March 1, 1966 M. FELIZIANI 3,237,345

MAGNETICALLY ACTUATED MOTILE TOY DEVICE

Filed April 16, 1963 4 Sheets-Sheet 1

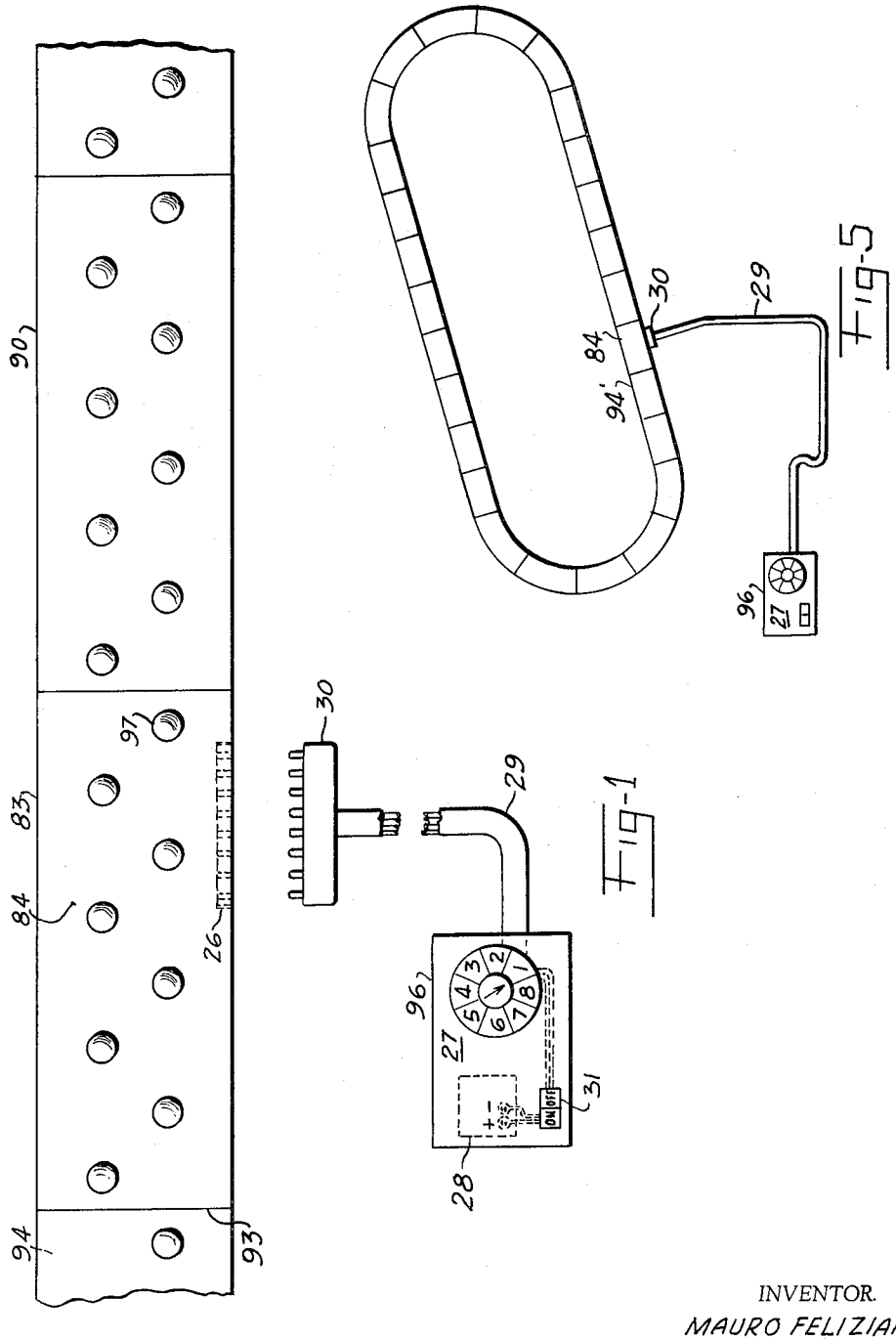


FIG-1

FIG-5

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MAGNETICALLY ACTUATED MOTILE TOY DEVICE

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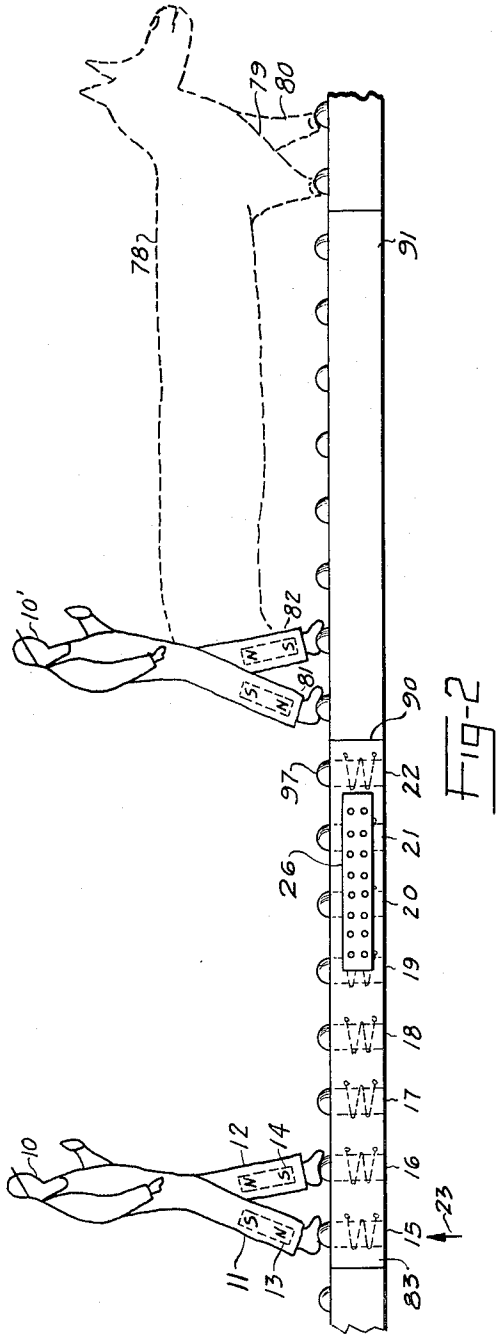


FIG-2

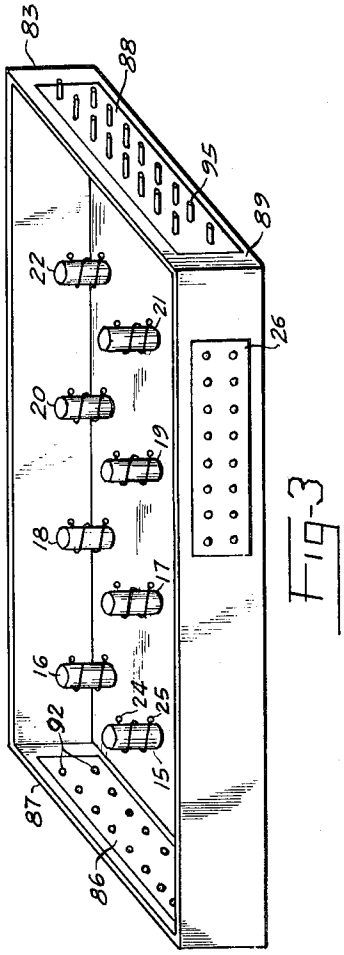


FIG-3

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MAGNETICALLY ACTUATED MOTILE TOY DEVICE

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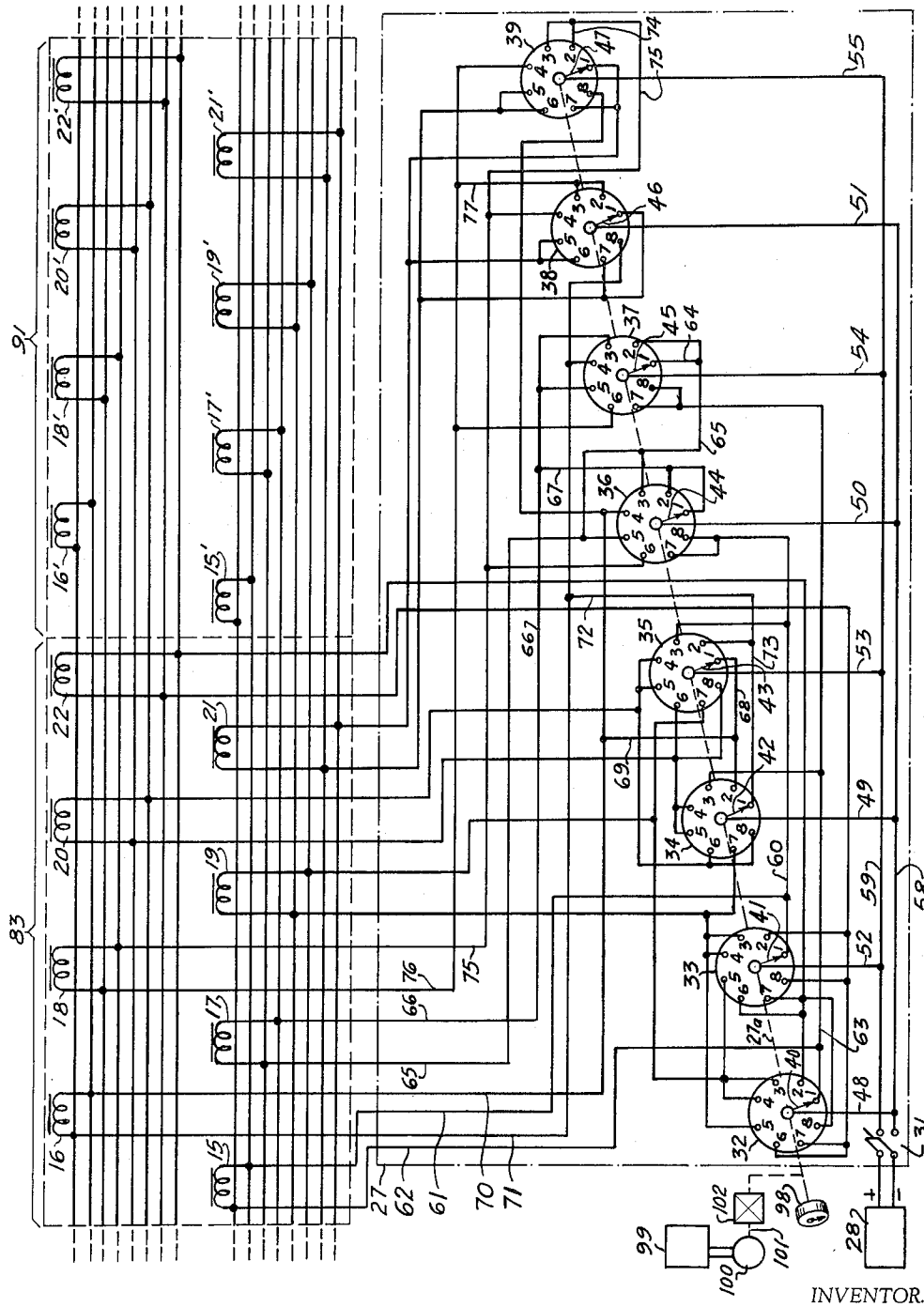


FIG-4

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MAGNETICALLY ACTUATED MOTILE TOY DEVICE

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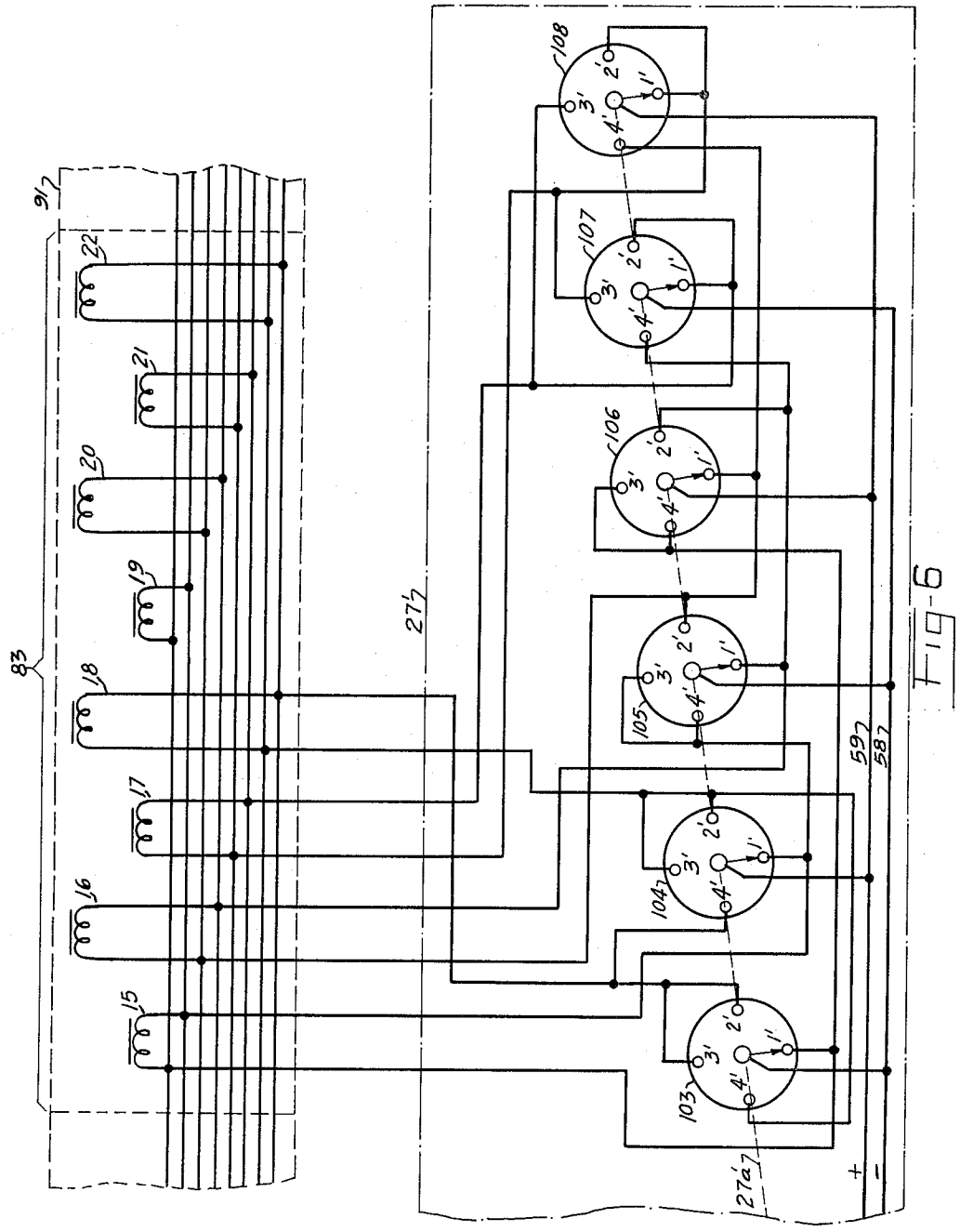


FIG-6

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3,237,345

Patented Mar. 1, 1966

3,237,345

MAGNETICALLY ACTUATED MOTILE TOY DEVICE

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Filed Apr. 16, 1963, Ser. No. 273,489
9 Claims. (Cl. 46—235)

This invention relates to toy devices and, more particularly, to toy devices of the kind relating to dolls which are magnetically actuated.

In one type of prior art device of the aforementioned kind, the doll is maintained in a fixed or substantially fixed position relative to an electromagnet. The doll is provided with magnetically responsive limbs which co-act with the magnetic field produced by the electromagnet. Hence, the doll or, if the limbs are movable, the movement of the limbs are actuated by the electromagnet. However, the inherent disadvantage of this and other prior art toy devices of the aforementioned kind is that the doll's movement and/or limb movement is confined and limited to a relatively fixed locale, i.e., in the immediate vicinity of the electromagnet and particularly in those prior art devices where the doll is actually pivotally affixed thereto.

An object of this invention is to provide a toy device of the aforementioned kind, in which the doll moves relative to a predetermined reference position.

Another object of this invention is to provide a toy device of the aforementioned kind, in which the doll simulates certain animated actions such as, for example, in the case of a biped, walking either on its feet or on its hands, or running, crawling, etc.

Another object of this invention is to provide a toy device of the aforementioned kind, in which a plurality of dolls simulate certain animated actions such as, for example, walking in a parade, crowd or the like.

Still other objects of this invention are to provide a toy device of the aforementioned kind, which is capable of being utilized with model railway systems and the like, is conducive to modular construction, etc., to name just a few.

Accordingly, this invention provides, inter alia, at least one doll having at least one pair of movable limbs. In addition, a plurality of electromagnetic means which are predeterminedly arranged in first and second rows are also provided. One of the movable limbs of the provided pair is adapted to be magnetically responsive to the electromagnetic means in one of the two provided rows and the other limb is similarly adapted to be magnetically responsive to the electromagnetic means of the other row. A switching means is provided for sequentially energizing the electromagnetic means of the first and second rows to actuate alternately the limbs and move the doll relative to some predetermined reference position.

Although such novel feature or features as are believed to be characteristic of the invention and are pointed out in the claims, the invention and the manner in which it may be carried out, may be further understood by reference to the description following and the accompanying drawings, in which:

FIG. 1 is a plan view of preferred embodiment illustrating the toy device of the present invention, the doll having been omitted for sake of clarity;

FIG. 2 is a side view of the embodiment of FIG. 1;

FIG. 3 is a perspective view of the interior of one of the modular units of the embodiment of FIG. 1.

FIG. 4 is a partial schematic view of the embodiment of FIG. 1;

FIG. 5 is a plan view illustrating an example of the layout of the modular units of the present invention; and

FIG. 6 is a partial schematic view of an alternative of the embodiment illustrated in FIG. 4.

Referring now to the figures in greater detail, like reference numbers denote like parts in the various figures.

As illustrated in FIGS. 1–4, the toy device of this invention broadly comprises at least one doll such as, for example, the biped doll **10**, FIG. 2, which has at least one pair of movable limbs that are illustrated, by way of example only, as being the right and left legs **11** and **12**, respectively. The movable limbs of the doll **10** are provided with magnetically responsive portions and for the preferred embodiment illustrated in the drawing are provided with the magnets **13** and **14** disposed within the legs **11** and **12**, respectively. It is to be understood, however, as will be obvious to those skilled in the art, that the limbs according to the broad aspects of this invention alternatively may be made magnetically responsive by simply being provided, for example, with a portion composed of iron or other permeable substance and that the particular manner of providing the movable limbs with the magnetically responsive portions illustrated in the drawings, as well as the manner in which they are actuated as will be explained hereinafter, is by way of example only in the preferred embodiment chosen to teach the principles of the present invention.

The movable limbs of the doll, according to the broad aspects of this invention, are adapted to be magnetically responsive to a plurality of electromagnetic means which are arranged in first and second rows. Thus, in the preferred embodiment illustrated in the drawings, eight, but not necessarily limited thereto, electromagnets **15** to **22**, shown in outline form in FIG. 2 for sake of clarity, are arranged in first and second rows, and as illustrated more clearly in FIG. 3, one row comprises the electromagnets **15, 17, 19, 21** and the other row comprises the electromagnets **16, 18, 20, 22**. As illustrated in the drawings, and by way of example only, the right leg **11** is adapted to be magnetically responsive to the row of electromagnets **15, 17, 19, 21** and the left leg **12** to the other row of electromagnets **16, 18, 20, 22**. The electromagnets of the first and second rows are sequentially energized, as will be explained in greater detail hereinafter, to actuate alternately the movable limbs **11–12** to move the doll **10** from a predetermined reference position such as the starting position designated by the arrow **23**, illustrated in FIG. 2.

The contacts of electromagnets **15** to **22**, such as the contact **24, 25** of electromagnet **15** are coupled by suitable conductors, not shown for the sake of clarity in FIGS. 2 and 3, to the appropriate contacts, not shown, associated with and located at the back of the electrical receptacle **26**. A switching means, indicated generally by reference numeral **27** and which is adapted to be coupled to a source of energy such as, for example, the battery **28** shown in outline form in FIG. 1, is coupled via the multi-conductor **29** and plug **30**-and-receptacle **26** assembly to the electromagnets **15–22**. Switching means **27** is operated, with the ON-OFF switch **31** in the ON position, to sequentially energize the electromagnets **15–22**.

Referring to FIG. 4 in greater detail, the switching means **27** of the preferred embodiment of this invention is illustrated, by way of example only, as having eight wafers **32–39** and respectively associated wiper arms **40–47** commonly ganged to the shaft **27*a***, illustrated as dash line **27*a***. Each wafer has eight contacts, commonly numbered **1–8** for sake of explanation, and thereby provides eight switching positions for the switching means **27**. Wiper arms **40, 42, 44, 46** are connected by the conductors **48, 49, 50, 51**, respectively, to the negative terminal of source **28** and wiper arms **41, 43, 45, 47** are connected by the respective conductors **52, 53, 54, 55** to the positive terminal of source **28** via the conductors **58** and **59**, respectively, and switch **31**.

The contacts of the electromagnets **15–22** are connected to predetermined contacts of the various wafers **32–39** in such a manner that the electromagnets **15–22** will be sequentially engaged to actuate alternately the limbs **11–12** as the wafer arms **40–47** engages their respective associated contacts **1–8**. Thus, in the broad aspects of this invention, as the electromagnets are sequentially energized, due to the magnetic portion of the limb associated with the row of the energized electromagnet being attracted thereto, it will cause the limbs to be actuated alternately and move the doll from the reference position **23**. Thus, as aforementioned, the magnetic portions need only be of a permeable composition in which case the polarity of magnetic field is not critical to the operation of the toy device. However, where the outer extremities of the limbs **11–12** have respective definite magnetic polarities, which can also be alike or different, associated therewith, then it is preferred that the electromagnets of the row associated with a given limb provide a magnetic field having a polarity opposite to the polarity of the limb's aforementioned extremity for attracting the limb thereto. Furthermore, in the embodiment illustrated in the drawings, the electromagnets are preferably connected so that not only will the succeeding electromagnet be energized to attract the appropriate limb but also the preceding electromagnet of the same row will be so energized as to provide a magnetic field which repels the magnetic pole associated in the extremity of the aforesaid appropriate limb. In all of the cases aforedescribed, it is desirable to provide concurrently energization of the particular electromagnet located in the other row and associated with the other limb so as to provide a magnetic field and/or a magnetic field of such a polarity that the aforementioned other limb will be attracted and held in place thereby while the limb associated with the adjacent row is being actuated by the electromagnet or electromagnets, as the case may be, that are located in the adjacent row.

Thus, for example, when the switching means **27***a* is in the first position, assuming switch **31** to be closed, the magnetic field, produced by electromagnet **15**, provides a north magnetic pole at the top of the winding of electromagnet **15**, FIG. 2, which repels the north pole of the magnet **13** while at the same time the electromagnet **17** produces a magnetic field which produces a south pole at the top of the winding which attracts the north pole of magnet **13** and the limb **11**. Also in the first switching position, the electromagnet **16** produces a magnetic field which provides a north pole at the top of the winding of electromagnet **16** that attracts and maintains the south pole of magnet **14** and consequently the limb **12** remains thereat. For the sake of explanation, it will be assumed that current direction from right to left in any particular electromagnet illustrated in FIG. 4 produces a north pole at the top of the winding associated therewith and, conversely, current direction from left to right produces a south pole thereat. Thus, in the first switching position illustrated in FIG. 4, the wiper arms **40–41** are closed upon their respective contacts **1** and as such the current passes from right to left through the winding of electromagnet **15** starting from the positive terminal of source **28**, the conductors **59**, **52**, wiper arm **41**, contact **1** of wafer **33**, conductors **60**, **61**, the winding of electromagnet **15**, conductors **62**, **63**, contact **1** of wafer **32**, arm **40**, through conductors **48**, **58** and terminating at the negative terminal of source **28**. Likewise, in the first position illustrated in FIG. 4, the current passes from left to right through winding **17** starting from the source **28**'s positive terminal, conductors **59**, **54**, arm **45**, contact **1** of wafer **37**, conductors **64**, **65**, electromagnet **15**'s winding, conductors **66**, **67**, contact **1** of wafer **36**, arm **44**, conductors **50** and **58** and ending at the negative terminal of source **28**. At the same time, the current flows from right to left through the winding of electro-

magnet **16** starting at the positive terminal of source **28**, conductors **59**, **53**, arm **43**, contact **1** of wafer **35**, conductors **68**, **69**, **70**, electromagnet **16**'s winding, conductors **71**, **72**, contact **2** of wafer **35**, conductor **73**, contact **1** of wafer **34**, conductors **49**, **58**, and ending at the negative terminal of source **28**. In this manner, the limb **11** of the doll **10** is actuated and moves from the vicinity of electromagnet **15** to the vicinity of electromagnet **17** while the limb **12** remains in the vicinity of electromagnet **16**.

At the second switch position, the wiper arms **40–47** are removed from their respective contacts **1** to their respective contacts **2**. As a result, the winding of electromagnet **15** is de-energized and the current direction in the winding of electromagnet **17** continues to flow in the same direction, viz., left to right as in the first switch position, commencing at the positive terminal of source **28**, conductors **59**, **53**, arm **43**, contact **2** of wafer **35**, conductors **72**, **71**, electromagnet **16**'s winding, conductors **70**, **69**, **68**, contact **2** of wafer **34**, arm **42**, conductors **49**, **58**, and from there to the negative terminal of source **28**. And in the winding of electromagnet **18**, the current flows in the direction from right to left commencing at the positive terminal of source **28**, through conductors **59**, **55**, arm **47**, contact **2** of wafer **39**, conductors **74**, **75**, electromagnet **18**'s winding, conductors **76**, **77**, contact **2** of wafer **38**, arm **46**, conductors **51**, **58** and to source **28**'s negative terminal. Thus, in the second switch position the limb **12** is actuated and moves from the vicinity of electromagnet **16** to the vicinity of electromagnet **18**, while the limb **11** remains in the vicinity of electromagnet **17**.

As is obvious from the schematic of FIG. 4, in a similar manner, the limbs **11** and **12** are actuated and move alternately in the remaining switch position via the proper energization of the appropriate electromagnet, whereupon at the end of the last or eighth switching position, the switching cycle repeats itself. The following Table I indicates the switching sequence and the magnetic condition of the electromagnets of FIG. 4 in relation to the respective limb with which it is associated.

Table I

Switch Position	Limb Actuated	Electromagnet Ref. Nos.							
		15	16	17	18	19	20	21	22
1	11	N	N	S	----	----	----	----	----
2	12	----	S	S	N	----	----	----	----
3	11	----	----	N	N	S	----	----	----
4	12	----	----	----	S	S	N	----	----
5	11	----	----	----	----	N	N	S	----
6	12	----	----	----	----	----	S	S	N
7	11	S	----	----	----	----	----	N	N
8	12	S	N	----	----	----	----	----	S

As is obvious to those skilled in the art, any number of electromagnets and switching positions may be utilized. Furthermore, for any given switching cycle, the range of operation of the doll **10** may be increased by connecting appropriately additional electromagnetic means in parallel with the already existing ones, such as, for example, by connecting electromagnets **15'–22'** to electromagnets **15–22**. Also, in these latter cases, one or more additional dolls, such as the doll **10'**, FIG. 2, may also be utilized to simulate parades, crowds, etc. since commonly connected electromagnets will be synchronously energized during the same part of the switching cycle. The principles of this invention are also applicable to other movable multilimbed dolls such as quadruped dolls, illustrated as, for example, the dog **78**, shown in outline form and having two pairs of magnetically responsive movable limbs **79–82**. The front legs of the doll **78** are adapted to co-act with the electromagnetic means of the appropriate rows that are connected in parallel to the electromagnetic means of the

appropriate rows which co-act with the rear legs of the dog **78** and are thereby synchronously energized therewith during the same part of the switching cycle.

The dolls utilized in the invention are preferably balanced and constructed of rubber or the like with a sufficient degree of flexibility to allow the limbs **11–12** to move freely in a direction parallel to the plane of the drawing and are further constructed to prevent the legs from moving in a direction oblique to the plane of the drawing. In this manner, each of the magnetic responsive portions of the limbs is prevented from being actuated by the electromagnets of the other row and/or, in the cases where the limbs are provided with magnets, from co-acting with each other. Alternatively, the doll may be constructed so that the limbs are pivotally attached to the body to allow the aforedescribed movement within the plane of the drawing and are unable to move obliquely thereto, in a manner well known to those skilled in the art.

This invention further contemplates housing the electromagnetic means in a housing means, such as the box-like housing assembly **83** having a top portion **84**, FIG. 1. The electromagnetic means are mounted and placed within the enclosed housing assembly **83**, such as the electromagnets **15–22** and suitable wire connections, not shown, are made to the contacts of receptacle **26** disposed on, for example, the side wall of assembly **83**. The assembly **83**, further provides a receptacle **86** located at the end wall **87**, thereof, and a plug assembly **88** located at the end wall **89** for connecting the electromagnets **15–22** to the appropriate electromagnets located in adjacent similar housing assemblies. For example, the electromagnets **15–22** located in assembly **83** are appropriately connected to the contacts, not shown, of plug **88**, the latter being adapted to be received by a receptacle, not shown, located in the end wall **90** of adjacent assembly **91**. Assembly **91** is adapted to house the electromagnets **15′–22′** and the latter are connected to the appropriate contacts of the aforementioned receptacle located in end wall **90**. In a similar manner, the electromagnets are appropriately connected by suitable wires, not shown, to the contacts, such as contact **92**, of receptacle **86**, which is adapted to receive the plug, not shown, located in the end wall **93** of the assembly **94**, partially illustrated. Assembly **94** also houses electromagnets, not shown, which are connected to the appropriate contacts, not shown, of the plug located in end wall **93**. It is preferred that the pins of the plug, such as pin **95** of plug **88** be constructed of rigid material so that the assemblies may be mechanically, as well as electrically, firmly coupled. It is obvious, that generally only a single assembly, such as assembly **83**, will require a receptacle, such as receptacles **26**, for connection to the switching means **27** and source **28**, illustrated by way of example only as being disposed within the control box **96**. Magnetic members such as the hemisphere member **97** are affixed to the top **84** in the proximity of the mounted electromagnets.

In utilizing the housing assemblies as modular units, the assembly may be formed into a continuous non-closing layout not shown, such as straight layout, or it may be formed into a self-closing layout, such as the oval layout illustrated in FIG. 5. By judiciously selecting the curvature of the end modular assemblies, standard size straight or curved modular sections can be utilized. In self-closing layouts, it is obvious that the terminal modular unit, such as assembly **94′**, FIG. 5, would not be electrically connected to the assembly **84**, the disconnection being effected, for example, by not connecting the electromagnets, not shown, contained in assembly **94′** to the contacts of the plug contained in the end wall thereof.

The switch means **27** is preferably reversible and may be operated either manually by the dial **98**, or by suitable drive means, such as the assembly comprising motor driving and control means **99** and reversible motor **100**, the shaft **101** of which is connected to shaft **27*a*** by suitable gear means **102**, FIG. 4.

Referring to FIG. 6, there is partially and schematically illustrated an alternative of the embodiment of FIG. 4. As shown in FIG. 6, the electromagnets **19–22** are not connected directly to the switching means **27′** but are coupled in parallel to electromagnets **15–18**, respectively. The wafer switch is also modified to comprise only six wafers **103–108**, having four switching positions represented by the contacts commonly numbered **1′–4′**, respectively. As the draft **27′*a*** is rotated from position **1′** to **4′**, the electromagnets **15–22** will be energized and the limbs **11**, **12** of the doll **10** will be actuated as indicated in the following Table II, the shaft **27′*a*** being required to be rotated twice to move the doll from the electromagnet **15** to the electromagnet **22**.

Table II

Switch Position	Limb Activated	Electromagnet Ref. Nos.							
		15	16	17	18	19	20	21	22
1′	11	N	N	S	----	N	N	S	----
2′	12	----	S	S	N	----	S	S	N
3′	11	S	----	N	N	S	----	N	N
4′	12	S	N	----	S	S	N	----	S

While the switching means has been described with reference to a specific embodiment, it is apparent that other types, such as, for example, electronic switching means may be utilized as well as different arrangements and/or quantities of the electromagnetic means and/or assembly units of the present invention.

Furthermore, it is apparent that other modifications of the modular units as well as other embodiments thereof may be utilized in practising the principles of this invention and that the modular units described herein are to illustrate the preferred embodiment of the present invention and are in no way to be considered a limitation thereto.

I claim:

1. A toy device comprising, in combination, at least one dol having at least one pair of movable limbs, a plurality of electromagnetic means predeterminedly arranged in first and second rows, means on one limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of one of said first and second rows and means on the other limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of the other of said first and second rows and switching means adapted to be coupled to a source of electrical energy for sequentially energizing the electromagnetic means of said first and second rows to actuate alternately said limbs and move said doll relative to a predetermined reference position.

2. A toy device comprising in combination at least one doll having at least one pair of magnetically responsive movable limbs, the limbs of said doll having predetermined magnetic polarities associated at the respective extremities thereof, a plurality of electromagnetic means predeterminedly arranged in first and second rows, means on one limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of one of said first and second rows and means on the other limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of the other of said first and second rows, and switching means adapted to be coupled to a source of electrical energy for sequentially energizing the electromagnetic means of each of said first and second rows to actuate alternately said limbs and move said doll relative to a predetermined reference position, each of the electromagnetic means in each of said rows being arranged in circuit to be energized to provide a magnetic field to attract the respective limb associated with the respective row thereof whenever said respective limb is being repelled by a predetermined adja-

cent electromagnetic means of the same row and arranged in circuit to be energized by the coaction of said switching means and said source to provide a magnetic field to repel said respective limb whenever said respective limb is being attracted by a magnetic field provided by a predetermined adjacent electromagnetic means of the same row.

3. A toy device according to claim 2 wherein the limbs of said doll have mutually exclusive opposite magnetic polarities associated at the respective extermities thereof.

4. A toy device comprising in combination at least one doll having at least one pair of movable limbs, a plurality of electromagnetic means predeterminedly arranged in first and second rows, means on one limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of one of said first and second rows and means on the other limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of the other of said first and second rows, housing means for housing said electromagnetic means, and switching means adapted to be coupled to a source of electrical energy for sequentially energizing the electromagnetic means of said first and second rows to actuate alternately said limbs and move said doll relative to a predetermined reference position.

5. A toy device according to claim 4 wherein said housing means comprises a plurality of similar adjacent housing units, each of said housing units housing a predetermined number of electromagnetic means of each of said first and second rows, means for coupling the electromagnetic means of each of said housing units to the similar electromagnetic means of the housing unit adjacent thereto, and at least one of said units having means adapted to be coupled to said switching means.

6. A toy device comprising in combination at least one doll having at least one pair of magnetically responsive movable limbs, the limbs of said doll having predetermined magnetic polarities associated at the respective extremities thereof, a plurality of electromagnetic means predeterminedly arranged in first and second rows, means on one limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of one of said first and second rows and means on the other limb of said doll being positionally disposed to be magnetically responsive to the electromagnetic means of the other of said first and second rows, housing means for housing said electromagnetic means, and switching means adapted to be coupled to a source of electrical energy for sequentially energizing the electromagnetic means of said first and second rows to actuate alternately said limbs and move said doll relative to a predetermined reference position, each of the electromagnetic means in each of said rows being arranged in circuit to be energized by the coaction of said switching means and said source to provide a magnetic field to attract the respective limb associated with the respective row thereof whenever said respective limb is being repelled by a magnetic field provided by a predetermined adjacent electromagnetic means of the same row and arranged in circuit to be energized by the coaction of said switching means and said source to provide a magnetic field to repel said respective limb whenever said respective limb is being attracted by a magnetic field provided by a predetermined adjacent electromagnetic means of the same row.

7. A toy device according to claim 6 wherein said housing means comprises a plurality of similar adjacent housing units, each of said housing units housing a predetermined number of electromagnetic means of each of said first and second rows, means for coupling the electromagnetic means of each of said housing units to the similar electromagnetic means of the housing unit adjacent thereto, and at least one of said units having means adapted to be coupled to said switching means.

8. A toy device according to claim 7 wherein the limbs of said doll have mutually exclusive opposite magnetic polarities associated at the respective extremities thereof.

9. A toy device comprising in combination at least one doll having at least one pair of magnetically responsive movable limbs, the limbs of said doll having respective opposite predetermined magnetic polarities associated at the respective extremities thereof, a plurality of electromagnetic means predeterminedly arranged in first and second rows, means on one limb of said doll being positionally disposed to be magnetically responsive to the electromagnets of one of said first and second rows and means on the other limb of said doll being positionally disposed to be magnetically responsive to the electromagnets of the other of said first and second rows, a plurality of similar modular housing units for housing said electromagnets, each of said housing units housing a predetermined number of the electromagnets of each of said first and second rows and having means for coupling the electromagnetic means housed therein to the similar electromagnets of a housing unit adjacent thereto, and switching means adapted to be coupled to a source of electrical energy and to the electromagnets housing in at least one of said housing members for sequentially energizing the electromagnets of each of said first and second rows to actuate alternately said limbs and move said doll relative to a predetermined position, each of the electromagnets in each of said rows being arranged in circuit to be energized by said switching means to provide a magnetic field to attract the respective limb associated with the respective row thereof whenever said limb is being repelled by a magnetic field provided by a predetermined adjacent electromagnet of the same row and arranged in circuit to be energized by the coaction of said switching means and said source to provide a magnetic field to repel said respective limb whenever said limb is being attracted by a magnetic field provided by a predetermined adjacent electromagnet of the same row.

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