March 31, 1970 MASARU AOKI ET AL 3,503,152

DRIVE SYSTEM FOR WALKING TOYS

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Fig. 1

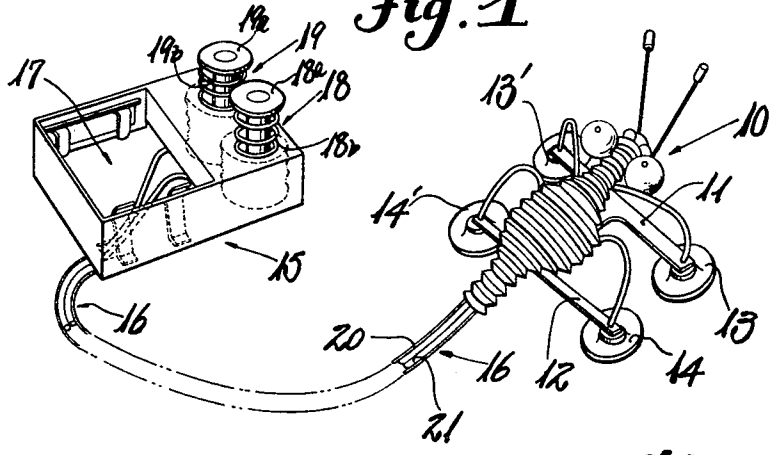


Fig. 2

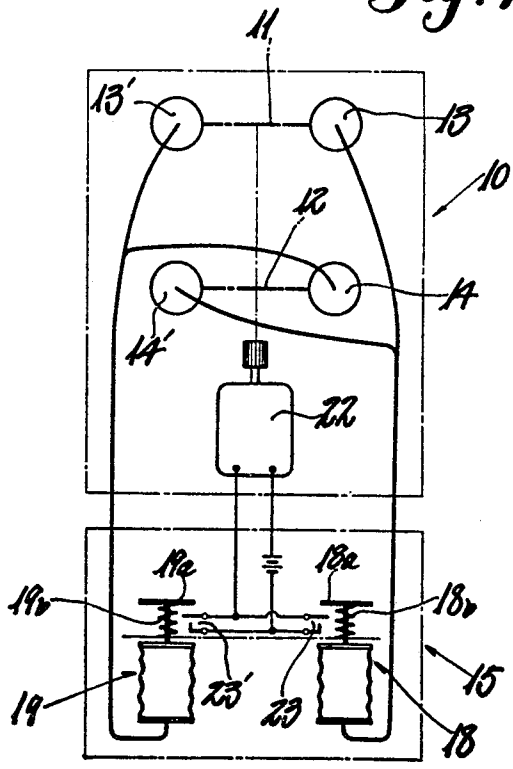


Fig. 3

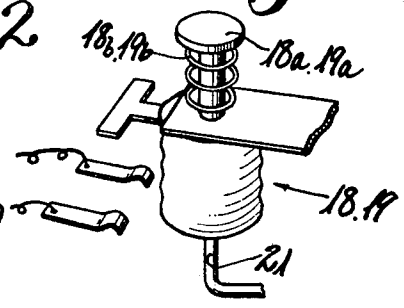
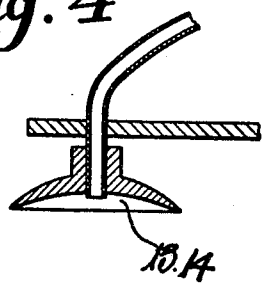


Fig. 4



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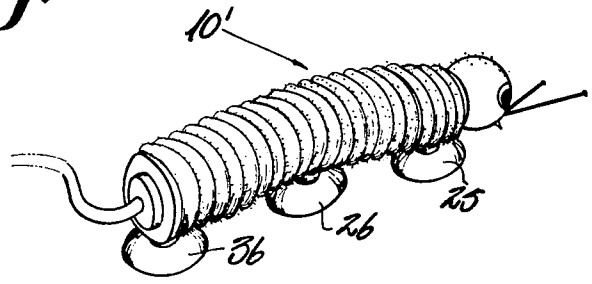
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DRIVE SYSTEM FOR WALKING TOYS

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Fig. 5



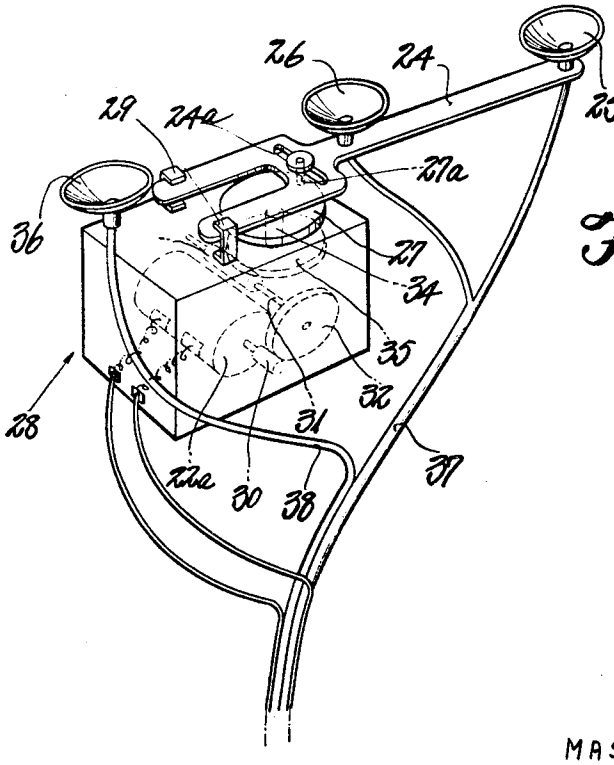


Fig. 6

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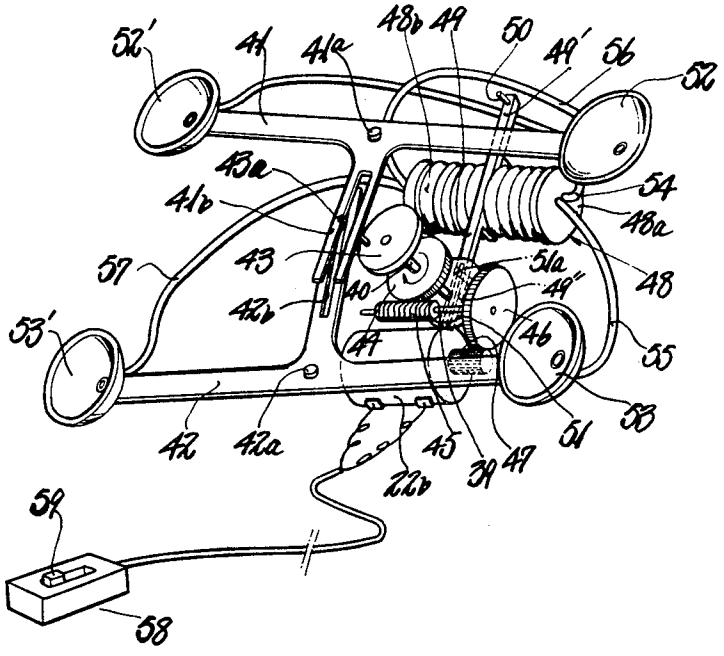
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DRIVE SYSTEM FOR WALKING TOYS

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Fig. 1.



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3,503,152

DRIVE SYSTEM FOR WALKING TOYS

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U.S. Cl. 46—247 9 Claims

ABSTRACT OF THE DISCLOSURE

A drive system for walking toys which enables such toys to crawl about such surfaces as a wall face, a ceiling face, etc. The drive system comprises a limb mechanism, which is operated by an electric motor, and a plurality of suckers to and from which air is supplied and removed by means of pneumatic systems. By operating the pneumatic systems the suckers are forced to stick fast to and to separate from a contacting surface, thereby enabling the toy to walk along any desired surface.

SUMMARY OF THE INVENTION

The present invention relates to a walking toy, and more particularly to a new and useful drive system for walking toys that can be applied to various kinds of walking toys and is capable of walking such toys on any surface.

An object of the present invention is to provide a new and useful drive system for walking toys which is capable of walking the toy not only on level surfaces, but also on any other surfaces, such as face of a glass window, a pillar face, a ceiling face, etc.

Another object of the present invention is to provide a new and useful drive system of the kind stated above which can be applied advantageously to animal simulating toys having a plurality of legs or limbs.

The drive system according to the present invention includes a limb assembly, which is operated by an electric motor, and is provided with a plurality of suckers to or from which air is supplied or removed by means of pumps, so that when the pumps are operated the suckers can stick fast to or separate from a contacting surface, thereby enabling the toy, in which the system is employed, to walk along any desired surface including a vertical surface.

Accordingly, a further object of the present invention, is to provide a new and useful drive system, of the kind described above, which enables such toys to crawl or move about along such surfaces as a wall face, a ceiling face, etc.

Therefore, if the drive system or device according to the present invention is applied to moving toys simulating insects, reptiles, etc. or other moving toys simulating small animals, such as worms, caterpillars, centipeds, alligators, lizards, etc., it will surely raise the so-called "play value" of these toys.

In accordance with the present invention there is provided a drive system for walking such toys which comprises two or more groups of suckers to be controlled by two or more pneumatic systems, two or more leg or limb members having such suckers at their ends and a mechanism for alternately pivoting such limb members, and is adapted to drive the toy fitted with the device in a forward or backward direction when the pneumatic systems and the mechanism are synchronously and associatedly operated for controlling the sticking action of the suckers and the rotational movement of the limb members.

The pneumatic systems including pumps and the mechanism including an electric motor may be so constructed as to be controllable by means of a remote-control unit.

It is, therefore, a still further object of the present invention to provide a device of the character stated above which is provided with a remote-control unit so as to drive the toy by manual operation thereof, said remote-control unit comprising pump means for supplying or removing air from the suckers, switch means for controlling the motor circuit, said switch means operative for actuating the limb structure and said pump means being operated associatedly and synchronously.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. 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 like reference characters refer to like elements in the several views.

In the drawings:

FIGURE 1 is a perspective view of a preferred embodiment of the present invention, illustrating the same systematically;

FIGURE 2 is a schematic diagram illustrating the construction of the embodiment shown in FIGURE 1;

FIGURE 3 is a perspective view of a pump unit to be used in the embodiment;

FIGURE 4 is a cross-sectional view of a sucker in the embodiment;

FIGURE 5 is a perspective view of another embodiment of the present invention, depicting a caterpillar-like worm toy to which the present device is applied.

FIGURE 6 is a perspective view from below of the embodiment shown in FIGURE 5, illustrating the operating mechanism of the limb structure thereof; and

FIGURE 7 is a perspective view from below of another embodiment in which pump means are integrally incorporated with the limb structure operating mechanism.

Referring to FIGURES 1 to 4, there are shown one of the preferred embodiments of the present invention and its principal parts. As shown in FIGURE 1, the device according to the present invention is provided with a frame comprising a pair of leg members **11, 12** and fixed to the body **10** of a toy, such as an insect simulating model.

In the illustrated embodiment, a pair of leg members **11, 12**, suckers **13, 13', 14, 14'** attached to respective ends of the leg members, and the body **10** form a quadrupedal model, which is connected to a remote-control unit **15** through a control wire **16**. The remote-control unit is of a box type and comprises a dry cell case **17** and a pair of pump units **18, 19**, and the control wire **16** comprises a plurality of electric wires **20** to supply electric power to an electric motor mounted in said toy body **10** and a plurality of air tubes **21** connected to said suckers.

The embodiment is further illustrated diagrammatically in FIGURE 2, in which numeral **10** indicates the body of a toy insect equipped with the drive system having leg members **11, 12**, and numeral **15** represents a remote-control unit forming a part of the system and having therein a pair of pumps **18, 19**. As shown, suckers **13, 13'** are secured to the ends of a front leg member **11** and connected by means of air tubes to pumps **18, 19**, respectively, while the other suckers **14, 14'** secured to the ends of a rear leg member **12** are also connected to pumps **18, 19**, respectively, in a similar way.

The two leg members **11, 12** are so attached to the toy body as to be swingable forward and backward, and

operated by means of an electric motor **22**. The electric circuit is so arranged as to be in operative connection with pushbuttons **18***a*, **19***a* of said pumps **18**, **19**.

Pushing the button **18***a* of one pump **18**, air is fed into a sucker **14'** at one end of the rear leg member **12** and into a sucker **13** at the end, opposite thereto, of the front leg member **11**, and at the same time, the switch **23** is closed to start the motor **22**, thereby enabling the leg members **12**, **11** with suckers **14'**, **13** suction of which has been. When the button **18***a* is released, it is returned to its original position by the action of a coil spring **18***b* to cause the pump **18** to inhale, and at the same time the switch **23** is opened to stop the motor **22**, thus causing the suckers **14'**, **13** to stick fast to the travelling surface by the suction thereof.

Pushing the button **19***a* of the other pump **19**, the suckers **14**, **13'** at the opposite sides receive air, and at the same time, the switch **23'** is closed to start the motor **22**, and the leg members **12**, **11** rotate with the suckers **14'**, **13** as fulcra. Releasing at this moment the button **19***a* of the pump **19**, the suckers **14**, **13'** stick again to the travelling surface and serve as fulcra for the next rotational movements of the leg members **11**, **12** made by the operation of the pump **18** of opposite side.

Thus, by effecting repeatedly such adhering and swinging actions of suckers, the toy **10** is enabled to walk or crawl on the travelling surface in a given direction.

FIGURE 3 shows a preferred example of pump unit capable of repeatedly supplying air into the suckers to eliminate suction thereof and removing air from the suckers to make them stick onto the travelling surface.

Preferably, this pump is of a bellows-like reciprocating cylindrical hollow body made of elastic plastic material. To the inlet and outlet port of the cylinder, a flexible air tube **21** is connected. The tube **21** is connected to the suckers to and from which air is supplied and removed.

FIGURE 4 illustrates a structure of each sucker **13**, **14**, **13'** and **14'**. These suckers are preferably made of rubber material as soft and elastic as possible.

FIGURE 5 shows another embodiment of the present invention as applied to a worm-like toy **10'** crawling by expanding and contracting its own body.

In this embodiment, there are provided three suckers which are longitudinally linearly arranged. Of the three, the one at the hindmost position is fixed to the rear portion of the bottom of the body, and the other two are fixed to a leg member **24** which is adapted to slide in the longitudinal direction of said body. The working mechanism of this example will now be explained with reference to FIGURE 6.

Two suckers **25**, **26** are installed at the tip and intermediate portions of a leg member **24** which is slidably fixed to the bottom of the body **10'**, said member being provided at its base portion with a transversal link hole **24***a*, and an eccentric pin **27***a* of a cam **27** to be driven in reduced speed by means of a motor **22***a* is engaged in said link hole **24***a*.

The casing **28** having therein a motor **22***a* etc. is suitably mounted in the body. Guide members **29** are provided on said casing so as to guide the leg member **24** therealong during its sliding movement.

Within the casing **28**, a reduction gear shaft **31** with a gear **32** engaging with a pinion **30** of motor **22***a* is provided, and the worm of said said shaft is engaged with the wheel **35** of cam shaft **34**, permitting longitudinal reciprocation of the leg member **24** which is engaged with pin **27***a* by rotating the cam wheel **27**. The sucker **36** fixed to the body and the suckers **25**, **26** fixed to the leg member are connected to different pumps through different air tube systems **37**, **38**, and also connected to the remote-control unit which, as explained with reference to the first embodiment (FIGS. 1 and 2), makes and breaks the electric circuit for the motor **22***a* and operates the pneumatic systems **37**, **38**, so that starting of the motor **22***a* and pumping in and out the suckers **25**, **26**, **36** may be effected synchronously and remotely.

In operation, the fixed sucker **36** is kept stuck onto the travelling surface, and air is supplied to the movable suckers **25**, **26** to eliminate their sucking action, and at the same time the motor **22***a* is actuated so as to move the leg member **24** with suckers **25**, **26** in a given direction through the operation of link mechanism including link hole **24***a* and eccentric pin **27***a*. Then the suckers **25**, **26** are stuck onto the surface by suction at the position where they are located and start the motor **22***a* is started to remove suction from the fixed sucker **36** at the rear, and then stick sucker **36** to the surface at an advanced position in the same direction. Repeating this operation the toy is enabled to keep walking or crawling on the travelling surface.

In this embodiment, the terms "fixed sucker" and "movable suckers" have only relative meaning: because the body of worm-like toy is constructed so as to freely expand and contract and the toy is adapted to advance with the suckers while expanding and contracting its own body. Consequently, in this sense, the term "fixed sucker" may not be distinguished from the term "movable suckers."

Each of the above-mentioned two preferred embodiments has two pumps outside the body of the walking toy, that is, the pumps being provided in a remote-control unit to be operated manually. A switch mechanism to control the motor contained in said body is also mounted in the remote control unit. It is to be noted, however, that separate disposition of the pump units and the toy body is not essential for the present invention, that is, it is an easy matter to incorporate one or more such pump units with the leg operating mechanism including a motor in the toy body in such a way that they may be associatedly operated by means of a motor.

FIGURE 7 illustrates another embodiment in accordance with the present invention. In this embodiment, which is illustrated as applied to a quadrupedal model toy as shown in FIGURE 1, the motor unit and limb structure are incorporated into the toy body.

As may be seen from the illustrated embodiment, the motor **22***b*, reduction gear shaft **39**, and cam shaft **40** are attached to the frame (not shown) which is fixed to the toy body, and similarly, a pair of T-shaped leg members **41**, **42** are pivoted to the frame at the middle parts **41***a*, **42***a* thereof. Forked portions **41***b*, **42***b* of the leg members are superposed upon each other, and an eccentric pin **43***a* of cam wheel **43** which is fixed to one end of the cam shaft **40** is engaged in each link groove **41***b*, **42***b*. A wheel **44**, fixed to the middle portion of said cam shaft, is engaged with worm **45** of said reduction gear shaft **39**, and the gear **46** is engaged with pinion **47** of said motor **22***b*.

While, a unit **48** containing a pair of pump chambers **48***a*, **48***b* adapted to expand and contract alternately is provided. A base portion **49'** of a lever **49** engaging an intermediate portion between pump chambers **48***a*, **48***b* of said unit is pivoted to an appropriate portion of the body with a pin **50**, said lever having at its tip portion **49''** a forkshaped link grove engaged by an eccentric pin **51***a* of cam wheel **51** fixed to the other end of said cam shaft **40**.

The suckers **52**, **52'**, **53**, **53'** provided at the ends of leg members **41**, **42** are connected to pumps **48***a*, **48***b* through air tubes **54**, **55**, respectively, as shown. The lever **49** is adapted to swing with the pivot pin **50** as a fulcrum to cause alternate expansion and compression of pump means **48***a*, **48***b*, thus imparting alternate exhaling and inhaling actions to each sucker.

In operation, when a controller **58** having therein a source of electricity and switch means **59** is electrically connected to the electaric circuit of the motor **22***b* and the motor **22***b* is actuated by closing said switch, the cam shaft **40** starts to rotate and the forked portions **41***b*,

42*b* engaging the eccentric pin 43*a* of cam wheel 43 cause the leg members 41, 42 to be rotated about the axes of the pins 41*a*, 42*a*, respectively. At the same time, the lever 49 engaging the eccentric pin 51*a* of cam wheel 51 swings right and left with pin 50 as a fulcrum, thus causing one of pumps 48*a*, 48*b* to be compressed and the other to be expanded.

When one of the pumps 48*a* is compressed, the suckers 52', 53 connected to the pump loose their sticking action and are subjected to rotating action of cam wheel 43 through link connection between the eccentric pin 43*a* and the forked portions 41*b*, 42*b*, as a result, the leg members 41, 42 are adapted to swing with the other suckers 52, 53', which are stuck on the surface, as fulcra. As the cam shaft 40 further rotates, the pump 48*a* is expanded and the other pump 48*b* is compressed, thereby causing the suckers 52', 53 connected to the pump 48*a* to stick fast to the surface and the other suckers 52, 53' connected to the other pump 48*b* to be released from suction. In this case, since the leg members 41, 42 are pivotally fixed to the toy body through pins 41*a*, 42*a*, respectively, and the motor, frame, etc. are also fixed to the body, the body is enabled to advance in a given direction.

Thus, according to this embodiment, the pump units and the motor means are all attached to the same frame to be mounted in a desired toy body and the pumps can be operated by a single motor for actuating the limb structure, and accordingly, there is no need of manually operating each pump means. It is noted that in this embodiment the remote controller includes only a power switch. The remote controller is not always essential for the present invention. Because the limb structure to be actuated by the pump units and the motor, and the power cell can be all mounted in the toy body simulating small animal etc. and yet, if desired, a suitable switch means can be provided on any desired portion of the toy body directly so that the toy can walk about without being controlled through a remote-control means.

While particular embodiments of the invention have been illustrated and described, modifications thereof will readily occur to those skilled in the art. It should be understood therefore that the invention is not limited to the particular arrangements disclosed but that the appended claims are intended to cover all modifications which do not depart from the true spirit and scope of the invention.

What is claimed is:

1. A drive system in combination with a walking toy comprising a toy body, a plurality of suckers secured to said toy body and arranged to contact and adhere by means of suction to a traveling surface for supporting the walking toy thereon, at least two pump means for supplying and removing air from different ones of said suckers for alternately establishing and removing the suction effect between said suckers and the traveling surface, flexible air tubes connecting said pump means to the respective said suckers, a limb mechanism secured to said toy body said limb mechanism supporting at least one of said suckers, means for moving said limb mechanism, means for operating said pump means, a member for actuating said means for moving said limb mechanism, and said means for operating said pump and said member for actuating said means for moving said limb mechanism interconnected for combined operation for effecting movement of the walking toy.

2. The combination as set forth in claim 1, wherein each said pump means comprises a bellows-like reciprocating member arranged to operate alternately to supply air to at least one of said suckers for removing its suction effect and to withdraw air from said sucker for establishing its suction effect.

3. The combination as set forth in claim 2, wherein said means for operating said pump comprises a plunger member arranged to compress said bellows-like reciprocating member and expel air therefrom through said flexible tube to said sucker, and spring means mounted on said plunger for urging said plunger into a position whereby said bellows-like reciprocating member is maintained in the non-compressed condition for withdrawing air through said flexible tube from said sucker.

4. The combination as set forth in claim 3, wherein said means for moving said limb mechanism comprises an electric motor mounted in said toy body and operatively connected to said limb mechanism whereby when said motor is actuated it is arranged to impart movement to said limb mechanism.

5. The combination as set forth in claim 4, wherein a housing is spaced from said toy body, said pump means disposed in said housing, and electric switch mounted in said housing, a switch contact member attached to each of said pump means and arranged to close said electric switch when said plunger members are depressed compressing said bellows-like reciprocating members.

6. The combination as set forth in claim 5, wherein at least two said limb mechanisms are secured to and extend transversely of said toy body, each of said limb mechanisms having a pair of spaced suckers attached thereto, each of said suckers connected by said flexible air tubes to a different one of said pump means whereby one of said suckers connected to one of said limb mechanisms is secured by suction to the traveling surface, the other said sucker connected thereto is free to move on the traveling surface and as said pump means removes the suction action of said sucker connected thereto the electric motor is activated and pivots said limb mechanism about said sucker connected thereto and secured by suction effect to the traveling surface.

7. The combination as set forth in claim 1, wherein a pair of spaced said suckers are secured to said limb mechanism and are connected by said flexible air tubes to the same said pump means, another said sucker secured to said toy body, said toy body between the point of attachment of said limb mechanism and the another said sucker member having a bellows-like structure whereby the toy body can be disposed in an expanded and a contracted position, said means for moving said limb mechanism comprising an electric motor mounted within said toy body and a device interconnecting said electric motor and said limb mechanism for imparting motion initiated by said motor to said limb mechanism, and switch means for activating said electric motor arranged whereby as the suction effect of said suckers attached to said limb mechanism is removed, said switch means are closed and said electric motor is activated thereby causing the limb mechanism and said suckers attached thereto to move relative to the traveling surface, and when the suction effect of said suckers attached to said limb mechanism is re-established and the suction effect of said other sucker member is removed, the bellows-like construction of said toy body permits it to contract for effecting movement of the another said sucker relative to the traveling surface.

8. The combination as set forth in claim 1, wherein said limb mechanism comprises a pair of elongated leg members disposed in spaced relationship, each of said leg members having a forked portion forming a slot extending transversely therefrom at a point intermediate its ends, said forked portions arranged with one overlaying the other and the slots therein in general alignment, each said leg member having one said sucker at each of its ends, said means for moving said limb mechanism comprising an electric motor mounted within said toy body, a pinion member extending from and arranged to be operated by said electric motor, a first gear member disposed within said toy body and arranged to engage said pinion, a shaft having a worm positioned thereon extending from said first gear member, a cam shaft mounted within said toy body, a first cam wheel having an eccentric pin extending therefrom is disposed on said cam shaft, a second gear member is mounted on said cam

shaft and is disposed in engagement with said worm, the slots in said forked portions fitting on said eccentric pin of said cam wheel, a lever disposed within said toy body, a second cam wheel fixed to said cam shaft and spaced from said first cam wheel, said second cam wheel arranged to contact and reciprocate said lever, said lever in contact with said pump means for alternately expanding one and contracting the other of said pump means, said flexible tubes disposed within said toy body connecting said pump means with said suckers, and a switch member for operating said electric motor whereby in response to the motion of said cam shaft driven by said electric motor said pump means alternately establishes and removes the suction effect of said suckers whereby on each said leg member one of said suckers is in suction contact with the traveling surface while the other said sucker thereon is free to move, and said eccentric pin on said first cam wheel displaces said forked portions of said leg members and pivots said leg member about the end thereof having said sucker in suction contact with the traveling surface.

9. The combination as set forth in claim 7, wherein said pair of pump means comprises two pumps disposed in axial alignment, said pumps having first ends directed in opposite directions and a common second end, said pumps are of a bellows-like reciprocating type, and a lever disposed in contact with said second common end of said pumps whereby as the lever is pivoted by said second cam wheel it compresses one of said pumps and expands the other said pump.

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U.S. Cl. X.R.

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