Nov. 17, 1964 B. WALLACH 3,157,401

PIVOTED MOVING SATELLITE SIMULATING SPACE TOY

Filed March 15, 1963 2 Sheets-Sheet 1

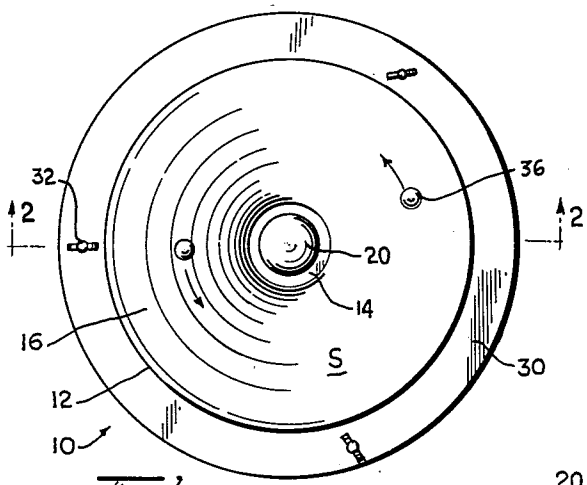


Fig. 1.

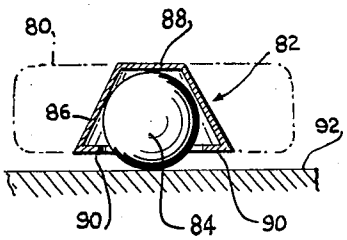


Fig 8.

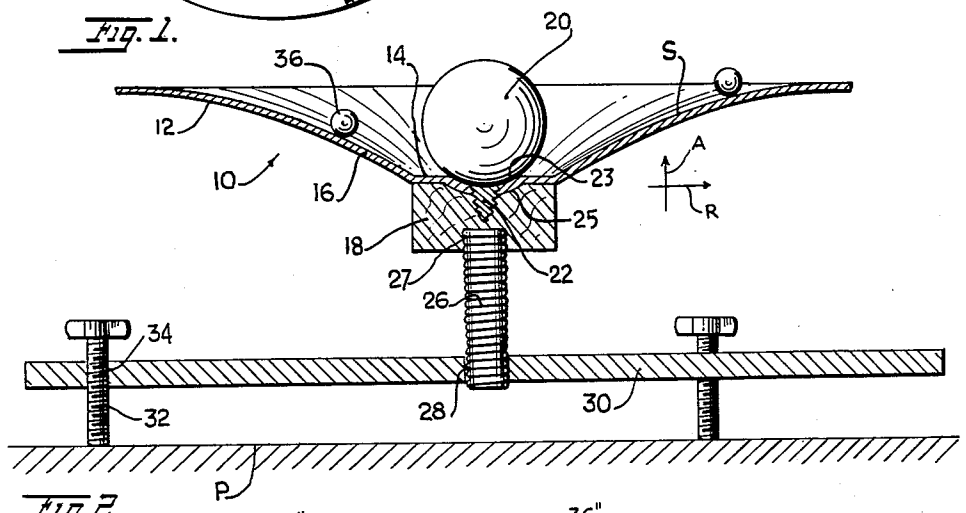


Fig. 2.

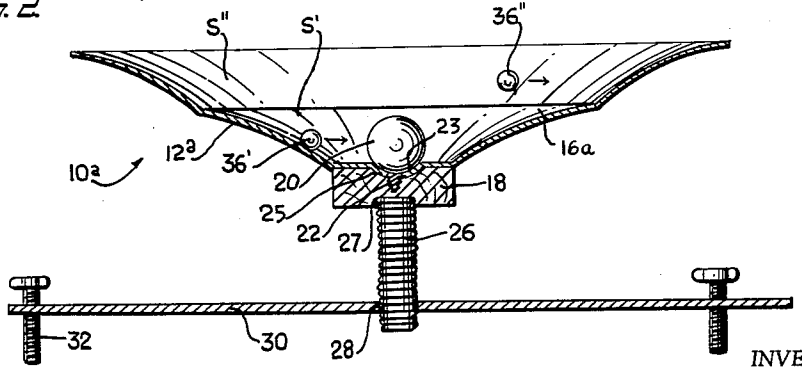


Fig. 3.

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PIVOTED MOVING SATELLITE SIMULATING SPACE TOY

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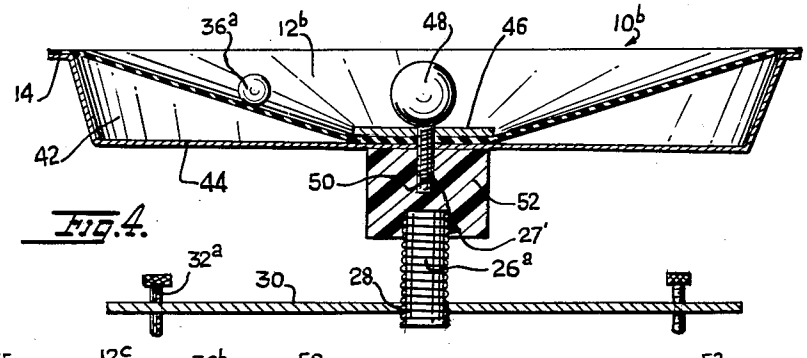


Fig. 4.

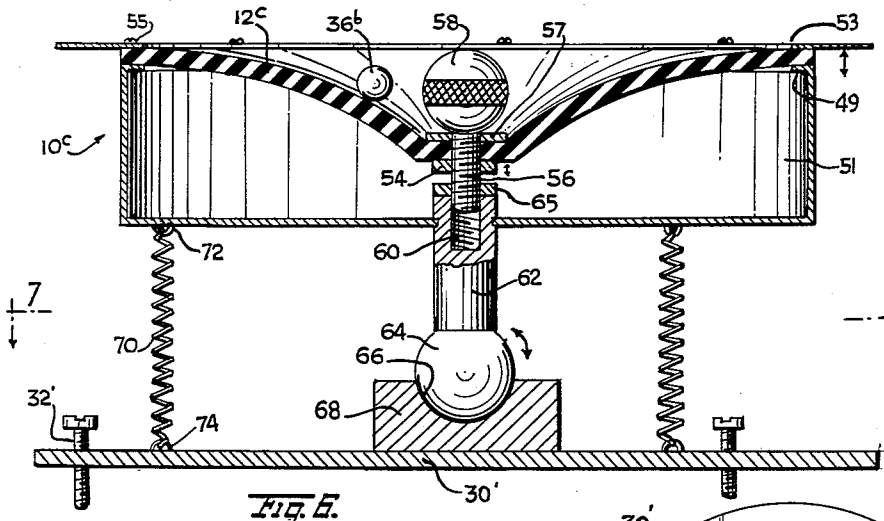


Fig. 6.

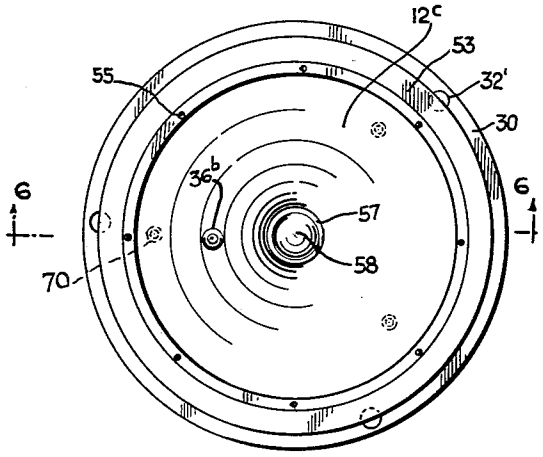


Fig. 5.

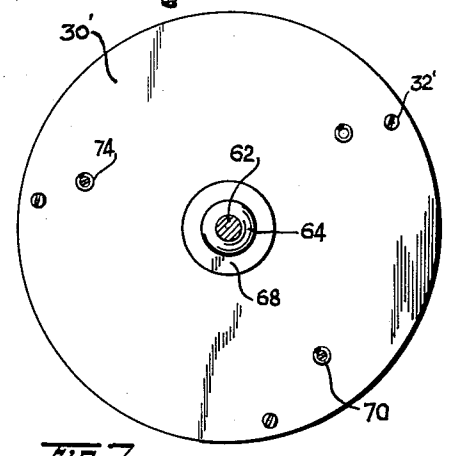


Fig. 7.

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PIVOTED MOVING SATELLITE SIMULATING SPACE TOY

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3 Claims. (Cl. 273—110)

This invention concerns a toy adapted to simulate movments of a planet or satellite in orbit, or of a space ship.

According to one form of the invention, there is provided a device having a three-dimensional indented surface flaring outwardly from its center. This indented surface is shaped so that in cross section it has an inverse square curvature which represents the inverse law of gravitational attraction. A ball is provided for rolling freely around this surface. The ball represents a space vehicle, space missile, satellite or planet. At the center of the surface, which represents outer space, may be placed a stationary sphere representing a sun around which the ball moves in orbit. The ball will roll in "space" in an orbit around the central "sun." The "space" surface is supported on a universal mounting in such a way that the surface can be tilted, in all vertical planes on horizontal axes, but it cannot be rotated. By tilting or rocking the space surface, the player can keep the ball revolving in orbit as long as desired. Some skill is required to do this. This skill is developed with practice. In operation of the device the players imparts a force to the rolling ball which tends to overcome rolling friction and restores centrifugal kinetic energy. The force of gravity on the ball tends to pull the ball radially inwardly or centripetally toward the central sun. The balance of forces results in a dynamic stabilization so that the ball revolves in orbit continuously. More than one ball can be employed to represent a plurality of planets, satellites, etc., in orbit around the central sun. More than one indented surface path may be provided upon each of which one or more planets may revolve around the central sun. The indented surface may be made adjustable to simulate different gravitational fields.

According to another form of the invention, there is provided a space ship mounted on a conical frame frictionally supported on a sphere adapted to roll over a supporting surface.

It is therefore a principal object of the invention to provide a toy or game in which one or more balls roll freely on an indented surface of a support which is tiltable on a universal mounting.

A further object is to provide a device in which a rolling ball simulates a satellite in orbit around a central sun, the space path of the satellite being provided by a curved supporting surface whose curvature simulates the inverse square law of gravitational attraction.

Another object is to provide a device as described wherein the supporting surface is tiltable universally only on horizontal axes.

Another object is to provide a device as described having a plurality of curved supporting surfaces upon which a plurality of balls can roll in simulated orbits.

Still another object is to provide adjustment means for varying the curvature of the supporting surface for the orbiting ball.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawings, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawings forming a material part of this disclosure:

FIG. 1 is a top plan view of a toy, game or device embodying the invention.

FIG. 2 is a sectional view on an enlarged scale taken on line 2—2 of FIG. 1.

FIGS. 3 and 4 are sectional views similar to FIG. 2 of two other embodiments of the invention.

FIG. 5 is a top plan view of a further embodiment of the invention.

FIG. 6 is a cross-sectional view on an enlarged scale taken on line 6—6 of FIG. 5.

FIG. 7 is a cross-sectional view on the same scale as FIG. 5 taken on line 7—7 of FIG. 6.

FIG. 8 is a side view partly diagrammatic and partly elevational showing another modification of the invention.

Referring first to FIGS. 1 and 2, there is shown a device 10 including a dished rigid plate 12. The plate is a rigid member made of metal, plastic or the like. The plate has a circular central bottom 14 and an upwardly and outwardly flaring body 16. The body 16 in cross-section taken radially has an upper surface S whose curvature is convex and may be represented mathematically by the equation:

$$A=C-\frac{K}{R}$$

where A is the axial distance from the plane of plate bottom 14 to any point on the surface; R is the radial distance from the central axis of the surface to the same point on the surface; K is a constant; and C is a constant.

From the above relation, the slope of the surface would be

$$\frac{dA}{dR}=\frac{K}{R^2}$$

giving the desired inverse square relation.

The plate bottom rests on a block 18 and may be secured thereto by a sphere 20 having a screw extension 22 engaged in the block. An indentation 23 may be provided in the plate bottom. This indentation will fit into a recess 25 formed in the block. The block is supported on a coil spring 26 axially aligned with the central axis of the plate. The upper end of the spring is secured in a bore 27 in the block. The lower end of the spring is secured in a bore 28 of a leveling plate 30. Plate 30 has a plurality of circumferentially spaced leveling screws 32 engaged adjustably in holes 34. One of more balls 36 roll freely on the upper surface S of the plate body 16. Block 18 can serve as a finger grip. By adjusting the screws 32, the axis of the plate body can be made vertical with respect to the supporting surface P.

If any ball or balls 36 are thrown on the surface S they can be kept rolling around the surface by rocking or tilting the plate on its universal mounting spring 26. The spring keeps the plate from rotating in a horizontal plane on its vertical axis but permits the plate to be tilted in all possible vertical planes on horizontal axes. By exercising reasonable care and skill the player can keep the balls rolling continuously around the sphere 20 which represents the sun. The balls tend to roll downwardly and inwardly toward the sun due to gravitational attraction of the earth. This tendency is overcome by the centrifugal force imparted to them by the player's manipulation of the plate.

FIG. 3 shows device 10^a which is similar to the device 10 and corresponding parts are identically numbered. Plate 10^a has two curved surfaces S' and S'' each having a convex curvature corresponding to that of surface S of device 10. The surface S' and S'' are arranged as two concentric annular bands in the body 16^a of plate 12^a. By skillful manipulation of the plate 12^a, both planetary balls 36' and 36'' can be kept rolling continuously in their respective space paths represented by surfaces S' and S''.

FIG. 4 shows another device 10b which is similar to the device 10. This device has an elastic diaphragm or membrane 12b which has its outer edge secured by cement or the like to the annular rim 14 of a pan 42. The diaphragm assumes a generally frusto-conical form between the open top and closed circular bottom 44 of the pan since the diaphragm is held in tension at its center to the center of the pan bottom by a flat disk 46. A spherical knob 48 bears on the disk and has a screw 50 engaged in bore 27' in block 52 which supports the pan. A coil spring 26a supports the block and pan in a horizontal position. The spring is engaged in bore 28 of leveling plate 30. Leveling screws 32a permit the plate 30 to be leveled horizontally. The pan 42 can be tilted in various vertical planes by the player to keep ball 36a rolling continuously on diaphragm 12b around the sphere 48, to simulate a satellite revolving in orbit around a sun.

The conical form of diaphragm 12b only approximates the desired inverse square relationship corresponding to that of gravitational attraction between two masses. The device 10c of FIGS. 5 and 6 shows another arrangement of the invention in which a thick flexible rubber diaphragm 12c is used to assume a curved configuration more closely approximating the ideal forms such as those of rigid plates 12 and 12a. This diaphragm has its peripheral edge secured to the annular rim 49 of a pan 51 by means of an annular ring 53 and screws 55. This ring extends radially outward of the pan 50 to provide an extension which can be grasped by a player for tilting the pan. The diaphragm is engaged at its center between a washer 57 and a nut 54 screwed on screw 56 extending down from spherical knob 58. The screw 56 is adjustably threaded in a threaded bore 60 of a post 62. A lock nut 65 on the screw 56 holds the screw in any desired position of axial extension with respect to the post.

At the bottom end of the post 62 is a ball 64 rotatably disposed in a hemispherical recess or socket 66 of a block 68. The block is carried on leveling plate 30' supported by circumferentially spaced leveling screws 32'.

Circumferentially spaced coil springs 70 are secured between eyes 72 at the underside of the pan and eyes 74 on the upper side of plate 30'. The coil springs substantially prevent axial rotation of the pan in a horizontal plane and prevent lifting of the ball 64 out of socket 66. The ball 64 in the socket serves as a universal joint permitting the diaphragm 12c to be tilted in any desired direction to keep ball 36b rolling continuously around the sphere 58. The sphere simulates a central sun while the ball simulates a satellite. The radial curvature of the diaphragm can be changed by turning the screw 56 in or out of bore 60 in post 62. With each change in diaphragm configuration a different orbital path will be followed by the ball 36b in its rotation around the sphere.

In all forms of the invention heretofore described, the satellite or planetary balls revolving in their orbits will tend to roll toward the central sun represented by the central sphere. The force tending to move the balls in this way is actually the gravitational attraction of the earth, but in the device, it appears to be the pull of the central sun on its satellites.

In the modification of the invention shown in FIG. 8, a space ship 80 is shown in dash lines mounted on a conical shaped frame 82 supported frictionally on a ball 84. The frame 82 is formed with a conical shaped body having straight tapering sides 86, a blunted top 88 and horizontally disposed flanges 90 forming the base. The sides frictionally rest on the surface of the ball and the frame is so dimensioned that its center of gravity is below the center of the ball, and a portion of the ball extends outwardly of the base. The inner surfaces of the sides are smooth thereby reducing friction between the ball and frame. The ship 80 can be rolled over a supporting surface 92 manually by the player, the shape of the frame being such that the frame automatically

remains vertical so that the ship is always in a truly horizontal position. The ball 84 with supported frame and ship readily moves over the supporting surface 92 because of the smooth inner surfaces of the sides 86 of the frame.

There has thus been provided, according to the invention, an entertaining and instructive toy, game or device in which a player by skillful manipulation of the device keeps a simulated satellite in space flight around a central sun which seems to be exerting a gravitational pull upon the satellite.

While I have illustrated and described the preferred embodiments of my invention, it is to be understood that I do not limit myself to the precise constructions herein disclosed and that various changes and modifications may be made within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new, and desire to secure by United States Letters Patent is:

1. A space flight toy, comprising a circular member having an intended surface for supporting a rolling ball simulating a satellite in orbit, a spherical knob centrally disposed on said surface and simulating a central sun, a universal joint support for said surface permitting said member to be tilted in various vertical planes on horizontal axes, and a leveling plate carrying said joint support for positioning said member to an axially vertical position, said member being formed of rigid material, said surface having two annular concentric bands outwardly of said spherical knob, said surface at each of said bands having a convex curvature radially of said member, there being an abrupt change in curvature of one concentric band relative to the other concentric band at the abutting edges of said concentric bands.

2. A space flight toy, comprising a circular member having an indented surface for supporting a rolling ball simulating a satellite in orbit, a support for said member centrally located thereunder, a spherical knob centrally disposed on said surface and simulating a central sun, fastening means extending from said knob into said support and securing said knob to said support, universal joint means carrying said support and holding said member in an axially vertical position, said universal joint means permitting said member to be tilted in vertical planes for keeping the ball rolling on said surface around said spherical knob, and adjustable leveling means supporting said universal joint means for adjusting said member to an axially vertical position, said member being formed of rigid material, said surface having two annular concentric bands outwardly of said spherical knob, said surface at each of said bands having a convex curvature radially of said member, there being an abrupt change in curvature of one concentric band relative to the other concentric band at the abutting edges of said concentric bands.

3. A space flight toy, comprising a circular member having an indented surface for supporting a rolling ball simulating a satellite in orbit, a support for said member centrally located thereunder, a spherical knob centrally disposed on said surface and simulating a central sun, fastening means extending from said knob into said support and securing said member to said support, universal joint means carrying said support and holding said member in an axially vertical position, said universal joint means permitting said member to be tilted in vertical planes for keeping the ball rolling on said surface around said spherical knob, adjustable leveling means supporting said universal joint means for adjusting said member to an axially vertical position, said member being an elastic diaphragm, said support comprising a pan having an annular rim and circular bottom, said diaphragm having its periphery secured to said rim of the pan, said fastening means comprising a screw passing into said support, and a disk under said knob bearing centrally on said

diaphragm and holding the same in tension radially of said member.

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