A battery operated miniature toy locomotive for use in a toy railway system is claimed. The toy railway system comprises a toy railway track configuration made up of a plurality of wooden toy railway track segments. Each wooden track segment has a pair of uniformly spaced depressions extending from a first connecting end to a second connecting end of each wooden track segment. The toy locomotive has a first pair of wheels positioned at a proximal end of the toy locomotive and a second pair of wheels positioned at a distal end of the toy locomotive. The first and second pairs of wheels are adapted for placement within the depressions formed on each wooden track segment. The toy locomotive further comprises a locomotive housing which has an interior surface and an exterior surface, and a motor for providing energy to the first pair of wheels and the second pair of wheels. The motor is positioned within the housing and operatively connected with the first pair of wheels and the second pair of wheels wherein both pairs of wheels are simultaneously powered by the motor.
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FOUR-WHEEL DRIVE TOY LOCOMOTIVE

Technical Field

The present invention relates generally to toy vehicles and, more particularly, to a four wheel drive toy locomotive for inclusion in a toy railway system.

Background

In the toy vehicle industry, small toy trains are often run on wooden tracks. These railway systems are designed to grow with the child. In other words, railway configurations can range from very simple ovals to complex systems incorporating bridges, buildings, tunnels, and towns. Many other accessories are available as well such as: toy figurines, bushes, shrubs, and trees to lend the system a realistic effect; playmats, playboards, and play tables on which to build a railway system; carry bags and boxes in which to store the railway system when not in use; and, storybooks, iron-ons, decals, and coloring books to further stimulate the child's imagination.

The railway configurations are built from individual track sections. The track sections range in size and shape. There are countless possibilities for individual track sections: some are straight; some feature switching mechanisms; some are curved; and, some are ascending for connection to another track
positioned at a higher level.

One of the most important aspects of these railway systems is that the track sections be interchangeable. Accordingly, most track sections include male and/or female connectors at opposing ends. This allows the track sections to be connected end to end in a variety of configurations. Adding to the interchangeability of the track sections is the fact that these track sections are usually reversible having rail depressions on both sides.

Until recently, the toy locomotives employed to push or pull other toy railway vehicles around the tracks were powered almost exclusively by external forces. The external forces were generally supplied by the person playing with the toy locomotive. Recently, battery powered toy locomotives were introduced so that the toy locomotives were self-powered and, therefore, capable of traversing along the toy railway configuration without the aid of external forces.

These attempts at providing a battery powered toy locomotive have been met with mixed results. Individually, the toy locomotive traversed the railway configuration adequately. However, when encumbered with a load, the toy locomotives performed less satisfactorily. For example, the toy locomotives were unable to pull other toy railway cars.

In addition, these early battery powered toy locomotives have been two-wheel, rear-wheel drive vehicles. This configuration does not provide the power necessary to reliably climb
ascending toy track segments nor does it provide the power necessary to push and pull other toy railway cars.

Furthermore, these toy locomotives do not have a fully disengageable clutch. Therefore, when the toy locomotive is not powered, these toy locomotives do not freewheel and are difficult to advance without some effort by the user.

Finally, the early attempts at providing a battery operated toy locomotive utilized AAA sized batteries. Coupled with the inefficiency of the motors employed, the useful life of the battery was insufficient.

Therefore, there is a need for an improved battery operated toy locomotive for use with the toy railway systems described herein.

**Summary of the Invention**

The present invention provides a novel self-powered toy vehicle for use in a railway system. The toy locomotive is generally attachable to a second toy vehicle and capable of traversing along a toy railway configuration made up of a plurality of wooden toy railway segments. Each of the wooden track segments has a pair of uniformly spaced depressions extending the length of the wooden track segment.

The toy locomotive is a miniature, battery operated toy vehicle. It has a first pair of wheels positioned at a proximal end of the locomotive and a second pair of wheels positioned at a distal end of the locomotive. The wheels are adapted to fit within the depressions formed on the wooden track.
segments. The toy locomotive further comprises a housing and a motor. The motor fits within the housing and is operatively connected to the first and second pairs of wheels. The wheels are simultaneously powered to provide a four wheel drive vehicle.

Other features and advantages of the invention will be apparent from the following specification taken in conjunction with the following drawing.

**Brief Description of the Drawings**

Figure 1 is a perspective view of a battery operated miniature toy locomotive;

Figure 2 is an exploded perspective view of a battery operated miniature toy locomotive;

Figure 3 is a cut away bottom view of the upper portion of a housing of a battery operated miniature toy locomotive; and

Figure 4 is a cut away top view of the lower portion of a housing of a battery operated miniature toy locomotive.

**Detailed Description**

While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail a preferred embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the embodiment illustrated.

Figure 1 is a perspective view of a self-powered toy vehicle 10 of the present
invention. The self-powered toy vehicle 10 of Figure 1 comprises a miniature locomotive body 12, a first wheel system 16 positioned at a proximal end 20 of the toy vehicle 10, and a second wheel system 24 positioned at a distal end 28 of the toy vehicle 10.

Figure 2 is an exploded perspective view of the self-powered toy vehicle 10 of the present invention. Figure 2 shows that the first and second wheel systems 16, 24 are substantially identical. Accordingly, each wheel system 16, 24 comprises a drive gear 29 and an axle 30 which connects opposing tire assemblies 31. The drive gear 29 has a square opening for receiving an elongate, square-ended boss located on the tire assembly 31. This structure leads to an easy assembly because the axle 30 easily passes through the larger square opening in the drive gear 29 rather than force fit through the drive gear 29. Furthermore, this structure provides a more reliable wheel system because the drive gear 29 directly drives the tire assembly 31 rather than relying on a high tolerance press fit with the axle 30. It also provides shock protection to the axle 30 because the elongate, square-ended boss transmits the shocks experienced by the tire assembly 31 directly to a housing 32 rather than the axle 30.

As shown in Figure 2, the locomotive body 12 provides a cover for the housing 32. The cover can be fashioned to resemble any toy vehicle, but in the preferred embodiment of this invention, the cover resembles a toy locomotive body. The housing 32 comprises an
upper portion 36, a lower portion 40, an
interior surface 44, and an exterior surface
48. The upper portion 32 includes a battery
receiving portion 52 adapted for maintaining a
AA sized battery 56. A positive terminal 60 is
positioned at one end of the battery receiving
portion 52 and a negative terminal 64 is
positioned at an opposing end.

The lower portion 40 of the housing 32
provides the chassis for the toy vehicle 10.
Accordingly, the lower portion 40 provides a
space for a motor 66 and the gearing that
drives the first and second wheel systems 16,
24. In the preferred embodiment, a Mabuchi FA-
130RA-2270 double drive shaft motor is
utilized.

The gearing that drives the first and
second wheel systems 16, 24 comprises first and
second wobble gear assemblies 68, 70. These
wobble gear assemblies 68, 70 provide increased
efficiency over the gearing assemblies
currently available, and the life of the
batteries used to power the toy vehicles is
prolonged as high as three times. The first
and second wobble gear assemblies 68, 70 are
substantially identical. The first wobble gear
assembly 68 drives the first wheel system 16,
and the second wobble gear assembly 70 drives
the second wheel system 24.

The first and second wobble gear
assemblies 68, 70 each comprise a pinion 72, a
crown gear 74, a spur gear 76, an internal gear
78, and a rod 80. The pinion 72 is joined to a
drive shaft 82 which extends from the motor 66.
As the drive shaft 82 turns, the pinion 72
turns. The pinion's 72 teeth mate with the crown gear's 74 teeth to drive the crown gear 74. The crown gear 74 spins freely about the rod 80 which defines an axis of rotation. The teeth of the crown gear 74 are generally parallel with the axis of rotation. The crown gear 74 is backed by an eccentric spur gear driver 84. The eccentric spur gear driver 84 is used to drive the spur gear 76. The eccentric spur gear driver 84 is positioned on the rear face of the crown gear 74 and is slightly off-center. In the preferred embodiment, the eccentric spur gear driver 84 is positioned approximately 0.012 ins. from the axis of rotation.

The spur gear 76 has an appendage 86 which extends from the body of the spur gear 76. The appendage contacts a portion of the housing 32 to prevent the spur gear 76 from rotating about the axis of rotation. Rather than rotating about the axis of rotation, the spur gear 76 has an orbital movement. The spur gear 76 orbits about the axis of rotation. The teeth of the spur gear 76 engage the teeth of the internal gear 78 to drive the internal gear 78. In the preferred embodiment, the spur gear 76 has nineteen teeth and the internal gear 78 has twenty teeth. Therefore, the spur gear 76 rotates the internal gear 78 through the equivalent of one tooth space for each orbit. Thus, the crown gear 74 will make twenty revolutions to one revolution of the internal gear 78.

The rod 80 is attached to the internal gear 78 so that one revolution of the internal
gear 78 produces one revolution of the rod 80. The rod 80 extends through the spur gear 76 and the crown gear 74 so that the spur gear 76 and the crown gear 74 freewheel about the rod 80. The rod 80 is attached to a clutch assembly 88 at an end opposing the end connected to the internal gear 78.

In the preferred embodiment, there are first and second clutch assemblies 88. The clutch assemblies 88 are substantially identical. Accordingly, each clutch assembly 88 comprises a block key 90, a first clutch 92 plate, a second clutch plate 94, a wheel gear 96, and a clutch spring 98. In the preferred embodiment shown in the drawings, a single clutch spring 98 is provided. The rod 80 is attached to the block key 90 which is slidable fit into the first clutch plate 92. The first clutch plate 92 engages the second plate 94 and transfers movement by the rod 80 to the second clutch plate 94 which freewheels about the rod 80. The teeth on the first and second clutch plates 92, 94 are rounded so that they are not tightly interlocked. In other words, when a force external to the toy vehicle 10 is greater than the force that holds the first and second clutch plates 92, 94 in contact, the first clutch plate 92 partially disengages the second clutch plate 94 by sliding back along block key 90, and the clutch plates 92, 94 will not be locked together because the teeth are not tightly interlocked and, therefore able to turn against each other when this occurs. These clutch assemblies 88 prevent damage from occurring to the various gears and the motor 66.
from overheating.

The wheel gear 96 is connected to the second clutch plate 94. Each wheel gear 96 drives the corresponding wheel assembly 16, 24 by engaging the wheel assemblies' drive gears 29.

The clutch spring 98 engages the first clutch plate 92 and provides the engaging force between the first and second clutch plates 92, 94. In the preferred embodiment, the clutch spring 98 is a thin, elongate member produced from a material which is capable of undergoing a degree of elastic deformation.

The clutch spring 98 is attached to a pivotal lever 100 which supports the clutch spring 98 within the housing 32. The pivotal lever 100 is attached to the upper portion 36 of the housing 32 by a round boss 102 (see Figure 3) which frictionally engages an aperture 104 located approximately in the center of the pivotal lever 100. The pivotal lever 100 is capable of pivoting about the round boss/aperture connection. This allows the clutch spring 98 to be selectively positioned so that the engaging force, which keeps the first and second clutch plates 92, 94 in operative communication, is either applied or not applied.

A transmission switch 106 provides the pivoting force which determines whether the engaging force is selectively applied or not applied. The transmission switch 106 is a three position switch. Accordingly, the transmission switch 106 can be selectively positioned in a neutral or off position in
which the clutch assemblies 88 are disengaged and the motor 66 is not powered, a reverse position, or a forward position. In the reverse and forward positions, the motor 66 is powered and the clutch assemblies 88 are engaged. As the names suggests, the reverse position causes the toy vehicle 10 to move backward, and the forward position causes the toy vehicle 10 to move forward. The transmission switch 106 includes a small arm 108 that contacts the pivotable lever 100 when the transmission switch 106 is in the forward and reverse positions. This arm 108 forces the pivotable lever 100 to move the clutch spring 98 into contact with the first clutch plate 92, and thus provide the engaging force to the clutch assembly 88.

While specific embodiments have been illustrated and described, numerous modifications are possible without departing from the spirit of the invention, and the scope of protection is only limited by the scope of the accompanying claims.
Claims

What is claimed is:

1. A toy railway system comprising a miniature battery operated toy locomotive attachable to a second toy railway vehicle for traversing along a toy railway track configuration made up of a plurality of wooden toy railway track segments, each wooden track segment having a pair of uniformly spaced depressions extending from a first connecting end to a second connecting end of each wooden track segment, the toy locomotive having a first pair of wheels positioned at a proximal end of the toy locomotive and a second pair of wheels positioned at a distal end of the toy locomotive, the first and second pairs of wheels adapted for placement within the depressions formed on each wooden track segment, the toy locomotive comprising:

   a toy locomotive housing having an interior surface and an exterior surface; and
   a motor for providing energy to the first pair of wheels and the second pair of wheels, the motor positioned within the housing and operatively connected with the first pair of wheels and the second pair of wheels wherein both pairs of wheels are simultaneously powered by the motor.
2. A self-powered toy vehicle attachable to a second toy vehicle and capable of transferring movement to the second toy vehicle, the self-powered toy vehicle comprising:

5 a housing having an interior surface and an exterior surface;

a first wheel system having a pair of wheels, at least a portion of each wheel extending beyond the exterior surface of the housing;

a motor for providing energy to the first wheel system positioned within the housing; and

a first wobble gear assembly engaging the motor at a first end and the first wheel system at a second end for transferring energy from the motor to the first wheel system.
3. The self-powered toy vehicle of claim 2 wherein the first wobble gear assembly comprises:
   a pinion connected to a drive shaft which extends from the motor;
   a crown gear for engaging the pinion on one side and having an eccentric spur gear driver on an opposing side;
   a spur gear in communication with the eccentric spur gear driver wherein a rotational movement provided to the crown gear produces an orbital movement in the spur gear;
   an internal gear powered by the spur gear wherein the orbital movement of the spur gear produces a rotational movement in the internal gear; and
   a rod connected at a first end to the internal gear and having a second end for transferring energy to the first wheel system wherein the rotational movement by the internal gear is transferred along the rod to the first wheel system.

4. The self-powered toy vehicle of claim 3 wherein the crown gear has an axis of rotation and the eccentric spur gear driver is located at a position which is off-center from the axis of rotation.

5. The self-powered toy vehicle of claim 3 wherein the crown gear freewheels about the rod.

6. The self-powered toy vehicle of claim 3 wherein the spur gear freewheels about the rod.
7. The self-powered toy vehicle of claim 3 wherein the spur gear comprises an appendage which engages the housing to prevent the spur gear from having a rotational movement whereby the spur gear exhibits the orbital movement.

8. The self-powered toy vehicle of claim 3 including a clutch assembly connected to the second end of the rod and positioned between the wobble gear assembly and the first wheel system for disengaging the first wobble gear assembly from the first wheel system wherein each wheel is freewheeling when the clutch assembly is disengaged.

9. The self-powered toy vehicle of claim 8 wherein the clutch assembly comprises:
   a first clutch plate and a second clutch plate in mirror image relationship, the first and second clutch plates being cooperatively engageable;
   a block key in communication with the first clutch plate for transferring energy from the motor to the first clutch plate;
   a wheel gear in communication with the second clutch plate for transferring energy to the first wheel system; and
   a clutch spring for providing an engaging force by which the first and second clutch plates are engaged.
10. The self-powered toy vehicle of claim 9 further comprising a second wheel system having a second pair of wheels, at least a portion of each wheel extending beyond the exterior surface of the housing, and a second wobble gear assembly substantially similar to the first wobble gear assembly and engaging the motor at a first end and the second wheel system at a second end for transferring energy from the motor to the second wheel system.

11. The self-powered toy vehicle of claim 2 wherein the motor can be operated in either a forward mode or a reverse mode.

12. The self-powered toy vehicle of claim 2 wherein the first wheel system comprises a tire assembly, an axle, and a drive gear the drive gear having a square aperture and the tire assembly having an elongate, square-ended boss for insertion into the square aperture.
13. A self-powered toy vehicle which is attachable to a second toy vehicle and capable of transferring movement to the second toy vehicle, the self-powered toy vehicle comprising:

a housing having an interior surface and an exterior surface;

a first wheel system having a pair of wheels, at least a portion of each wheel extending beyond the exterior surface of the housing;

a motor engaging the first wheel system for providing energy to the first wheel system; and

a clutch assembly for disengaging the motor from the first wheel system wherein the first wheel system is freewheeling when the clutch assembly disengages the motor from the wheel system.

14. The self-powered toy vehicle of claim 13 wherein the clutch assembly comprises:

a first clutch plate and a second clutch plate in mirror image relationship, the first and second clutch plates being cooperatively engageable;

a block key in communication with the first clutch plate for transferring energy from the motor to the first clutch plate;

a wheel gear in communication with the second gear for transferring energy to the first wheel system; and

a clutch spring for providing an engaging force by which the first and second clutch plates are engaged.
15. The self-powered toy vehicle of claim 14 wherein the engaging force can be offset by an external force applied to the first wheel system wherein the first and second clutch plates partially disengage allowing the first and second clutch plates to slidably rotate against each other wherein the external force is not transferred to the first wobble gear assembly.

16. The self-powered toy vehicle of claim 15 wherein the clutch spring is interconnected to a transmission switch.

17. The self-powered toy vehicle of claim 15 wherein the transmission switch can be selectively positioned between a forward position, a reverse position, and a neutral position wherein the clutch assembly is engaged in the forward and reverse positions and disengaged in the neutral position.

18. The self-powered toy vehicle of claim 17 wherein the clutch assembly further comprises a pivotable lever for supporting the clutch spring, the pivotable lever being engageable with the transmission switch wherein selectively positioning the transmission switch in the forward and reverse positions causes the pivotable lever to move the clutch spring into a position to provide the engaging force to the first clutch plate.
19. The self-powered toy vehicle of claim 14 further comprising a first wobble gear assembly between the motor and the clutch assembly, the first wobble gear assembly engaging the motor at a first end and the clutch assembly at a second end for transferring energy from the motor to the clutch assembly.

20. The self-powered toy vehicle of claim 19 wherein the first wobble gear assembly comprises:

- a pinion connected to a drive shaft which extends from the motor;
- a crown gear for engaging the pinion on one side and having an eccentric spur gear driver on an opposing side;
- a spur gear in communication with the eccentric spur gear driver wherein a rotational movement provided to the crown gear produces an orbital movement in the spur gear;
- an internal gear powered by the spur gear wherein the orbital movement of the spur gear produces a rotational movement in the internal gear; and
- a rod connected at a first end to the internal gear and having a second end for transferring energy to the first wheel system wherein the rotational movement by the internal gear is transferred along the rod to the first wheel system.
21. The self-powered toy vehicle of claim 19 further comprising a second wheel system having a second pair of wheels, at least a portion of each wheel extending beyond the exterior surface of the housing, and a second wobble gear assembly substantially similar to the first wobble gear assembly and engaging the motor at a first end, and the clutch assembly including third and fourth clutch plates substantially similar to the first and second clutch plates, the fourth clutch plate for driving the second wheel assembly, the second wobble gear assembly connected at a second end to the third clutch plate wherein energy is transferred from the motor along the second wobble gear assembly through the third and fourth clutch plates to the second wheel system.

22. The self-powered toy vehicle of claim 13 wherein the first wheel system comprises a tire assembly, an axle, and a drive gear the drive gear having a square aperture and the tire assembly having an elongate, square-ended boss for insertion into the square aperture.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6  A63H19/10  A63H19/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6  A63H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is taken alone and when combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

3 May 1999

Date of mailing of the international search report

12/05/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
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Tel. (+31-70) 340-3040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Grossmann, C.
<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>A</td>
<td>GB 2 024 633 A (SHAW C W) 16 January 1980 see page 1, line 50-75</td>
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<tr>
<td>A</td>
<td>US 1 842 021 A (HANLEY JOHN A) 19 January 1932 see column 1, line 1-11 see page 2, line 22-28</td>
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INTERNATIONAL SEARCH REPORT

Box I  Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.☐ Claims Nos.; because they relate to subject matter not required to be searched by this Authority, namely:

2.☐ Claims Nos.; because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3.☐ Claims Nos.; because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II  Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2.☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4.☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1998)
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claim :1
   Toy railway system comprising 4-wheel-drive locomotive.

2. claim:2-12
   Toy vehicle with wobble gear assembly.

3. claim:13-22
   Toy vehicle with clutch assembly that allows freewheeling of a wheelsystem when disengaging from the motor.
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<th>Publication date</th>
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<tr>
<td>US 5427561 A</td>
<td>27-06-1995</td>
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<td>US 4596533 A</td>
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<td>GB 2011016 A</td>
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<td>US 1842021 A</td>
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