Aug. 15, 1967 N. K. ELWARD 3,335,519

ORBITING TOP MECHANISM

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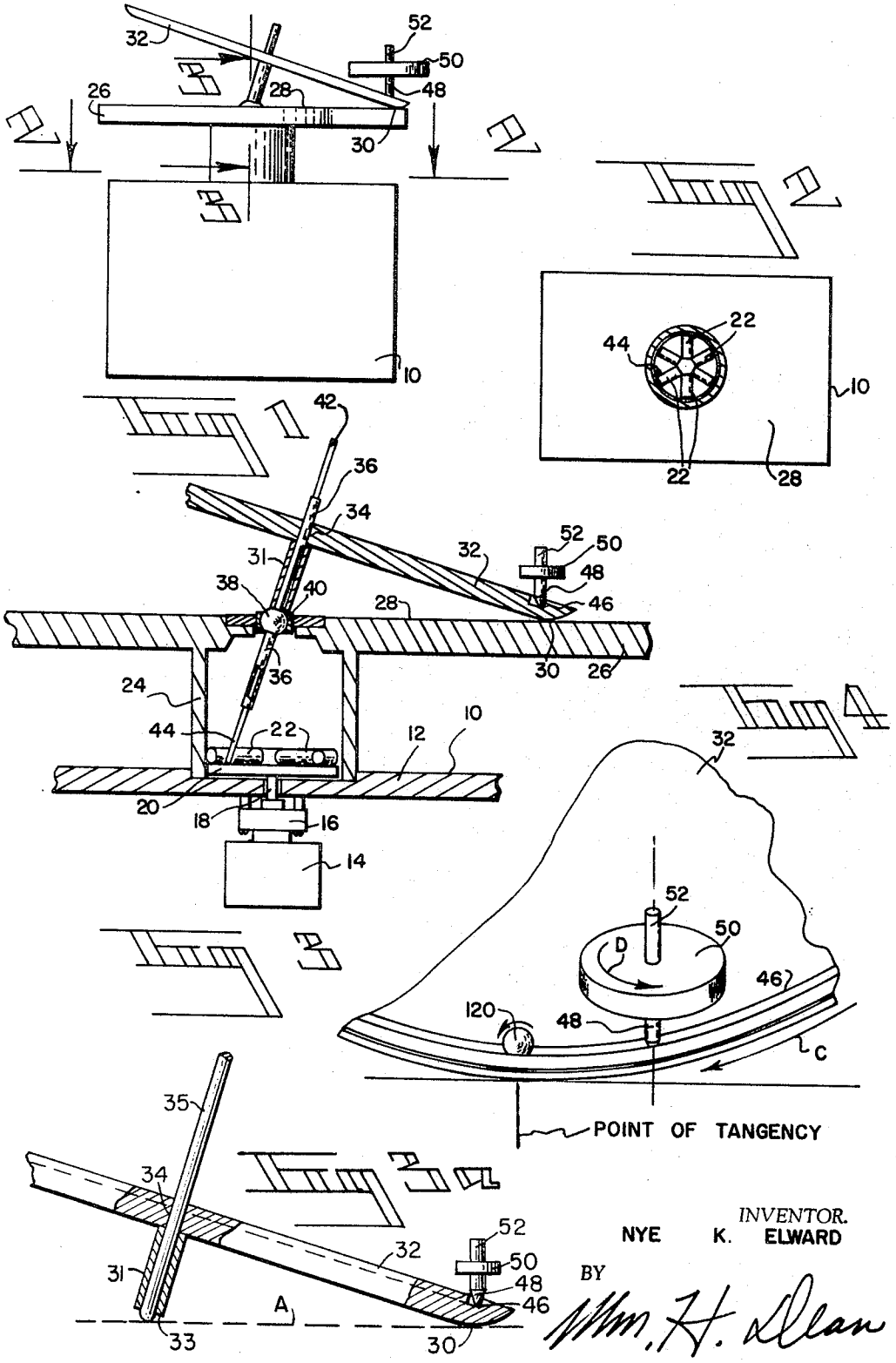

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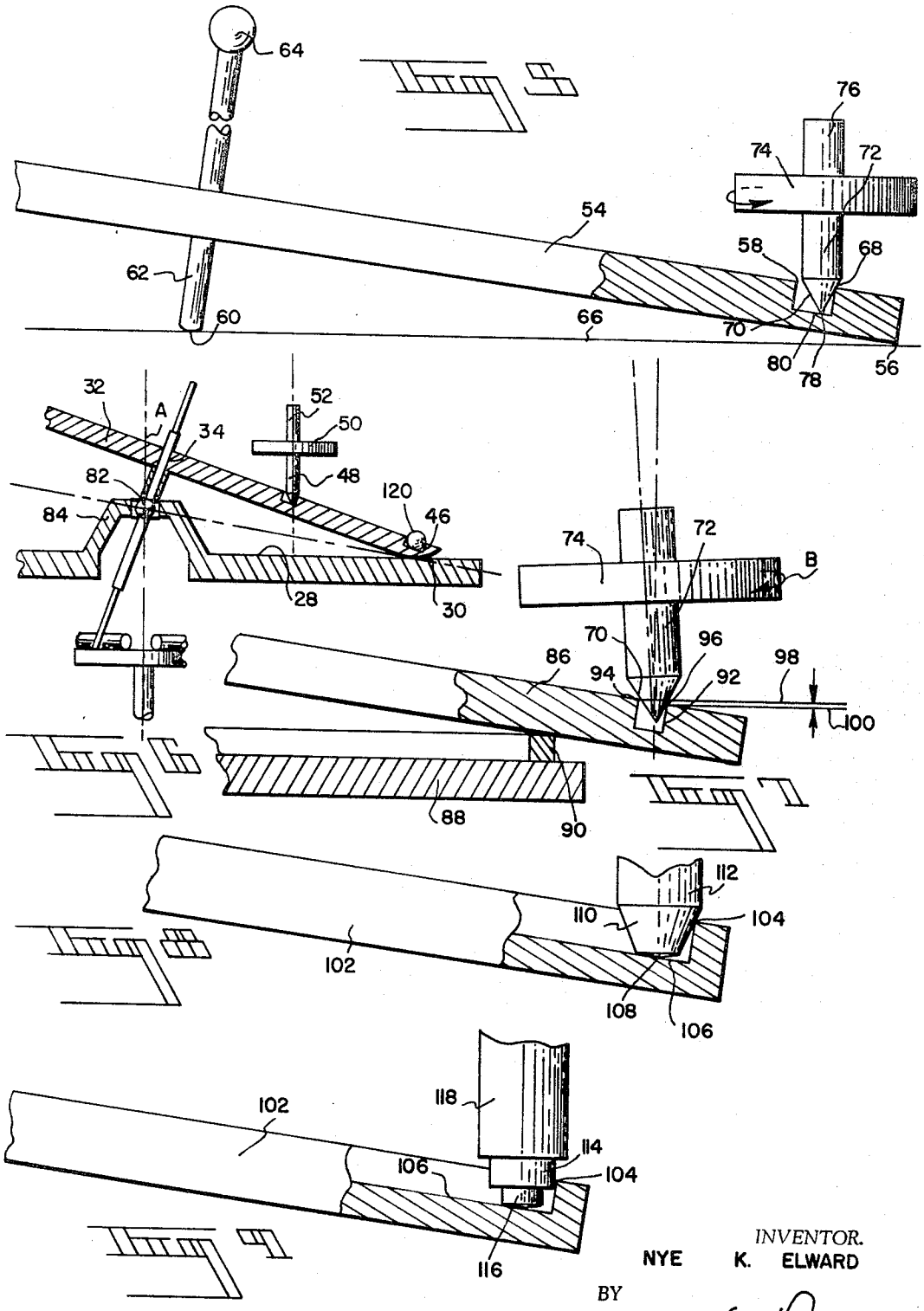

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ORBITING TOP MECHANISM

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5 Claims. (Cl. 46—65)

This is a continuation-in-part application of my copending application, Ser. No. 315,947, filed Oct. 14, 1963 now abandoned.

This invention relates to an orbiting top mechanism and more particularly to an orbiting top mechanism wherein an oscillating wobble plate is provided with an endless track and wherein a spinning top is provided with a spindle engaging said track so that rotary tilting sinusoidal oscillations induced in said plate may perpetuate spinning of said top around said track.

It is an object of the present invention to provide a very novel orbiting top mechanism which may be used as a toy.

Another object of the invention is to provide an orbiting top mechanism which is very useful in developing physical coordination of the operator and skill in operation of the mechanism whereby the operator may tiltably rotate and oscillate an oscillating plate in a sinusoidal action thereby perpetuating the spinning of a top on an endless track on the plate.

Another object of the invention is to provide a novel orbiting top mechanism which may pose various geometric problems of force, gravity and friction which can be suggestive to engineering students so that they may utilize the mechanism as a three dimensional study.

Another object of the invention is to provide an orbiting top mechanism which develops skill and coordination of the operator and therefore may be used as a therapeutic device for training or mechanically rehabilitating various persons.

Another object of the invention is to provide an orbiting top mechanism which is very economical to produce.

Another object of the invention is to provide an orbiting top mechanism having an oscillating plate which may be tilted in a rotary sinusoidal motion and which is provided with an endless track thereon adapted to guide a variety of spinning tops having various diameters and weights whereby variables in the operation of the orbiting top mechanism of the invention may be introduced.

Another object of the invention is to provide a motor operated orbiting top mechanism, wherein an oscillator (wobble) plate is motor actuated, in a rotary tilting manner to display a constant physical and geometric phenomenon in which sinusoidal action of the oscillator plate causes continuous spinning of a top having its rotating spindle engaged in an endless track on the plate.

Another object of the invention is to provide an orbiting top mechanism which is very suggestive of a spinning body in celestial orbit.

Another object of the invention is to provided an orbiting top mechanism which, when manually operated, requires the operator to attain finite control and coordination of accelerative forces in order to maintain continuous spinning of the top on the oscillator plate of the invention.

Further objects and advantages of the invention may be apparent from the following specification, appended claims and accompanying drawings, in which:

FIG. 1 is a side elevational view of a motor driven orbiting top mechanism in accordance with the present invention;

FIG. 2 is a plan sectional view taken from the line 2—2 of FIG. 1 showing motor driven actuating mechanism for the oscillator plate of the invention;

FIG. 3 is an enlarged fragmentary vertical sectional

view taken from the line 3—3 of FIG. 1 showing the mechanism of the invention rotated horizontally 90 degrees;

FIG. 3*a* is a fragmentary sectional view, showing a manually operable version of portions of the mechanism, shown in FIG. 3, and illustrating portions of the mechanism, shown in FIG. 3, removed from the motorized equipment of the invention and placed upon a flat plane so that the oscillating plate of the invention may be operated manually;

FIG. 4 is a fragmentary perspective view of a portion of the oscillator plate of the invention having an endless track thereon and on which a top is spinning;

FIG. 5 is a fragmentary side elevational view of a manually operable orbiting top mechanism of the invention showing portions of the mechanism broken away and in section to amplify the illustration;

FIG. 6 is a sectional view similar to FIG. 3 showing modifications of a motor driven version of the orbiting top mechanism of the invention;

FIG. 7 is an enlarged fragmentary sectional view of a modification of the invention showing an oscillator plate thereof, engaging a stationary circular bearing means therebelow;

FIG. 8 is an enlarged fragmentary sectional view of an oscillator plate of the invention which comprises a novel endless track mechanism, which oscillator plate may be used in various forms of the invention, such as shown in FIGS. 1 and 5 or other views disclosing the invention; and

FIG. 9 is a view similar to FIG. 8, but showing a modification of the spindle bearing mechanism of a spinning top of the invention.

As shown in FIG. 1 of the drawings, the motorized version of the orbiting top mechanism of the invention is provided with a base **10** having generally box shaped structure **10**, as shown in FIG. 3 is provided with an element **12** supporting an electric motor **14** having a gear reduction mechanism **16** provided with an output shaft **18** operating at relatively low speed. Coupled to this shaft **18** is a plate **20** to the upper surface of which are fixed a plurality of radially disposed drive bars **22**. A hollow housing section **24** is supported on the element **12** of the base **10** and this section **24** supports a bearing plate **26** having an upper surface **28** engageable by a lower circular bearing portion **30** of an oscillator plate **32**, as shown in FIG. 1. This plate **32** is provided with a central opening **34** disposed on a hollow shaft **36** provided with universal spherical bearing **38** held movably captive in a socket **40** carried by the plate **26**. A rod **42** is removable slidably positioned in the hollow shaft **36**. The upper end of the rod **42** projects above the hollow shaft **36** and the lower end **44** of the rod **42** projects outwardly from the lower end of the hollow shaft **36** and engages the radial drive bars **22** carried by the plate **20**. Thus, when the shaft **18** of the reduction gears **16** is rotated, the rod **44** is engaged by the radial bars **22** and is caused to rotate in a substantially circular path, whereby the peripheral portion **30** of oscillator plate **32** is rolled around pivot **38** on surface **28** of plate **26** in a substantially sinusoidal oscillation. The plate **32**, thus, is caused to produce a continuous wave motion when actuated by the motor **14**.

As shown in FIG. 3 of the drawings, a hollow tubular sleeve **31** is fixed to a lower surface of the plate **32**, and this sleeve **31** is provided with a bore which aligns with the opening **34** in the plate **32**. A lower end of the sleeve **31** rests on the spherical bearing **38**, and supports the plate **32** thereon.

As shown in FIG. 3*a*, the sleeve **31** at its lower end **33** is adapted to rest on a table top surface, indicated at A in FIG. 3*a* of the drawing. A rod **35** is inserted through the

opening 34 and into the sleeve 31 and a lower end of the rod 35, also may rest on the table top surface A.

A person may grasp an upper end of the rod 35 to cause oscillatory motion of the plate about its bearing surface 30 on the table top A and, thus, these elements of the invention may be operated independently of the motor 14, and the elements 32, as hereinbefore described. Additionally, the sleeve 31 may be held by a person's hand beneath the plate 32, and in this instance, the rod 35 may be dispensed with, such that the plate may be oscillated by a person holding the sleeve 31 as a handle under the plate 32.

In the upper surface of the plate 32 is an endless track 46. This track 46, as shown is circular and is disposed to be engaged by a spindle 48 of a spinning top 50 which is provided with an upwardly extending finger grasping spindle portion 52 used manually to impart initial spin to top 50 and to thereby place the spindle portion 48 in the track 46. In operation, the rod 42 is slidably moved upwardly out of the hollow shaft 36 a sufficient distance to clear the lower end 44 relative to the drive bars 22. Thus, when the motor 14 is started, the plate 20 is rotated and the drive bars are carried around therewith, but the lower end 44 of the rod 42 is disengaged. The operator then twirls the spindle portion 52 of the top 50 between his fingers causing it to spin; concurrently placing the spindle 48 in the recessed track 46. As the top continues to spin in the track 46, the rod 42 is lowered through the hollow shaft 36 so that the end 44 of the rod 42 is engaged by one of the drive bars 22 and the oscillator plate 32 is set in motion causing it to roll on its lower annular surface 30 around the upper surface 28 of the plate 26. This rotary motion of the hollow shaft 36 causes the plate 32 to rotate in a circular sinusoidal oscillating fashion, whereby action of the plate simulates a wave motion comparable to an ocean wave driving a surf board to which the top is analogous.

As the oscillator plate 32 continues its sinusoidal oscillations, the top 50 continues to spin due to gravity and wave motion acting thereon, whereby the spindle 48 slidably traverses the track 46.

The track 46 in the oscillator plate 32 is or may be similar to any of the tracks hereinafter described in the respective oscillating plates shown in FIGS. 5 to 9 of the drawings.

As shown in FIG. 5 of the drawings, a manually operable oscillator plate 54 is provided with an annular portion 56 on its lower surface and is provided with an annular groove shaped track 58 in its upper surface. This oscillator plate 54 is rolled about a lower end bearing portion 60 of a rod 62 which projects therebelow and above the plate 54. This rod 62 is provided with a manually operable handle 64 above the plate so that the plate may be moved manually progressively to roll the lower surface 56 on a table top 66 or other comparable horizontal surface. Thus, the plate 54 may be operated manually in a manner similar to that hereinbefore described in connection with the motorized version shown in FIGS. 1 to 4 of the drawings. The manually operated version of the mechanism is well suited to perform experiments with stroboscopes, gyroscopes, coefficients of friction and centrifugal force, particularly since the operator is, per se, a variable speed actuator.

The track 58 being an annular groove is provided with a ledge 68 adjacent to which an inverted conical point 70 of a spindle 72 of a top 74 revolves.

This top 74 is provided with a finger engaging spindle 76 extending upwardly which is similar to the spindle 52 of the top 50.

The main body of the top 74 is an annular fly wheel structure similar to that of the top 50.

Reference is here made to FIGS. 4 and 5 which are both applicable in studying the action of the tops 50 and 74 with respect to the tracks 46 and 58. When the oscillator plate is rotated clockwise, the conical spindle portion 70 bears centrifugally against ledge 68 which action

combined with the gravitational pull causes a downgrade, sliding, clockwise, displacement of spindle 72 in track 58, and a coincidental torque acting counterclockwise on spindle 72, such torque causing spindle 72 to spin synchronously with the frequency of oscillation and in the ratio of the radii involved, respectively;

$$\frac{\text{radius of ledge 68}}{\text{radius of 70 at 68}}$$

A burnished or otherwise finished bearing point 78 at the lower end of the conical portion 70 is supported in the bottom portion 80 of the groove track 58 and since this bottom 80 is tilted relative to the horizontal, gravity tends to force the point 78 to move outwardly and downwardly away from the spindle 62 which is the oscillating axis of the plate 54. Thus, as the point 78 moves downwardly on the declined bottom surface 80 of the grooved track, the side of the conical point 70 engages the ledge 68 and tractively coordinates rotation of the spindle and the top relative to the respective wave motion of the respective oscillator plate which motion also causes the track bottom 80 to be disposed at an angle to the horizontal, whereby gravity tends to force the spindle 72 and the top 74, or the top 50, to move around the endless track 58 or 46, respectively.

Reference is now made to FIGS. 3 and 6 of the drawings and principally to the bearings 38, as shown in FIG. 3 of the drawings.

The plate 32, as shown in FIG. 6 of the drawings is similar to the plate 32 shown in FIG, 3, and a universal bearing 38 is similar to the bearing 82 which is disposed above the plane of the plate surface 28, a vertical distance equal to the slant height of opening 34 above the surface 82. This geometry creates two identical right triangles having a common hypotenuse. The longer sides of the two right angles represent the radii of the rolling periphery and the path on which it rolls, respectively. These radii being equal, the differential action between the rolling periphery 30 and its path, on the surface 28, is eliminated.

In the modification shown in FIG. 7 of the drawings, a plate 86 is an oscillator plate equivalent to the plate 32, but may have any peripheral shape desired and a supporting plate 88 is provided with an annular upwardly extending bearing 90 on which the lower surface of the oscillator plate 86 is progressively rolled, this being the equivalent of the annular bearing surface 30 operating on the upper surface 28 of the plate 26, as hereinbefore described.

As shown in FIG. 7 of the drawings, a modification of the annular track 68 shown in FIG. 5, is illustrated. This modification comprises an annular grooved track 92 having both annular upper edges 94 and 96 engaged by the conical portion 70 of the spindle 72 of the top 74. Accordingly, the edge 94 of the groove track 92 engages the conical portion 70 on a contact line 98 which intersects at a larger diameter of the conical point than a line 100 which coincides with the engagement of the ledge 96 with the conical point 70. Thus, since the conical point 70 engages the ledge 94 at a greater diameter than the engagement of the point with the ledge 96, the top 74 tends to spin with the greater traction in a direction opposite to that as shown in FIG. 5, of the drawings. Thus, the top 74, shown in FIG. 7 of the drawings acted upon by gravity and wave motion of the oscillator plate 86 travels clockwise in the groove track 92 and spins in a clockwise direction, as indicated by an arrow B in FIG. 7, while the plate 86 is rotatably oscillated in a clockwise direction.

In the modification of the invention shown in FIG. 8 of the drawings, an oscillator plate 102 is similar to the hereinbefore described oscillator plates 32 and 54, but this plate is merely provided with a track ledge 104 extending above an annular track portion 106 which supports a reduced diameter spindle portion 108 of a conical spindle portion 110 at the lower end of a spindle 112

which is similar to the hereinbefore described spindles **48** and **72**.

It will be seen that the bearing portion **108** is of a lesser diameter than a portion of the conical point **110** which engages the ledge **104**, thus, the top may normally tend to rotate in the direction of the arrow D as shown in FIG. 4 of the drawings. The bearing point **108** being broader than the conical point **78** shown in FIG. 5 of the drawings may be more durable when made of certain materials.

In the modification shown in FIG. 9 of the drawings, the oscillator plate **102** at its ledge **104** is engaged by strict cylindrical spindle portion **114** which is also provided with a reduced spindle portion **116** having lesser diameter than the spindle portion **114**. This spindle portion **116** spins on the bottom **106** of the oscillator plate track, thus, the structure shown in FIG. 9 provides for automatic compensation for wear of the tip **116** and thereby maintains a constant ratio radius of the spindle **118** to the radius of the engaging ledge no matter how much wear occurs on the reduced supporting spindle portion **116**. This wear, of course, is limited to reasonable amount, but it will be seen that as the spindle portion **114** passes downwardly adjacent the ledge **104**, a constant ratio of spindle spin to oscillation frequency will be maintained as hereinbefore described in connection with the plate **32** and also the plate **54**.

It will be seen that the invention comprises an oscillator plate which produces a sinusoidal wave motion and that an annular track on the plate may be followed by various articles responding to gravity, as for example, the tops hereinbefore described or a ball bearing **120** shown in FIG. 4 of the drawings and also in FIG. 6 of the drawings. Additionally, small vehicles, such as toy automobiles, or the like, may be made to follow the track **46** or the track **58** or other similar tracks, if desired. Operating in connection with the motor **14** or any equivalent device, a very novel display may be made with respect to various articles traveling around the track in response to the wave motion of the oscillator plate plus the force of gravity acting upon the articles traversing the track.

The manually operable version, as shown in FIG. 5 of the drawings may be operated by manual engagement of the finger engaging portion **64** which is used for actuating the oscillator plate **54** in a rotary sinusoidal motion about the bearing portion **60** of the spindle **62** which may be placed on any suitable surface **66** which may be a table top or any other flat surface which is preferably horizontal.

It will be obvious to those skilled in the art that a further manually operable version of the invention may be resorted to by holding the oscillator plate of the invention in the palm of the hand and actuating it in a rotary sinusoidal motion about its center whereupon the top may be operated in its spinning action on the track means of the plate as hereinbefore described, thus, in this manually operable version of the invention, no plate actuating spindle is used and no horizontal surface is necessary upon which to support the plate. It is merely held in the hand or on the palm of the hand of the operator and, thus, a very interesting game of skill may be performed in the accurate rotary sinusoidal action or actuation of the plate by the human hand.

The term, sinusoidal, as hereinbefore employed, shall be construed to include the specific mathematical definition of the oscillatory motion ascribed to the track bearing plate of the invention. Designating as P any point on the track at which the top slides, the ordinate Y for such point P is defined, viz; $Y=R$ (1-cos alpha) sin ϕ, in which expression alpha is the parameter, or phase angle of rotation of above mentioned plate to effect Y. Angle ϕ is the inclination of the plate in neutral equilibrium. R—the radius of the track. Since R sin ϕ has a constant value for any integrated mechanism, the equation of the subject

oscillatory motion becomes a function of the versed sine of the said parameter angle alpha.

It will be appreciated by those skilled in the art that the top **50** or the top **74** may be started spinning, as shown in FIGS. 4 and 5 of the drawings and then the oscillator plate set in motion either manually or by motor driven means, as hereinbefore described to perpetuate spinning of the top in the track as it traverses the same thereabout.

It will be obvious to those skilled in the art that various modifications of the present invention may be resorted to in a manner limited only by a just interpretation of the following claims.

I claim:

1. In an orbiting top mechanism the combination of: an oscillating plate; a circular bearing for a lower surface of said oscillating plate; a projecting means coupled to said plate and projecting normally below said plate, said projecting means having a pivot means spaced below said plate; a support means for said pivot means whereby said plate is adapted to tilt about the axis of said pivot means relative to said circular bearing and whereby said plate is tiltably rotated thereon in a sinusoidal oscillating action about said pivot means; means for causing said plate to oscillate; an upper surface of said plate; a circular track means at the upper surface of said plate; an orbital and rotatable top; a spindle for said top; and a lower end of said spindle engageable with said track, whereby said top when spinning with its spindle engaging said track means may be continued in its spinning motion by sinusoidal tilting rotation of said plate on said circular bearing about the axis of said pivot means; said track means being a channel shaped groove in the upper surface of said oscillating plate; said spindle having a conical point engaging opposite side portions of said channel shaped groove.

2. In an orbiting top mechanism the combination of: an oscillating plate having a lower peripheral surface forming a circular bearing; a projecting means coupled to said plate and projecting normally below said plate, said projecting means having a pivot means spaced below said plate adapted to bear on a substantially horizontal surface, whereby said plate is adapted to tilt about the axis of said pivot means and said circular bearing may roll on said substantially horizontal surface, whereby said plate is tiltably rotated thereon in a sinusoidal oscillating action about said pivot means; an upper surface of said plate; a circular track means at the upper surface of said plate; an orbital and rotatable top; a spindle for said top; and a lower end of said spindle engageable with said track, whereby said top, when spinning with its spindle engaging said track means, may be continued in its spinning motion by sinusoidal tilting rotation of said plate on said circular bearing about the axis of said pivot means; and a handle projecting above said oscillating plate and connected thereto and manually operable to actuate said plate in said sinusoidal tilting oscillating motion on said circular bearing and about the axis of said pivot means.

3. The invention, as defined in claim **2**, wherein: said track means comprises a channel-shaped groove in the upper surface of said oscillating plate; and said spindle having a conical point simultaneously engaging opposite side portions of said channel-shaped groove.

4. In an orbiting top mechanism the combination of: an oscillating plate having a lower peripheral surface forming a circular bearing; a projecting means coupled to said plate and projecting normally below said plate, said projecting means having a bore; a handle projecting through said bore and forming a pivot means spaced below said plate and adapted to bear on a substantially horizontal surface, whereby said plate is adapted to tilt about the axis of said pivot means and said circular bearing may roll on said substantially horizontal surface, whereby said plate is tiltably rotated thereon in a sinus-

oidal oscillating action about said pivot means; an upper surface of said plate; a circular track means at the upper surface of said plate; an orbital and rotatable top, a spindle for said top; and a lower end of said spindle engageable with said track, whereby said top, when spinning with its spindle engaging said track means, may be continued in its spinning motion by sinusoidal tilting rotation of said plate on said circular bearing about the axis of said pivot means; said handle projecting above said oscillating plate and removably disposed in said bore and manually operable to actuate said plate in said sinusoidal tilting oscillating motion on said circular bearing and about the axis of said pivot means.

5. The invention, as defined in claim 4, wherein: said track means comprises a channel-shaped groove in the upper surface of said oscillating plate; and said spindle

having a conical point simultaneously engaging opposite side portions of said channel-shaped groove.

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