

A SELF-PROPELLED RECONFIGURABLE RUNNING TOY

This invention relates to a self-propelled reconfigurable running toy.

The invention provides a self-propelled reconfigurable running toy capable of both a translational movement across a support surface in a first configuration and a rotational movement to transform it to a second configuration while it is being played with, comprising:

- a frame member having a longitudinal axis;
- a wheel assembly attached to the frame member;
- a motor assembly attached to the frame member

and which is capable of operatively driving the wheel assembly for translational movement across the support surface; and

means for rotating the frame member about an axis transverse to its longitudinal axis so that its longitudinal axis is moved to a substantially vertical position at approximately 90° to its initial substantially horizontal position at the start of said translational movement after a predetermined period of translational movement and including a base member pivoted to the frame member and providing alternative means for mounting the running toy on said support surface said base member being locked to the frame member in the first configuration; means for releasing the locking means after the predetermined running time, means for causing the unlocked base member to rotate about the pivot with sufficient force to cause the frame member to rotate, whereby said toy is stood upright on said surface on said base member in the second configuration, said base member carrying auxilliary wheels to enable the toy in its second configuration to continue movement over said support surface, and the frame member carrying stop means for defining the range of rotation of the base member and projecting means on its underside for contacting the support surface on rotation of the base member to cause a reaction to the force generated by the rotation of the base member.

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One embodiment of the invention comprises a self-propelled running toy which in a running vehicle mode, can travel with leg portions folded up and locked in a position above a body portion, and which is so designed that, while running, the folded-up portions can suddenly extend straight forward to assume the form of legs so that the toy has a robot-like shape.

The toy of this invention is so constructed that the folded-up portions suddenly extend while the toy is travelling to provide a turning movement so that the toy is rotated into an upright (standing) posture by the reaction force generated by the sudden movement of the folded-up (leg) portions.

The following problems are involved in the realization of such a reconfigurable running toy.

The first problem was that, in order to ensure the maintenance of a stable standing-up posture of the toy, it was necessary to concentrate the reaction force created by the rapid rotational movement of the leg portions, which is the motive force producing the standing-up motion, and it was found

that the toy was unable to sustain a stable, upright, standing posture unless this reaction force was controlled so as to lie within a certain specified range.

The second problem concerned a means for stopping the leg portions instantaneously just at the position at which they have extended straight forwards relative to the toy body portion. This is essential to enable the entire toy assembly, including its upper half, to achieve a standing-up motion under the reaction force produced by the rapid rotational extension movement of the folded-up portions of the toy when in a running mode.

The third problem resided in the necessity for providing a means for eliminating any excess reaction force that would remain after the toy has achieved its standing posture. If any excess reaction force remains after the toy has taken up its standing posture, this might force the toy to tumble forward.

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As a feature of this invention, a member for expediting the standing motion of the toy is provided at a lower part of the toy body portion to serve as a fulcrum for the standing motion, the member being so designed that it projects by a certain distance. A means is also provided for defining the range of rotation of the leg portions when they are released from the lock position, so that the leg portions can take up a substantially extended-forward position relative to the body portion. Further, an auxiliary wheel assembly is mounted at the end of each leg portion to enable the toy to move while maintaining its standing posture.

The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which :

FIG. 1 is a general perspective view of a self-propelled, reconfigurable running toy in accordance with this invention, the toy being shown in a running mode with its leg portions folded up into a locked position.

FIG. 2 is also a general perspective view of the toy of FIG. 1, reconfigured into a standing robot-like figure with the leg portions extended.

FIG. 3 is a rear perspective view of the embodiment of FIG. 2.

FIG. 4 is a longitudinal section taken along the line IV-IV of FIG. 1, showing the internal mechanism.

FIG. 5 is an exploded perspective view of the drive mechanism.

FIG. 6 is an exploded perspective view of a member expediting the standing motion, illustrating the manner of adaptation of said member.

FIG. 7 is a plan view of the head portion of the toy when in its robot configuration.

FIG. 8 (A) and (B) illustrate the relationship between the standing motion expediting member and the floor surface.

FIG. 9 are sequential sketches of the toy,

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illustrating the process of its reconfiguration.

The following description is provided to enable any person skilled in the toy industry to make and use the present invention and sets forth the best modes contemplated by the inventor for carrying out his invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the generic principles of the present invention have been defined herein specifically to provide a novel self-propelled reconfigurable running toy.

The accompanying drawings show an embodiment of the invention applied to the type of toy which can be transformed from a running vehicle form into a robotic humanoid, or vice versa. That is, the self-propelled reconfigurable toy according to this invention can take either the form of a running toy (FIG. 1) when folded up, or the form of a toy robot (FIG. 2) when extended. The toy consists essentially of a body portion 2 and a pair of leg portions 3 rotatably secured to the body portion 2 so that they can be rotated up or down (i.e., folded up or extended), each of the leg portions having

a sole surface 30 traverse to the longitudinal axis of the toy.

This reconfigurable toy 1 can be changed from the folded-up state shown in FIG. 1 into the extended state shown in FIG. 2, or vice versa.

The mechanism and structural parts of the toy 1 of this invention will now be described in detail.

Referring to the mode in which the toy can be played with as a robot (FIG. 2), a protuberance 4 with the appearance of a head is provided at the top end of the body portion 2, and a pair of arms 5 are rotatably mounted on either side of the body.

The rear of the body portion 2 has a first surface 40 which, when the toy is folded up as shown in FIG. 1, constitutes the bottom surface of the running toy. Projecting from this rear surface, at positions close to the shoulder portions, are a pair of wheels 6 (FIG. 3) for facilitating the movement of the toy when in running mode. Although there are two of these wheels shown in the embodiment, any number of wheels can be selected as required.

A pair of projections 7 are integrally formed at the lower end of the first surface 40 on the rear of the body portion 2, as shown in FIGS. 3 and 4,

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the projection being designed to abut against the rear of the leg portions 3 when in the robot mode (in the standing configuration) to restrict the rotation of the leg portions 3.

A known pull-back type of spring-powered prime mover assembly 8 is housed in the body portion 2, as shown in FIG. 4. This prime mover assembly 8 (shown in perspective in FIG. 5) is attached to the inside of the first surface 40 of the body portion 2 and consists of, although not shown in the drawings, a spring and a gear train linked to the spring. A shaft 9 passes through a section of the prime mover assembly close to one end, so that the shaft 9 is given a driving force to rotate the wheels 6 mounted at either end of the shaft 9.

A cam 11 is mounted on the prime mover output shaft 10 which rotates at a low speed, to act as a means for releasing the lock of the leg portions, the cam 11 having a pawl 11a.

A lever 13 is provided on the outside of the shaft 9 side end of the prime mover assembly 8 so that the lever 13 can rotate about a shaft 12. The lever 13 is T-shaped and has a hook 14a at the end of a vertical portion 14 thereof. A horizontal portion 15 of this T-shaped lever 13 also has a hook

15a formed at its end. The hooked end of the vertical portion 14 of the lever 13 projects from an opening 2a formed in the chest portion on one side of the body 2, for example on the left side as you face the robot (see FIGS. 2 and 4). The hook 15a at the end of the horizontal portion 15 is so positioned that it can engage with the pawl 11a of the cam 11 (see FIG. 4).

A compressed spring 16 is positioned between the horizontal portion 15 of the lever 13 and the inner wall of the body 2 so that the lever 13 is always given a turning force in the clockwise direction in FIG. 5. Thus the end of the horizontal portion 15 normally stays in contact with the cam 11 and, accordingly, when the cam 11 turns in the counterclockwise direction in FIG. 4 when the toy is in a running mode, an arcuate portion of the pawl 11a of the cam 11 engages with the hook 15a to make the lever 13 turn in the counter-clockwise direction in FIG. 5 to release the hook 14a from the engaged leg portions, as described in more detail below.

Since the cam 11 fits tightly onto the output shaft 10 to provide a frictional engagement therebetween, the cam 11 is forced to turn with the output

shaft 10 unless sufficient external force is exerted on the cam 11 to inhibit its motion.

An opening 3a is formed in the leg portion 3 on the same side of the robot as the chest portion from which the hooked end 14a of the T-shaped lever 13 projects. When the toy is folded up, the hook 14a fits into the opening 3a and engages with its peripheral edge, thus holding the leg portions 3 in their folded-up position.

The sole of each leg portion 3 has a surface (second surface) 30 which is perpendicular to the longitudinal axis of the toy body and has a sufficient area to enable the toy to take up and maintain a standing posture. An auxiliary wheel 17 for movably supporting the standing toy 1 is rotatably mounted on the toe side of each second surface 30. These wheels 17 at the base of the leg portions engage with the support surface when the toy 1 is standing in the form of a robot. Therefore, when there is still excess turning moment acting in the forward direction on the toy 1 after it has assumed the standing posture, the toy is forced to make a forward inertial movement with the aid of the wheels 17, while keeping its standing posture, so that the excess turning moment in the forward

direction is cancelled out. Thus, the toy when in a standing mode (in the form of a robot) can securely maintain its standing posture with minimal danger of falling forward.

The leg portions 3 are rotatably (foldably) attached to the body portion 2 by a shaft 18 secured to the lower end of the front of the body portion 2. The leg portions 3 form the upper or base member of the toy, while the body portion 2 forms the lower or frame portion. The frame member 2 has a longitudinal axis that is parallel to the support surface in a vehicle configuration and the body portion 2 rotates to parallel alignment with this longitudinal axis when the toy is reconfigured into a standing robot. Although not shown, the shaft 18 is loaded by a torsion coil spring so that the legs 3, when folded up, are always urged to rotate in the extension direction by the force of the coil spring.

At the rear of the head portion 4 a cutout 19 is provided, as shown in FIG. 6, and a rhomboidal member 20 for expediting the standing motion of the toy is fitted into the cutout 19 so that the member 20 can rotate about a shaft hole 19b formed toward one end of the shorter diagonal of the rhomboid. The shaft hole 19b is fitted onto a pin (not

shown) in the cutout 19 so that the rhomboidal member 20 is freely rotatable about the pin. Recesses 20a, 20b are formed on the underside of the rhomboidal member 20, as shown by the broken lines in FIG. 6. These recesses 20a, 20b are designed to receive a protuberance 19a formed on the lower side of the cutout portion 19.

Edges 21, 22 of the member 20 protruding from the cutout 19 in the head portion 4 are at different distances ℓ_1 and ℓ_2 ($\ell_1 > \ell_2$) from the shaft hole 19b (FIG. 6). Therefore, if the member 20 is turned counterclockwise so that its edge 22 projects as shown in FIG. 7, the amount by which the member 20 protrudes is less than when the edge 21 projects. This is illustrated in FIGS. 8 (A) and (B). FIG. 8 (A) shows the condition where the edge 22 of the member 20 projects. In this case, the distance a between the member 20 and the support surface is large. FIG. 8 (B) illustrates the condition where the edge 21 projects; in which case the distance a' between the member 20 and the support surface is small.

This embodiment of the present invention will now be considered from the aspect of how to play with it.

First, the leg portions 3 are rotated upward about the shaft 18 against the elastic force of the torsion coil spring (not shown), and are thereby folded up into a position of which they lie over the body portion 2. The hook 14a of the lever 13 enters the opening 3a in one leg portion 3 (see FIG. 4). During the course of this movement,

the hook 14a hits an edge of the opening 3a and, as the lever 13 rotates further counterclockwise in FIG. 4, against the opposing force of the spring 16, and the hook 14a is forced to pass over the edge of the opening 3a and is caught inside thereof (FIG. 4),

In this condition, the leg portions 3 are held folded-up against the force of the torsion coil spring (not shown) by the engagement of the hook 14a. Thus the leg portions 3 are placed atop the body portion with their rear surfaces facing upwards, and the projections 7 integral with the body portion 2 are positioned with their ends facing forwards, forming the running vehicle toy as shown in FIG. 1. In this form of the toy, the wheels 6 are positioned in engagement with the support surface to enable the running motion of the toy.

To make the toy run, when a known pull-back type of spring powered prime mover is used, the child holds the toy body, presses the wheels 6 against the support surface, and pulls the toy backward so that the spring (not shown) is wound up by the axle 9 of the wheels 6. The output shaft 10 on which the spring is loaded is also forced to turn clockwise in FIG. 4, causing a corresponding rotation

of the cam 11. Consequently, the stepped portion of the pawl 11a of the cam 11 engages with the hook 15a, but since the cam 11 is only frictionally attached to the output shaft 10, the output shaft 10 alone is forced to turn clockwise while this engagement is maintained leaving the cam 11 slipping around the shaft, thereby winding up the spring (not shown).

When the child lets the toy go under this condition, the spring begins to unwind to make the wheels 6 rotate, causing the toy 1 to start running. As the output shaft 10 turns further counterclockwise in FIG. 4, the external arcuate portion of the cam pawl 11a hits the end of the hook 15a to raise it, forcing the lever 13 to turn counterclockwise in FIG. 4 against the elastic force of the spring 16, so that the hook 14a is disengaged from the edge of the opening 3a. Whereupon the leg portions 3 are urged to spring back to their extended position in relation to the body portion 2 by the restoring force of the torsion coil spring (not shown) wound around the shaft 18 which attaches the leg portions 3 to the body portion 2. As a consequence, the rhomboidal member 20 protruding from the rear end of the protuberance 4 is knocked against

the support surface to produce a turning moment (reaction force) in response to the action of the centrifugal force generated by the rapid rotation of the leg portions 3. This jerks the toy, which has now been transformed into a robot, up into the air, rotating it through about 90° , so that it lands on the floor with the sole surfaces (second surfaces) 30 of the leg portions 3 engaging with the support surface.

The force with which the projecting member 20 is knocked against the floor surface can be controlled by changing the distance between the member 20 and the floor surface by turning the member as illustrated in FIGS. 8 (A) and (B), and it is thereby possible to adjust the reaction force required for bringing the toy to its erect posture, thus ensuring that the toy can perform its standing motion.

Because of the provision of the pair of projections 7 which serve as means for restricting the rotation of the leg portions when they are released so that they can take up a substantially extended straight posture relative to the body portion of the toy, the leg portions can be brought to an instantaneous stop when they have reached their extended position after being released from their

folded-up position, making it possible to produce a large reaction force.

There will still be an excess reaction force when the toy has just landed on the floor surface, but since the auxiliary wheels 17 are provided at the ends of the leg portions 3, the toy 1 is able to make an inertial movement for an appropriate distance while maintaining its standing posture, so that any remaining moment in the forward direction is cancelled out. In other words, any excess force remaining after the toy has reached its standing posture is converted into a force which acts to let the toy make a forward inertial movement while maintaining its standing posture. This enables the sure and stable landing of the toy on the support surface with no danger of it tumbling forward, after it has assumed the standing posture.

The sequential motion of the toy during its transformation in play mode, until it assumes its standing posture as a robot is illustrated in FIG. 9.

CLAIMS

1. A self-propelled reconfigurable running toy capable of both a translational movement across a support surface in a first configuration and a rotational movement to transform it to a second configuration while it is being played with, comprising:

- a frame member having a longitudinal axis;
- a wheel assembly attached to the frame member;
- a motor assembly attached to the frame member

and which is capable of operatively driving the wheel assembly for translational movement across the support surface; and

means for rotating the frame member about an axis transverse to its longitudinal axis so that its longitudinal axis is moved to a substantially vertical position at approximately 90° to its initial substantially horizontal position at the start of said translational movement after a predetermined period of translational movement and including a base member pivoted to the frame member and providing alternative means for mounting the running toy on said support surface said base member being locked to the frame member in the first configuration; means for releasing the locking means after the predetermined running time, means for causing the unlocked base member to rotate about the pivot with sufficient force to cause the frame member to rotate, whereby said toy is stood upright on said surface on said base member in the second configuration, said base member carrying auxilliary wheels to enable the toy in its second configuration to continue movement over said support surface, and the frame member carrying stop means for defining the range of rotation of the base member and projecting means on its underside for contacting the support surface on rotation of the base member to cause a reaction to the force generated by the rotation of the base member

2. A toy according to Claim 1, wherein the base member can be rotated to a position in which it extends substantially coaxially



with the frame member, in which position the toy simulates a humanoid robot, the frame member simulating the body of the robot and the base member simulating the legs of the robot.

3. A toy according to Claim 2, wherein the base member is bifurcated to simulate a pair of legs and the auxilliary wheels are provided on each leg.
4. A toy according to Claim 3, wherein the legs include wheels along one edge only.
5. A toy according to any one of Claims 2 to 4, wherein the frame member includes a pair of robotic arm appendages.
6. A toy according to any one of Claims 2 to 4, wherein the frame member includes a pair of wings.
7. A toy according to any one of Claims 1 to 6 wherein the projecting means includes means for varying the reaction force for rotation of the frame member.
8. A toy according to Claim 7, the wherein degree of projection of the projecting means can be varied.
9. A toy according to Claim 8, wherein said project means comprises a rotatable lever that can be positioned at varying distance from the support surface.
10. A toy according to any one of Claims 1 to 9, wherein the stop means comprise pair of members extending forward of the frame member and parallel to the longitudinal axis thereof.
11. A toy according to any one of Claims 1 to 10, wherein the motor is a spring propelled motor.
12. A toy according to Claim 11, wherein the means for releasing the base member is activated by the spring propelled motor.



13. A toy according to any one of claims 1, to 12, including means for retaining said base member in a position in which it overlies the frame member with its longitudinal axis substantially parallel to the longitudinal axis of the frame member and means are provided for retaining the base member in said position for a predetermined period of translational movement of the toy, said means comprising a pivotally mounted lever carrying a latching member at one end and cam follower means at the other end, a cam co-operating with the cam follower means to pivot the lever to move the latching means from a latching position to a releasing position and rotating on translational movement of the toy, the lever being resiliently biased to the latching position of the latching member.

14. A toy according to any one of Claims 2 to 13, which in the non-robotic position simulates an aircraft.

15. A reconfigurable toy capable of a translational movement across a support surface and that is converted from a vehicle into a robot after a predetermined period of translational movement comprising:

a frame member having a longitudinal axis, the frame member simulating the body of a robotic figure;

means comprising a wheel assembly and a motor assembly attached to the frame member for translating the frame member across a support surface;

a base member pivotally mounted on the frame member for movement between a position in which it overlies the frame member and a position in which it extends substantially coaxially with the longitudinal axis of the frame member after rotation through approximately 180°, the base member simulating the legs of a robotic figure;

means for biasing the base member to its extended position in alignment with the longitudinal axis of the frame member and

means for locking the base member in its unextended position and;

means for releasing the base member from its unextended position overlying the frame member after a pre-determined time



during the translation of the toy in a vehicle configuration over a substantially longitudinal support surface whereby the rotational forces created by the movement of the base member relative to the frame member rotates the frame member automatically to a position in which its longitudinal axis is positioned substantially vertically at an angle of approximately 90° to an initial substantially horizontal position parallel to the support surface, such that when the toy terminates its movement and assumes a robotic configuration it is stood upright on the base member on the support surface.

16. A self-propelled reconfigurable toy capable of both a translational movement across a support surface in a first configuration and an automatic conversion into a second configuration after a predetermined period of translational movement the toy in its second configuration having a longitudinal axis rotated approximately 90° from the longitudinal axis of the toy in its first configuration comprising:

- a frame member having a longitudinal axis and a forward end and a rear end;

- means for translating the toy in its first configuration across the support surface;

- a base member pivotally attached to the forward end of the frame member;

- means for biasing the base member to an extended position in alignment with the longitudinal axis of the frame member in its second configuration;

- means for retaining the base member in a folded position above the frame member in the first configuration;

- means for releasing the base member from said folded position, the base member having sufficient weight that on rotation about its pivot point under the action of the biasing means the forward end of the frame member is initially lifted from the support surface in a first direction of rotation, which causes a reaction force between the rear end of the frame member and the support surface to then rotate it in a second opposite direction whereby when the second configuration is formed the toy is finally positioned upright standing on the base member with its axis at an



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angle of approximately 90° from the original position of the longitudinal axis.

17. A self-propelled reconfigurable running toy substantially as described herein with reference to the drawings.

