Nov. 25, 1952 J. M. HOFF 2,618,888

TOY VEHICULAR SYSTEM

Filed Oct. 12, 1948 2 SHEETS—SHEET 1

Fig. 1

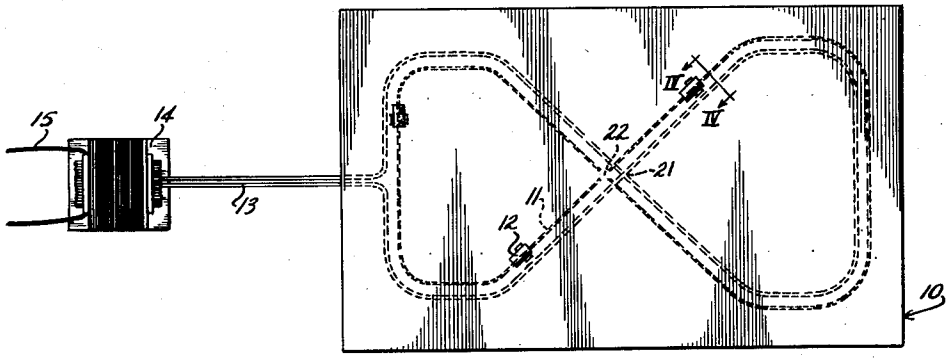

Fig. 2

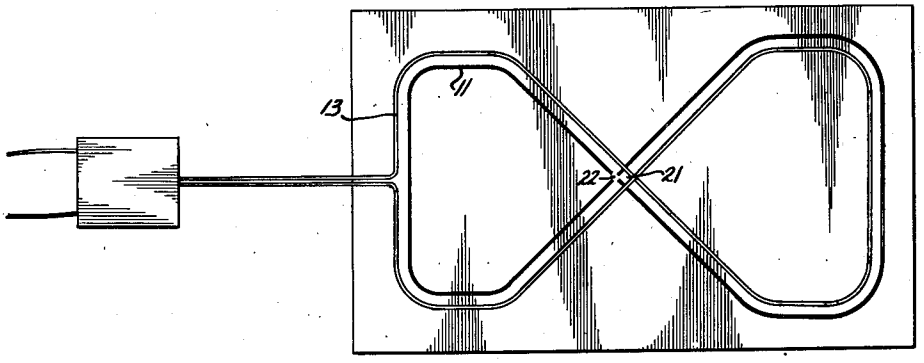

Fig. 3

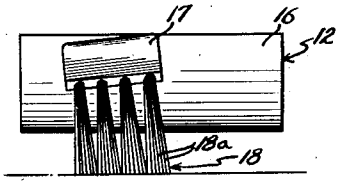

Fig. 4

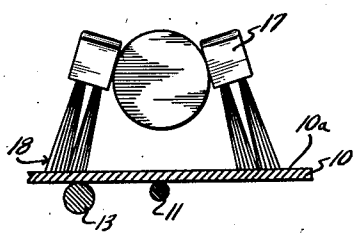

Fig. 5

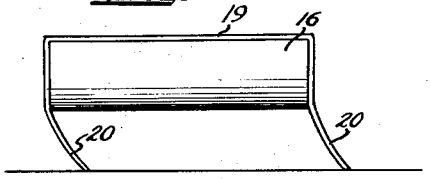

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Fig. 6

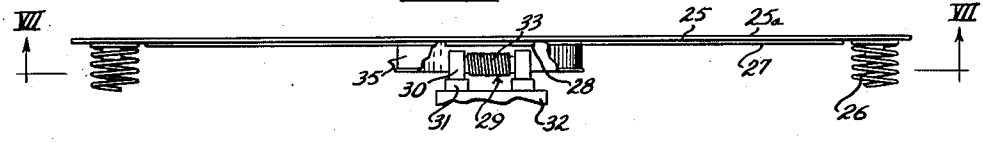


Fig. 7

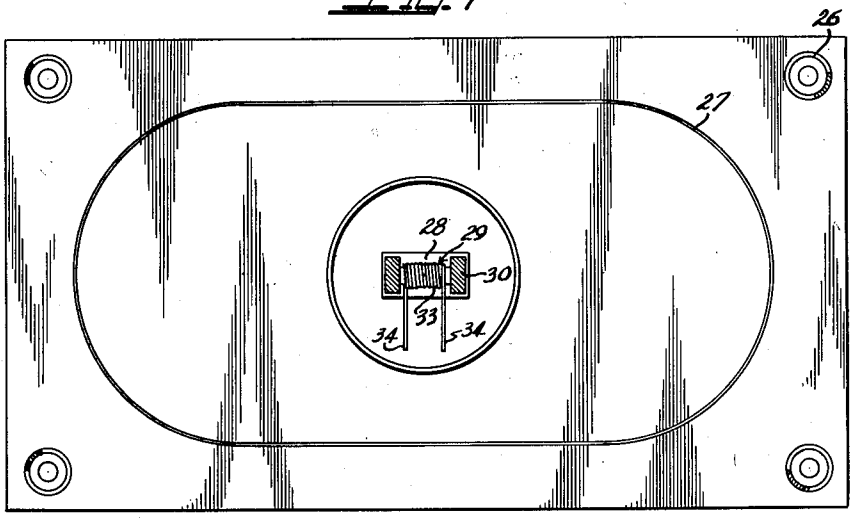
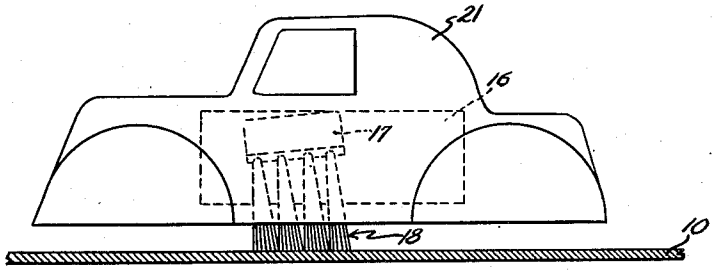


Fig. 8



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TOY VEHICULAR SYSTEM

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7 Claims. (Cl. 46—45)

1

The present invention relates to a toy vehicular system and more particularly to a permanent magnet toy, or a toy vehicle carrying a permanent magnet, which is moved along a base surface to follow a path defined by ferro-magnetic material disposed beneath the surface.

The toy of the present invention comprises generally a permanent magnet, or a toy vehicle, figure or the like carrying a permanent magnet, which is moved across a supporting base along a definite and predetermined path without the employment of visible propelling or guiding means. The base surface may be perfectly plane with no obstructions, guide rails, or the like, to maintain the toy upon the base. The toy operates in accordance with certain electrical and electromagnetic principles and affords an educational and amusing illustration of these phenomena. A plurality of vehicles or objects may be moved across a supporting base surface simultaneously in predetermined sequence and at any desired interval. The path followed by the vehicle or similar objects is flexible and may be varied at will by the user.

In accordance with the principles of the present invention, a permanent magnet mounted on resilient supporting means, such as a leaf spring or a plurality of bristle filaments, is rapidly vibrated upon a plane surface by means of an alternating current. The magnet is so supported by the resilient supporting means that these vibrations cause the magnet, or the vehicle or object to which the magnet is attached, to vibrate in accordance with the frequency of the current to move or travel across the base surface. The path of the magnet so moved across the supporting base surface is defined and determined by magnetic material, such as a ferromagnetic wire or strip, disposed beneath the base surface. The base is preferably formed of non-magnetic material so that there is no substantial interference between the magnetic field of the permanent magnet and the magnetic material disposed beneath the surface.

The permanent magnet may be vibrated by any desired suitable means, as for example, by the field of an alternating electric current flowing through a conductor disposed beneath the base or by mechanical vibration of the supporting base itself. In the preferred embodiment of the present invention, an electrical conductor attached to a suitable source of low voltage, high amperage alternating current is disposed beneath a supporting base surface. A permanent magnet when placed in the vicinity of the alternating current

2

will vibrate at a frequency determined by the frequency of the circuit and the resiliently supported magnet will be propelled along the surface, following a path defined by permanent magnet material, such as a soft iron wire, disposed beneath the surface.

In an alternative form of the present invention, the supporting base is resiliently supported and is vibrated vertically by means of an electromagnet disposed beneath the surface and acting upon an armature of magnetic material, which may be secured to the under surface of the supporting base within the field of flux of the magnet. The base is vibrated by constantly reversing or varying the intensity of the magnetic field set up by the electromagnet. As a result, permanent magnets, resiliently supported on the vibrating base, are caused to vibrate with the base and to move thereacross to follow a course determined by magnetic material disposed beneath the base.

It is, therefore, an important object of the present invention to provide a toy in which a vibrating permanent magnet resiliently supported upon a base is moved across the base to follow a path defined by ferromagnetic material disposed beneath the base.

It is a further important object of the present invention to provide a toy vehicular system in which a vehicle carrying a permanent magnet is freely and resiliently mounted on a supporting base and the vehicle is moved across the supporting base surface in a predetermined path by vibrating the magnet and guiding the vehicle by ferromagnetic material disposed beneath the surface.

A further important object of the present invention is to provide a toy vehicular system in which a toy vehicle carrying a permanent magnet is resiliently mounted for movement upon the surface of a supporting base and the permanent magnet is vibrated by means of an alternating current passed through a conductor disposed beneath the base surface, the vehicle being guided in a predetermined path by ferromagnetic material disposed beneath the base.

A still further important object of the present invention is to provide a toy vehicular system in which a toy vehicle carrying a permanent magnet is resiliently mounted upon a supporting base which is vibrated to move the vehicle across the surface thereof, the vehicle being guided by ferromagnetic material disposed beneath the base surface.

Other and further important objects of the

present invention will become apparent from the following description and the attached drawings.

On the drawings:

Figure 1 is a top plan view of a toy vehicular system of the present invention;

Figure 2 is a bottom plan view of the toy vehicular system of Figure 1;

Figure 3 is a side elevational view of a permanent magnet suitable for employment with the system of the present invention;

Figure 4 is an enlarged, fragmentary, cross-sectional view taken along the plane IV—IV of Figure 1;

Figure 5 is a side elevational view of a modified form of resiliently mounted permanent magnet suitable for use with the system of the present invention;

Figure 6 is a side elevational view with parts broken away of a modified form of the toy vehicular system of the present invention;

Figure 7 is a sectional view, with parts shown in elevation, taken along the plane VII—VII of Figure 6; and

Figure 8 is a side elevational view of a toy vehicle embodying a resiliently mounted permanent magnet in accordance with the principles of the present invention.

As shown on the drawings:

In Figure 1, reference numeral **10** refers generally to a supporting base formed of any suitable sheet material, preferably a non-magnetic sheet material such as aluminum, brass, wood, cardboard or fiberboard. As best shown in Figure 2, a strip or wire of magnetic material, such as an iron or other ferromagnetic material, is disposed beneath the surface of the supporting base **10** to define the pattern or path along which the electromagnet or vehicle **12** travels in a manner to be hereinafter more fully described.

An insulated electrical conductor **13** is attached to a suitable source of high amperage, low voltage alternating electric current. As shown in Figure 1, this current may conveniently be supplied through a transformer **14** connected to a source of household current through lead wires **15**. Preferably, the transformer **14** converts a household 110-volt current to a current having a voltage of less than 1 volt at an amperage of from 50 to 100. I have found that such a current is particularly desirable to produce the vibration of the magnet **12**. Such a current is also desirable since it obviates the possibility of electrical shock to the operator.

I prefer to employ the bristle-type resilient mounting for the permanent magnet as shown in Figs. 3 and 4 of the drawings and shown as mounted in a toy vehicle in Figure 8 of the drawings. In Figure 3 the magnet consists of a permanent magnet body **16**, preferably formed of a high energy magnetic alloy, such as an Alnico magnet formed from alloys of iron, aluminum, nickel and cobalt. The magnet body may suitably be cylindrical in shape, although this configuration is not necessary. A pair of bristle supports **17** are mounted on the outer peripheral surface of the magnet body **16** as best shown in Figure 4. These bristle supports **17** comprise a plurality of bristle filaments **18***a* grouped as indicated at **18** in Figures 3 and 4 and extending beyond the confines of the magnet body **16** to provide resilient supporting means for maintaining the magnet body in spaced relation above the upper surface **10***a* of the support **10** as shown in Figure 4.

As shown in Figure 3, the bristles are inclined rearwardly and the center of the bristle mounting **17** is placed slightly forward of the center of gravity of the permanent magnet body **16**, while the bristle filaments **18***a*, being directed rearwardly, support the magnet assembly with its weight distributed evenly on the bristle unit **18** as a whole. Thus when the magnet **16** is vibrated, as by being placed in the alternating electrical field of conductor **13**, the magnet may move forwardly due to the ease with which the bristles may be bent toward the rear but may not be moved rearwardly since the inclination of the brushes prevents this movement. If desired, forward movement of the magnet may also be aided by a slightly downward tilt of the forward portion of the magnet body **16**. This tilt places the forward pole of the magnet in closer proximity to the electrical field and the ferromagnetic strip inducing greater vibration and better guiding. Also, as shown in Figure 4, the bristles are directed laterally outward from the cylindrical magnet body **16**. This outward inclination to the bristles forms a wider base for the magnet unit and imparts stabiilty to the assembly as it moves across the surface **10***a*.

In the modified form of the permanent magnet assembly shown in Figure 5 of the drawings, the permanent magnet body **16** is provided with a leaf spring-type resilient support **19**. The leaf spring **19** which may be formed of a spring metal, is bent downwardly to project beyond the circular end faces of the cylindrical magnet body **16** and radially from the magnet body **16** to provide resilient supporting arms **20**. The rearward inclination of the spring arms **20** aids the forward movement of the magnet while preventing its rearward movement as hereinbefore described in connection with the bristles **18** as shown in Figures 3 and 4.

In Figure 8 of the drawings, the permanent magnet body **16** is shown in dotted outline as contained in a toy vehicular body **21** of any desired form. The body **21** is wheelless and no portion of the body is in contact with the surface of the base **10** so that any frictional forces tending to retard the forward movement of the vehicle **21** are held to a minimum. It will be understood that the body **21** may be in the form of an automobile, truck, locomotive, figure or any other desired configuration. Also, it will, of course, be understood that the entire vehicular body **16** may be formed entirely of "Alnico" alloy or of other permanent magnet material supported above the surface **10***a*.

In the embodiment of the present invention illustrated in Figures 1 and 2, an alternating current of low voltage and high amperage is passed through the conductors **13** to cause the permanent magnet **12** to vibrate, as has been hereinbefore described. This vibration is imparted to the bristles **18** and the magnetic units **12** move with more or less rapidity and uniformity across the surface of the base **10** in a path following that outlined by the magnetic material **11**. In Figure 2 the conductor **13** defines a pair of loops meeting at a center point **21**. It will be noted that the loops of magnetic material **11** terminate, as at **22**, without meeting. The reason for this gap in the loops will be readily understood from the fact that, if the loops met, the magnetic units **12** would be attracted by both strands of magnetic material at the juncture of the loops. By providing the break **22**, divergent forces of attraction upon the permanent magnet **12** are minimized and the magnet **12** following

along any one of the strips or strands of magnetic material will have sufficient momentum to be carried across the gap in a direction constituting a continuation of its former path.

In the modification of the present invention as embodied in Figures 6 and 7 of the drawings, the permanent magnets are mechanically vibrated upon the surface of a base **25** which may be formed of any desirable material, preferably non-magnetic. The base **25** is preferably, but not necessarily, resiliently supported by any suitable means, such as by coil springs **26**, mounted at each corner thereof. Alternatively the base **25** may be deformed so that it is supported by its edge portions with its center portion raised.

As shown in Figure 7, a closed loop **27** of magnetic material, such as a soft iron wire, is provided to underlie the base **25** in a manner hereinbefore described. A plate **28** of magnetizable material, such as soft iron, is secured to the undersurface of the base **25** in a central position. An electromagnet **29** having upstanding soft iron pole pieces **30** seated upon insulating blocks **31** and resting upon a supporting member **32** is provided to underlie the soft iron plate **28**. A coil **33** of the magnet **29** is connected through conductors **34** to a suitable source of electricity, such as an alternating current. The electromagnet **29** is preferably positioned beneath the surface so that, when the coil springs **28** are relaxed, the iron plate **28** is slightly spaced from, but within the magnetic lines of flux of, the pole pieces **30**. The plate **28** and the magnet **29** may be suitably protected against possible damage by a cylindrical flange **35** depending from the undersurface of the base **25** to surround these elements.

The operation of the device illustrated in Figures 6 and 7 is extremely simple and is analogous to that hereinbefore described. Upon the connection of the conductors **34** to a source of alternating current, the magnetic field of the electromagnet **29** is alternately energized in opposite directions in accordance with the change of direction of flow of the alternating current. The electromagnet thus alternately attracts and repels the plate **28** of magnetizable material and the base **25** is vibrated vertically upon the springs **26**. An object, such as a permanent magnet, placed on the base **25** will vibrate with the base and if the magnet is resiliently supported in the manner of those shown in Figures 3–5, inclusive, of the drawings, it will move across the surface **25***a* of the base **25** in the manner hereinbefore described. The moving magnets will follow the path defined by the strip or wire of magnetizable material **27** underlying the base **25** to define the path along which the magnets are to travel. Instead of an alternating current, a direct current with a suitable make-and-break device may be employed to energize the electromagnet.

Thus, it may be seen that I have provided a toy vehicular system wherein a permanent magnet or an object embodying a permanent magnet may be propelled along a predetermined path defined by magnetizable material underlying the surface upon which the object is placed. The operation of the two embodiments of the present invention illustrated in the drawings and described in detail herein is essentially identical, since in each case a magnet is caused to vibrate while resiliently supported upon the base surface and is guided therealong by magnetizable material disposed in a predetermined path in proximity thereto.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. A toy comprising a substantially flat supporting base of non-magnetic material, a permanent magnet, resilient mounting means secured to said magnet at a point in advance of the center of gravity of said magnet and extending rearwardly therebeyond for supporting said magnet in spaced relation to the upper surface of said base, a conductor connected to a source of alternating current and extending beneath said base for causing the magnet to vibrate in a vertical plane when placed within the electrical field set up by said conductor, the magnet having a translatory motion imparted thereto by its overbalanced support on said mounting means and being moved in one direction only by the resilient mounting means contacting the surface of said base, and ferromagnetic material disposed beneath said base adjacent said conductor and within the magnetic field of said magnet for determining the path along which said magnet is moved.

2. A toy comprising a substantially flat supporting base of non-magnetic material, a permanent magnet, flexible bristle filaments secured to said magnet and extending therebeyond for supporting said magnet from a point forward of the magnet center of gravity in spaced relation to the upper surface of said base, a conductor connected to a suitable source of low voltage, high amperage alternating current and disposed beneath said surface for causing said magnet to vibrate in a vertical plane when placed within the electrical field of said conductor, said bristle filaments being inclined to the axis of said magnet to permit only forward movement of said magnet along said surface as the magnet moves therealong due to its vibration and unbalanced condition and a ferromagnetic strip disposed beneath said surface adjacent said conductor for determining the path along which said magnet is moved.

3. A toy vehicular system comprising a substantially flat supporting base of non-magnetic material, a permanent magnet, resilient mounting means carried by said magnet and depending therefrom into contact with said base for supporting said magnet on the upper surface of said base in spaced relation thereto, said mounting means being inclined rearwardly to the axis of said magnet to facilitate movement of the magnet in one direction, and means for vibrating said magnet while thus supported to impart thereto a translatory movement, said means including a conductor carried by said base within the boundary of said base and generally parallel to and adjacent said upper surface thereof disposed beneath the upper surface of said base in proximity to said magnet and connected to a source of alternating electric current for subjecting said magnet to an electrical field of alternately reversed polarity.

4. A toy vehicular system comprising a supporting base of non-magnetic material, a toy vehicular body, a permanent magnet carried by said body, resilient mounting means also carried by said body for contacting said base to support said body in spaced relation thereto, a conductor connected to a source of alternating electrical current in proximity to said magnet for causing said magnet to vibrate vertically when placed

within the electrical field set up by said conductor, and a ferromagnetic strip carried by said base adjacent said conductor for guiding said body along a predetermined path as the vibration of said magnet imparts a translatory movement to said body to move the same across said base.

5. A toy comprising a non-magnetic substantially flat supporting base, a toy vehicular body carrying a permanent magnet, resilient mounting means also carried by said vehicular body and depending therefrom into contact with said base for supporting the magnet from a point displaced from the center of gravity thereof in spaced relation to the upper surface of said base, said mounting means including flexible elements inclined rearwardly with respect to the axis of said vehicle to limit movement thereof to a forward direction only, a conductor carried by said base within the boundary of said base and substantially in its plane, means for flowing a current of fluctuating intensity through said conductor to cause said magnet when in proximity to said conductor to vibrate, and a ferromagnetic strip also carried by said base within the boundary of said base and substantially in its plane for guiding said body along a predetermined path, said ferromagnetic strip being adjacent said conductor and laterally displaced therefrom so that vibration of said magnet induced therein by said current flowing through said conductor will effect magnet vibration in a plane at right angles to the said conductor, said vibrations having an appreciable vertical component relative to said base.

6. A toy comprising a support base of non-magnetic material having a generally flat upper surface, an elongated member of ferromagnetic material affixed to said base within the boundary thereof and generally parallel to and adjacent said upper surface, a permanent magnet having opposite poles in a generally horizontal line substantially in vertical alignment with said member, resilient means secured to said magnet and contacting said surface at spaced points on opposite sides of said elongated member for supporting said magnet for horizontal movement, and means for effecting relative vibratory movement of said base and magnet toward and away from each other.

7. A toy as defined by claim 6 in which said means for effecting relative vibratory movement of said base and magnet comprises electro-magnetic means for vibrating said base.

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