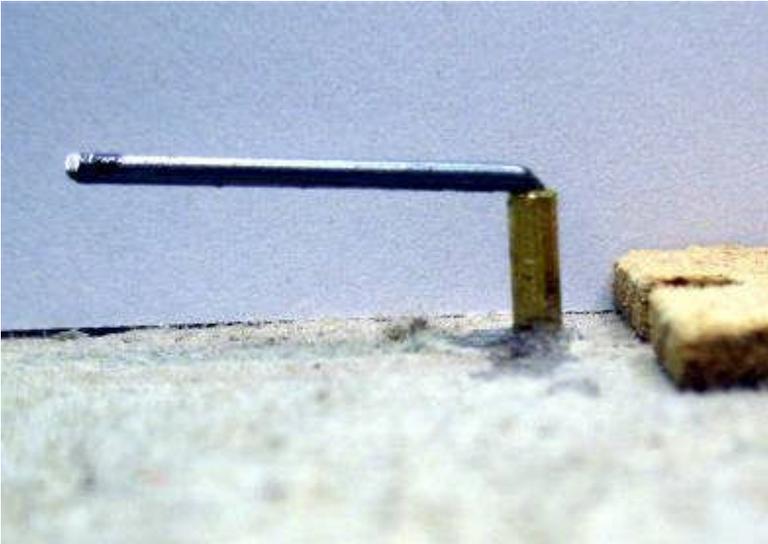


BRASS TUBE #9

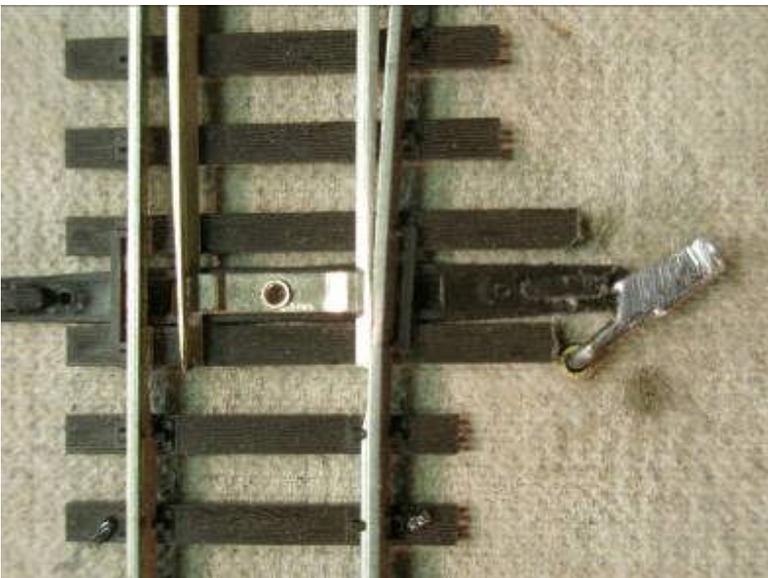
The 0.093 Dia. Brass Tube Item #9 goes from the top of the table and extends 1/4" inch below the table. Drill a 1/32 Dia. hole in the end of the turnout arm. Put the turnout out points in a mid. position, put the Drilling Template Figure 8, under the arm, and pin into position with a piece of 0,032 wire. Now, drill the 0.093 hole on top of the layout. To determine the tube length, put a piece of wire into the 0.093" hole and then cut it off about 1/4" below the surface. The BRASS TUBE of this wire length can be pushed flush to the turnout arm.

Music Wire with CRANK of Figure 7

Put the .055" Dia. music wire of Figure 7 TURNOUT CRANK, into the 0.093 Dia. Brass Tube. Also put the 1/32" Dia. hole into the turnout arm. With two inches more of wire sticking out of the bottom, determine in what direction you would like to make a 90 Deg. bend. With a Dermal grinding wheel, put about a 0.005" notch in the 0.055" Music Wire right next to the 1/4" extended tube in the direction of the bend. Now when you make the bend, the wire will form a small radius right at this notch. Cut it to a 3/4" length as shown in picture 9.

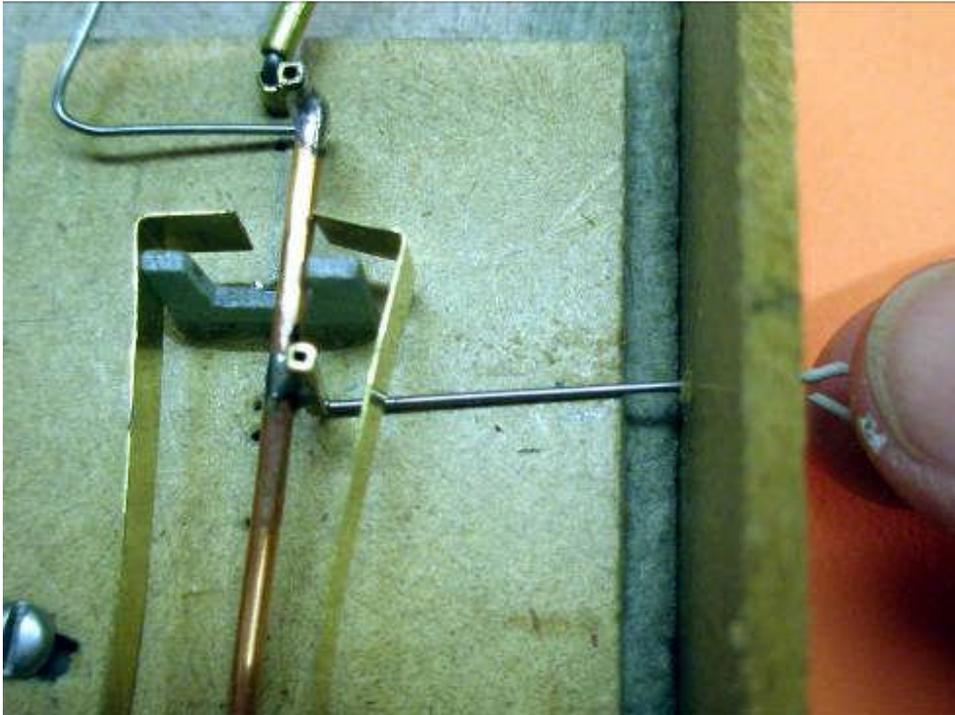


Picture 9 With a small notch on the music wire at the 1/4" extension, a very small radius at the 90 Deg bend can be made.



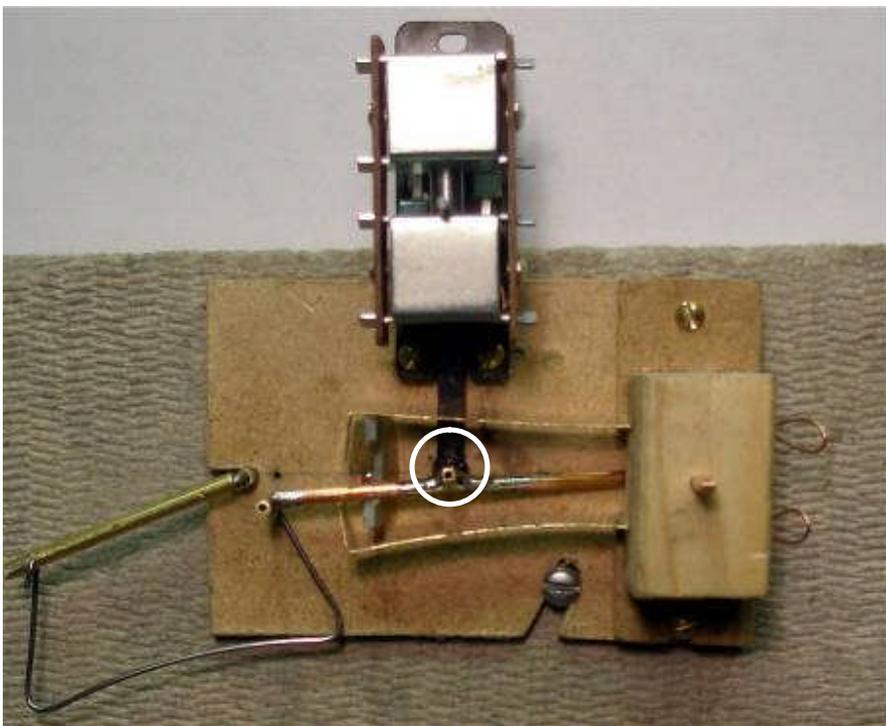
Picture 10 The rotation of the TURNOUT CRANK operates with a "snap action". The U SPRING under the layout keeps the points tight to either rail.

OPTION 1 A Panel operated Turnout



Picture 11 A 1/32 Dia. wire with a bend 3/8" high can extend beyond the panel surface. The action of pushing and pull on the wire can toggle the turnout.

OPTION 2 The Addition of a PECO TURNOUT MOTOR.



Picture 12 A Solenoid can be added **7/8"** from the BLOCK that holds the CONTACTS by soldering a 3/8" long SQ Tube on to the copper wire. Also add a 1/2" Dia, Hole in the Base so that the 3/8" long SQ Tube can project into this hole.

SOLENOID Added to the BASE

The Solenoid shown in Picture 12 is a PECO TURNOUT MOTOR (Switch Machine) PL-10. It is mounted on a PECO ADAPTOR BASE PL-12. This ADAPTOR BASE has a small toggle spring located in the center under a removable plate. The PECO toggle spring needs to be removed. (Two toggle springs are too much load for the TURNOUT MOTOR. A 1/16" x .014" by 3/8" long Sq. Brass Tube makes a good fit into the hole used in the moving part of the ADAPTOR. Before making the two #2 Screws hole to be drilled into the base, be sure the copper wire is centered in the CONTACTS, and the Solenoid Motor Pin is in its mid position.

The TURNOUT MOTOR (Switch Machine) will just work with 18VAC, but has a much better "snap action" when operated with a 30 VDC Capacitor discharge unit.

OPTION 3 SOLENOID operated by a Cap. Discharge which is Triggered by Locomotive wheels.

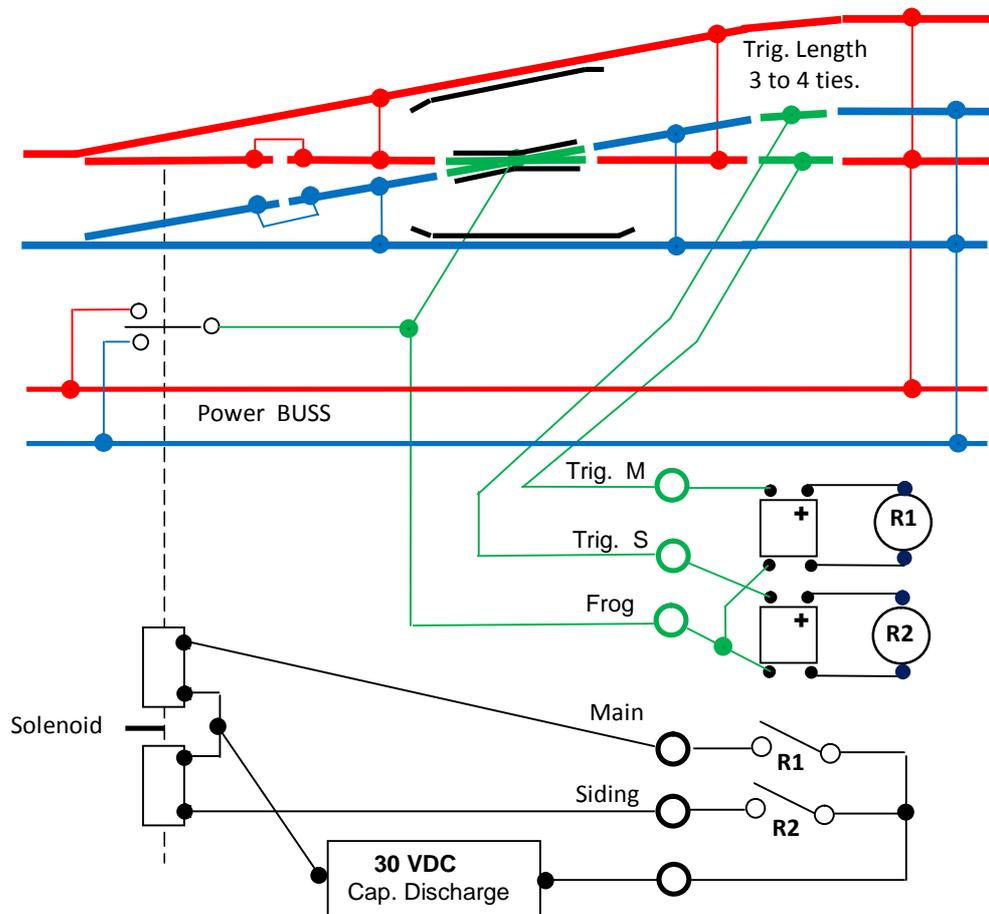
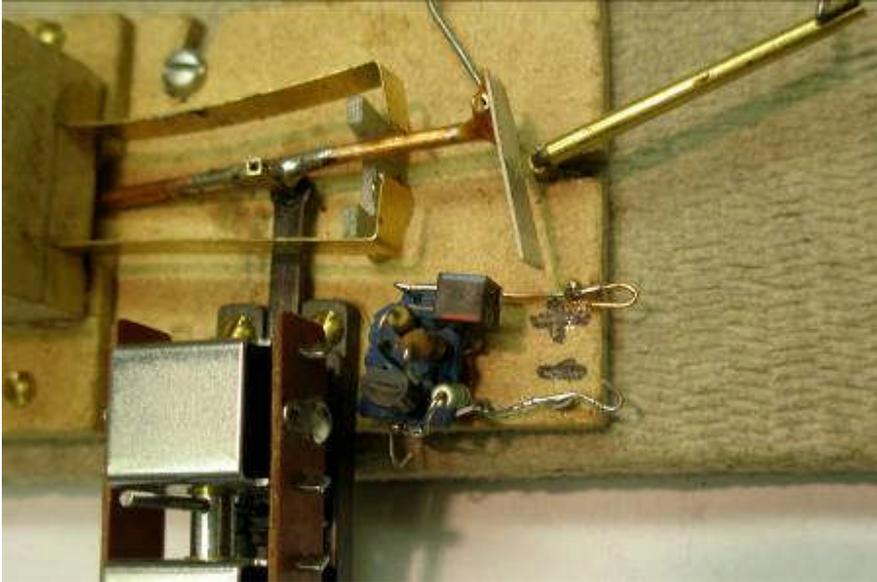


Figure 13 If the Turnout is set for the siding, and the locomotive wheels bridge the gap at Trig. M, then the rectifier operates the relay R1, which operates the Main solenoid with a 30 VDC Cap. Discharge unit. The electrical polarity to the frog changes when the turnout is operated. Note that the Relays R1 and R2 only operate if the train route, and the turnout route do not agree.

Any 1 Amp Bridge Rectifier can be used. (Digit-Key DB102-BPMS-ND) If your track power is DC, then a 5 VDC RELAY SPST, 5 Amps @ 30 VDC (DIGI-Key PB874-ND) can be used because the coil power is only momentary.

OPTION 4 A REFLECTIVE OBJECT SENSORS Operates Bi Polar LEDS.



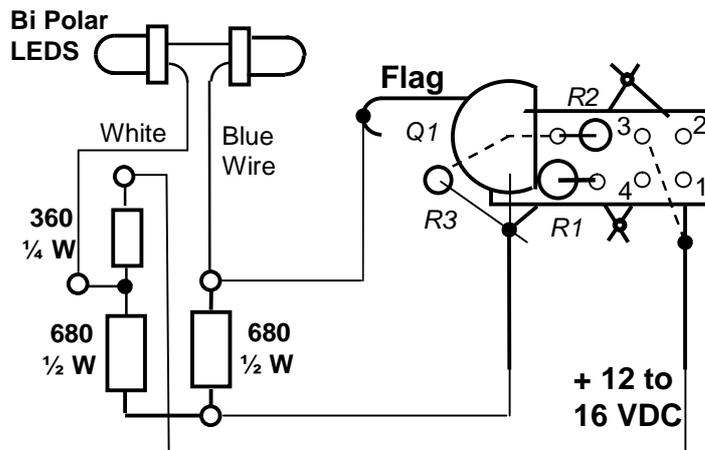
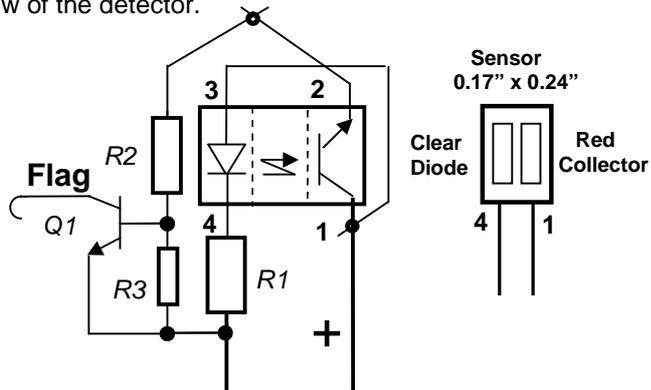
Picture 15 The Reflective Sensor responds to radiation emitted from the diode only when a reflective surface, (attached to the copper wire) is in the field of view of the detector.

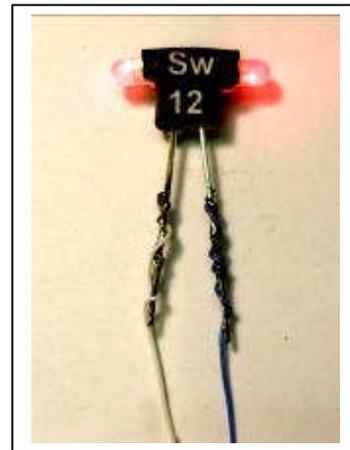
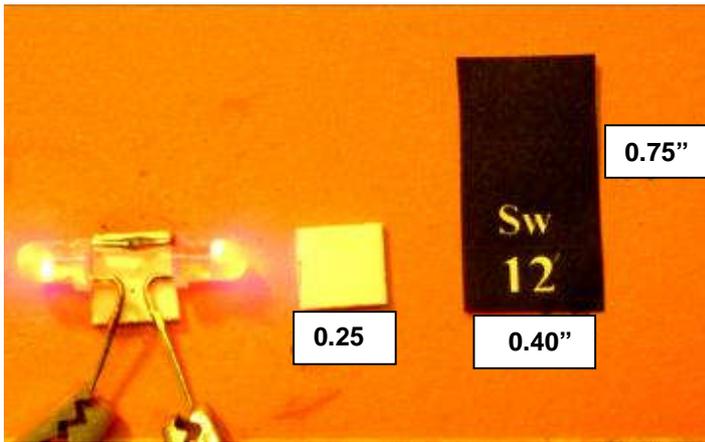
Digikey.com	Description
Q1 PN2222AFS-HD	TRANSISTOR NPN GP AMP
Q2 QRD1114-ND	IC SENSOR IR PHOTO TRANS
R1 PPC470BCT-ND	470 Ohm 1/2 W.
R2 P5.6KCACT-ND	5.6K Ohm 1/4 W.
R3 P2.2KCACT-ND	2.2K Ohm 1/4 W.

3mm Bi Polar LEDS
 2 Colors Red/Green, 2 Legs
 Miniatronics Corp. 12-220-05

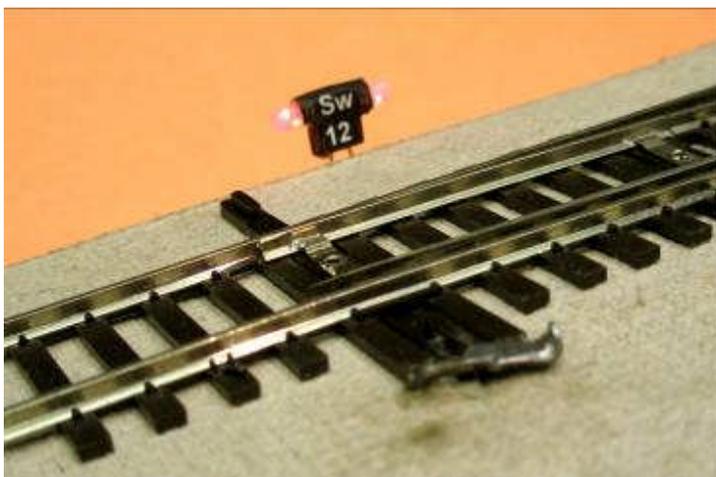
Figure 14 **Parts and Circuit**

Parts are mounted on a 1/16" thick, 0.26 by 0.56 Circuit Board with 0.1 inch spacing, (2 holes by 5 holes.) The dots outside the circuit board are the solder points where the component leads cross.



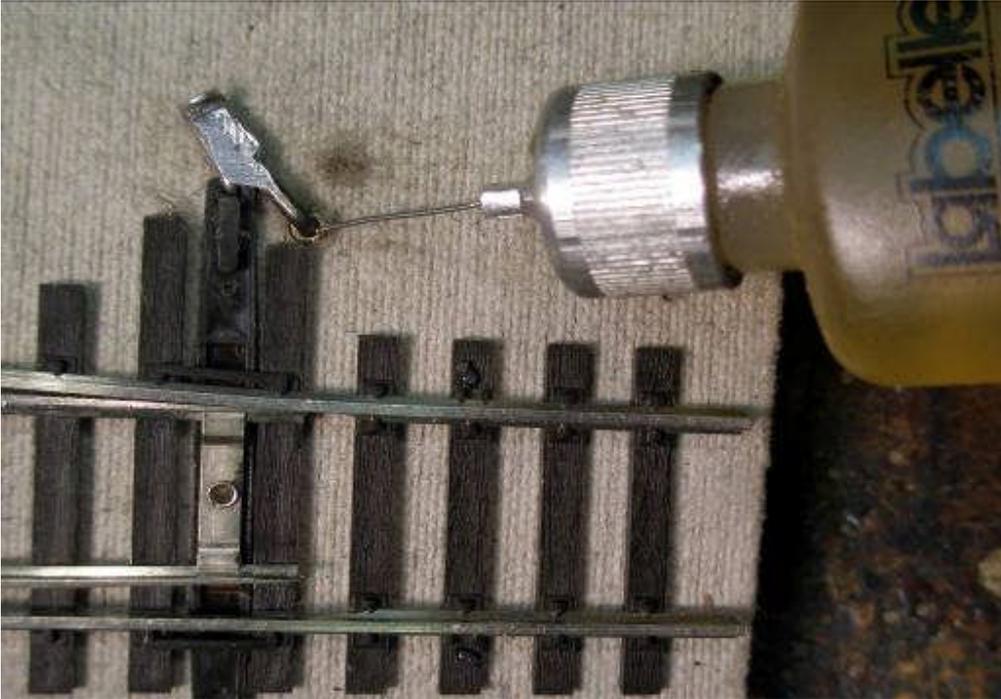


Picture 15 Bi Color Led soldered with two .040" thick white Styrene 0.25" by 0.25" add to each side. A Ink Jet printing: 0.40" by 0.75" with an optional Sw number, wrapped over the LEDS. The ends are cut and folded under the LEDS and glued to the Styrene. White and Blue wires are attached. (Blue wire = +3.9 VDC is Green and White wire = +3.5 VDC is Red.)



Picture 16 The Bi Color Signal is mounted near the turnout. The 4 terminal resistor assembly is connected below the two wire Turnout signal. Note that the two 680 Ohm 1.2 W are larger and the one 360 Ohm 1/4 W is smaller. The Blue wire and Flag wire both connect the terminal on the left, White wire on the right, and positive on the bottom. (digikey.com PPC680LCT-ND 680 Ohms 1/2 W, and P360CACT-ND 360 Ohms 1/4 W)

OPTION 5 LUBRICATION



Picture 15 An occasional few drops of a lubrication between the Brass Tube and the rotating Music wire, will help keep your old "U Toggle Turnouts" in a "snappy" condition!

Regards,

Bob Frey
RFrey5218@aol.com

From Web sites: <http://bobfrey.auclair.com/>
<http://auclair.com/bobfrey/>

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