ABSTRACT

A switching apparatus for a toy railroad is provided. A housing has a drive compartment and a motor positioned in the drive compartment in the housing. A movable actuating element is positioned entirely within the housing. A drive connection between the motor and the movable actuating element moves the movable actuating element between a first position and a second position. At least a portion of the movable actuating element is positioned in a protective compartment adjacent to said drive compartment to protect the movable actuating element from outside forces. A track switch directs toy trains to a selected one of a plurality of tracks. A connector between the movable actuating element and the track switch moves the movable actuating element between its first and second positions causes movement of the track switch between a first position and a second position.
TRACK SWITCH AND CONTROLLER

BACKGROUND OF THE INVENTION

[0001] This present invention relates to a track switch for O gauge and O scale electric model three rail toy trains and, in particular, a track switch mechanism utilizing a DC motor.

[0002] Replicating the railroad transportation need of determining, at given points, which of two tracks a train will travel on and the method of diverting the train to a possible branch or side line, model railroad track manufacturers have been challenged with modeling reliable systems as well. An intersection of two lines of track on which a train can be diverted from a main line onto a branch line is known as a "turnout," also known as a switch. A switch enables the train to be diverted from the main line to the branch line. In general, the movable parts of the switch only need to move a short distance, enough to clear the flanges on the train wheels in order to change the route of the train. The crossing of the two rails in the middle of the track turnout is known as a frog.

[0003] Logically, it would follow, that to a certain degree, model railroad turnout and switch systems would duplicate railroad track systems. Through various methods of operation, model railroad switches, generally, have utilized two basic concepts, either a turntable style or another type which implements the use of movable sections of the track rail often maneuvered by a rod pushing or pulling sliding rails.

[0004] The turntable design is seen in two early actual railroad inventions. U.S. Pat. No. 413,593 utilized a circular table or rotary switch for street railway cars in which the direction of the train depended upon the direction the table was turned. A similar concept is represented in U.S. Pat. No. 1,885,366 which discloses a rotating type turntable. In model railroading, the turntable style has been minimally used. The turntable style of switch is more common to toy-like type designs, such as the device of U.S. Pat. No. 5,440,996 which can function with a "figure eight" type track layout.

[0005] The design considered more prototypical in the model railroad industry was the design involving movable rails sections. Again, early actual railroad designs were utilized in railroad models. The design shown in U.S. Pat. No. 835,845 implemented the use of two rods, connected to a wheel and bell crank system and extending out to two sections of the turnout frog, which could push out the track sections of the frog to create a continuous section of track diverted to the side line and which would pull the same track sections back to position a continuous section of track on the main line. U.S. Pat. No. 981,495 illustrates a practical design of a rail frog which is useful in many switch systems in which one or more sections of the frog assembly itself included movable rails. An invention for a toy electric switch, illustrated U.S. Pat. No. 1,671,971, followed this general concept in using a rod pushing or pulling movable rails and frog. However, one factor that actual railroad track system designers did not need to consider was the presence of a third center rail used in many model toy train track systems to provide the electrical connection between the track and the train itself. The design described by U.S. Pat. No. 1,671,971 addressed this feature by allowing a space between the third rail sections to prevent unwanted contact with the shoe of the train as it passed over the turnout.

[0006] The slide rail and rod method proved very effective and practical. Subsequently designed switches concentrated on various improvements of the movable slide rails and/or frogs and improvements in the method of operating the rod to move the slide rails back and forth. An objective of each of the various designs was to produce a reliably operating assembly which would accurately direct the train to the correct track line while, at the same time, minimizing the risk of derailment.

[0007] One operating assembly utilizes an actuating solenoid to operate the connecting rod to the train track slide rails. U.S. Pat. No. 2,615,125 depicts the use of an actuating solenoid with crankshaft members that operate a cross arm designed to shift the switch track members. One solenoid activated switch, shown in U.S. Pat. No. 3,361,906, has a visual means of viewing the activity of the switch controlled from a remote location with parts of the switch concealed by the control board. Another design, shown in U.S. Pat. No. 3,553,667, employs a bar-like solenoid actuator having two actuating coils that are individually energizable. These and other solenoid activated switches, although a popular solution, have several drawbacks. The solenoid activated switches produce a loud noise during operation and require a substantial amount of electric current.

[0008] Another problem associated with the solenoid mechanism is the tendency to "bounce" if the voltage is too high. The moving part of the switch, the blades, hit the opposite rails so hard that they bounce and do not properly lock in place. If the blades are not in the proper position, they can cause the train to derail.

[0009] Another type of design uses of a spring to actuate the switch mechanism. As shown, for example, in U.S. Pat. Nos. 4,948,073 and 6,244,543, the spring actuator is connected to a link member which moves the throw bar. One drawback of these designs is that the use of the spring does not provide positive locking. The lack of positive locking can cause inexact positioning of the sliding rails of the turnout which would allow the train to proceed on the incorrect line.

[0010] A further type of turnout is illustrated by U.S. Pat. No. 6,308,920 which shows a switch mechanism actuated by a DC motor. The distinct drawback of the apparatus shown in U.S. Pat. No. 6,308,920 is that the lever extends outside of the housing and is connected to a linking member outside of the housing. This arrangement is subject to increased breakage of the relatively fragile lever, decoupling of the lever and the linking member, and inadvertent actuation of the switch. Furthermore, the switch mechanism is manufactured as a separate element from the track base. This arrangement is subject to weakened or damaged connections of the switch mechanism to the slide rails.

SUMMARY OF THE INVENTION

[0011] While all model railroad turnouts, by necessity, have some common features, the key variation among the designs discussed above is the mechanism used to manipulate the switch. Many older switches used a solenoid that was noisy, used a lot of current, snapped too quickly, and
took up too much space. The motor drive mechanism of this present invention is smoother and quieter than a solenoid because it moves at a controlled speed until the switch is in position. Once the switch is in the desired position, microswitch stops the motor. Not only is a quieter mechanism more pleasant to operate, but also, as with many aspects in model railroading, there is a constant striving for prototypical features. The switches used on actual train tracks are quiet, and therefore, it would be desirable to a model railroad enthusiast for their layout switches to similarly operate quietly.

[0012] The present switch design uses much less current than conventional switches by using a small motor with a gear reduction that draws less current than a solenoid developing to equivalent force. This feature is important because the transformers required to run a layout with a number of switches can be much smaller with this switch design. Since this switch requires less current, there is less chance of circuit overload which can effect operation of the train or other accessories.

[0013] The switch mechanism of this invention is also much smaller in size than one utilizing a solenoid. Solenoids must be larger and taller to develop the required force needed to operate the switch. A solenoid switch takes up too much space on the layout, making it hard to position the track as closely as needed to mimic a prototypical switch yard. The small motor and gear reduction of the present invention make it possible to place the mechanism directly next to the track, thereby reducing the overall footprint of the switch.

[0014] The motor and cam gear design of the present invention allows use of a gear reduction system to strengthen the force of the throw action. Thus, this design will enable a stronger movement than the solenoid design.

[0015] The motor and cam design of the present invention provides positive locking and is less likely to come out of position. In addition, this present design is more compact in size than those utilizing a spring actuator.

[0016] Another advantage of the switch of the present invention is that the switch can be operated in a controlled and precise manner.

[0017] The switch of the present invention has a sturdier, more compact arrangement than that shown in the prior art. Particularly, the switch mechanism is formed or molded with the track base to add increased stability.

[0018] A further advantage of the present invention is that the lever actuating the connector to the slide rails is positioned completely within a housing of the switch mechanism.

[0019] The main elements of this invention include a train track switch assembly, a switch controller, a terminal post and a connecting rod. The train track switch assembly includes train track rails attached to a track bed base that also houses the servomechanism and a wire terminal board. The switch controller is not required to be part of the track assembly but can connect to the track assembly wires at a terminal post. The switch controller, when activated by a lever, transmits a signal to the switch mechanism. The motor and the mechanisms of a servomechanism move a connecting rod in the chosen direction. The connecting rod pushes or pulls the slide rails, movable sections of the track switch, to allow the train to either proceed on the main line or to divert to the side line.

[0020] Switches can either be right hand switches or left hand switches, depending upon the direction that the train is to be diverted to the side line. The design of a left hand switch would be the reverse or mirror image of the right hand switch design, and vice versa.

[0021] The switch controller mechanism is connected by three wires to the terminal board. The first wire, or input wire, is the source of AC power from the track. The second wire, or through wire, and the third wire, or turnout wire, transmit signals to the switch mechanism when activated by the manually operated controller lever. Two LED’s on top of the controller can indicate which line, the main line or the branch line, will be open.

[0022] The outside two rails of three rail track are electrically ground. Since the switch body is plastic, the outer rails should be connected together by a wire or a metal strip. The two outer rails, nearest the center of the “v”, are insulated from the rest of the outer rails, because they are used to detect a train and throw the switch. This is the non-derailing feature. When a train enters the switch through the through or turnout section, the wheels of the train touch both the ground rail and the insulated piece of rail, and make a connection to cause the switch to move quickly in that direction to prevent a derailling that would occur if the switch was in the wrong position. When the controller is activated, it is electrically the same as when a train enters the switch, i.e., the insulated rail section makes contact with ground and activates the mechanism.

[0023] There are also metal rods or wires to connect the center rails of all three sections together. In a three rail track, the center rails are connected to one side of the AC power supply. Toy trains have rollers to pick up power from the center rail. If the center rail extends through the intersection in a switch, the wheels of trains passing through the switch would contact the center rail, and would short circuit the transformer. To prevent this problem, the center rails are made of non-conductive material in the region of the intersection. The center rails are then connected together beneath the switch using a wire or metal plate. The switch has the ability to be powered either by power from the track assembly or by an external transformer.

[0024] The switch controller of the present invention rectifies the AC voltage to provide positive or negative DC voltage for the sending control lines. Thus, when the lever is shifted, the control circuit board in the switch controller generates DC voltage that signals the servomechanism with either a positive current or a negative current. Each sending line moves the DC motor of the switch mechanism in a particular direction. Thus, a positive voltage moves the motor in one direction and negative moves the motor in the opposite direction. Depending upon the voltage input, the motor turns a spur gear either clockwise or counter clockwise. The spur gear moves a cam gear. The cam gear can have a small stud protruding from the back of the switch housing to allow for manual operation by the operator. The cam gear has a raised cam in a slot to move a slide lever. The cam and slot provide motion as well as positive lock at the end of travel in each direction. As the cam gear turns, upwardly arranged pegs on the cam gear actuates the switch.
arm to stop the voltage input by triggering the SPDT microswitch. This reverses the source of voltage to the DC motor, stops motion, and prepares the motor for movement in the opposite direction.

[0025] The connecting rod is attached to the movable train track slide rails and the servomechanism lever. The connecting rod can be a flattened shaft. The rod pushes or pulls the slide rail section to either allow the train to continue down the main line or to turn out onto the side or secondary line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 is a top plan view of a left turnout switch according to the invention.

[0027] FIG. 2 is a top plan view of a right turnout switch according to the invention.

[0028] FIG. 3 is an enlarged top plan view of the right turnout switch of FIG. 2.

[0029] FIG. 4 is an enlarged plan view of the switch connecting rod of FIG. 3.

[0030] FIG. 5 is an enlarged side cross-sectional view of the left turnout switch mechanism of FIG. 1.

[0031] FIG. 6 is an enlarged bottom plan view of the switch mechanism of FIG. 5 removed from the base plate.

[0032] FIG. 7 is the top plan view of the right turnout switch shown in FIG. 3 with the switch mechanism removed.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0033] FIG. 1 and FIG. 2 present the complete switch assembly of the present invention. FIG. 1 is a left turnout switch 1 with curved rail sections 2, 3, 4 which turn out to a left side or branch line 3 from the main train line 4. FIG. 2 is a right turnout switch assembly 5 and is a mirror image of the left turnout switch assembly 2 with curved rail sections 2 which turn out to the right side or branch line 6. Other than having oppositely curved branch lines 6, the right and left turnout switches have identical features. A track bed base 7 includes a section of three parallel straight train track rails and a section of three parallel curved rails branching out from the straight rails. A frog 8 is located at the intersection of the innermost straight rail and the outermost curved rail. A manually operated switch controller 11, the terminal board 12, switch mechanism 13, a connecting rod 14, and movable slide rails 15 are also provided in the switch assembly and are described below.

[0034] Referring now to FIG. 3, operation of the switch assembly is activated when the controller lever 16 of the switch controller 11 is manually moved in a lateral direction. Preferably, the lever 16 can be moved in either lateral direction. Other mechanisms can be designed to activate the switch assembly. As the controller lever 16 is moved, either the red LED signal 18 or the green LED signal 20 will light to notify the operator which of the two lines, the main line or side line, is open. Other indicating means can be provided. As an alternative, the switch assembly can be designed with no indicating signals. Preferably, the red and green LED's correspond with red and green LED's located on the switch mechanism. At the same time, a DC signal is transmitted over the through wire 24 or the turnout wire 26 to the terminal board 12, depending upon which direction the controller lever 16 is pushed.

[0035] The switch controller 11 is connected by three wires 22, 24, 26 to the terminal board 12 and can be physically connected to the terminal posts 28 on the terminal board. The first wire 26, or input wire, is the source of AC power from the track. The second wire 22, or through wire, and the third wire 24, or turnout wire, transmit signals to the switch mechanism 13. The switch controller, when activated, rectifies the AC voltage to provide positive or negative DC voltage for the sending control lines.

[0036] Referring to FIGS. 5 and 6, the switch mechanism 13 has an elongate housing 17 with a substantially flat top portion 19, but is open from below. An underside base plate, which is present in the completed assembly, is not shown in FIGS. 1-6. Generally, the housing 17 is divided into a drive compartment 25 and a protective compartment 27.

[0037] Each sending line activates movement of the DC motor 30 of the switch mechanism 13 in a particular direction. Depending upon the input, an output shaft of the motor 30 turns a spur gear 32 either clockwise or counter clockwise, to thusly move a cam gear 34. The cam gear 34 can be provided with a small stud 36 protruding from the back of the gear enable manual operation of the switch by an operator. The cam gear 34 causes the lever 40 to move smoothly. The cam gear and slot provide motion in addition to a positive lock at the end of travel in each direction. As the cam gear 34 turns, pegs 42 upwardly jutting from the gear also actuate the switch arm 44 and stops the voltage input by triggering the SPDT micro switch 46. This reverses the source of voltage to the coil DC motor, stops motion, and prepares the motor for movement in the opposite direction.

[0038] The lever 40 is housed completely within the housing 17, and extends from the drive compartment 25 into the protective compartment 27. Having the lever 40 contained completely within the housing 17, and particularly within the protective compartment, prevents inadvertent actuation of the switch assembly and protects the lever 40 from damage. In the protective compartment 27, the lever 40 is connected to a connector 48. The housing 17 has an opening on a side portion of the protective compartment 27 facing the track section. The connector 48 extends from its connection with the lever 40, through the opening 29 in the side portion of the protective compartment 27, and is coupled to the connecting rod 14. When actuated by the cam gear 34, the lever 40 moves the connector 48 to cause a smooth movement of the connecting rod 14. The connecting rod 14 slides the movable track slide rails 15 such that a train can either continue down a main line or be diverted to a branch line.

[0039] FIG. 7 illustrates a right turnout switch with the switch mechanism removed. As seen in FIG. 7, the base plate 21 is integrally formed with one end of several track ties 31 of the track section at connections 23. Preferably, the base plate 21 is formed from a single piece of material as the track section. The base plate 21 has a bottom surface flush with a bottom surface of the track ties 31.

[0040] The above description should not be construed as limitations on the scope of the inventions. Accordingly, the
scope of the invention should be determined not by the embodiments but by the appended claims and their legal equivalents.

1. A switching apparatus for a model railroad, comprising:
   a housing having a drive compartment;
   a motor positioned in the drive compartment in the housing;
   a movable actuating element positioned entirely within the housing;
   a drive connection between the motor and the movable actuating element to move the movable actuating element between a first position and a second position, at least a portion of the movable actuating element being positioned in a protective compartment adjacent to said drive compartment,
   whereby the movable actuating element is protected from outside forces;
   a track switch for directing toy trains to a selected one of a plurality of tracks; and
   a connector between the movable actuating element and the track switch, whereby movement of the movable actuating element between its first and second positions causes movement of the track switch between a first

switch position in which a first selected one of a plurality of tracks is selected and a second switch position in which a second selected one of a plurality of tracks is selected.

2. The switching apparatus of claim 1, further comprising a spur gear coupled to and driven by the motor, and a cam gear engaged to and driven by the spur gear, the movable actuating element being operatively connected to and driven by the cam gear.

3. The switching apparatus of claim 1, wherein protective compartment of the housing defines an opening on a side of the protective compartment facing the track switch.

4. The switching apparatus of claim 1, wherein the plurality of tracks form a track section.

5. The switching apparatus of claim 4, wherein at least a portion of the housing is molded to the track section.

6. The switching apparatus of claim 4, wherein the housing includes a base plate molded to the track section.

7. The switching apparatus of claim 1, wherein the track section includes two outer rails and a middle rail, the two outer rails being grounded and the middle rail carrying electrical current.

8. The switching apparatus of claim 1, wherein the movable actuating element is a lever.

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