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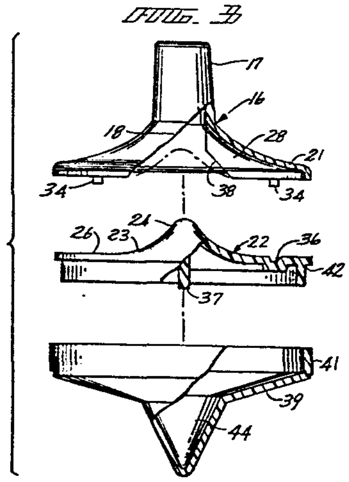
(54) **Air-driven toy spinning top.**

(57) There is provided an air-driven top comprising a turbine chamber wherein air, delivered by an air delivery tube axially through an axial passage, is directed gradually into horizontal air passages in the turbine chamber, and smoothly accelerated such that rotational velocities as high as 25,000 R.P.M. have been measured, using human lung power as the air source. The air passages are separated by turbine vanes of uniform thickness. The air passages extend from substantially radial inner ends continuous with the axial passage in a spiral to substantially tangential outer ends continuous with air discharge ports at the periphery of the top. The top further comprises means for forming an axial point to support the top during rotation and means for generating a whistling sound during rotation.

FIG. 3



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AIR-DRIVEN TOY SPINNING TOP

Background of the Invention

A number of tops have been devised in which rotational momentum is imparted by a source of air flow.

Typically, the air flow is utilized in one of two ways. One technique directs an air flow against some form of structure or surface incorporated on the top so that, in reaction to the force, the top rotates. An example of this technique is U. S. Patent No. 3,372,511 which discloses a top wherein rotation is imparted by an exterior tangential air flow which impinges upon peripherally located vanes. This structure comprises an impact turbine.

The second technique directs an axial air flow introduced through a tube to a radial direction and then a substantially tangential direction through the use of spiral air passages within the top. Typically, the air flow is directed from an axial direction abruptly to a radial direction by means of openings in the wall of a vertical entrance barrel into generally horizontal air passages. The air passages extend from a substantially radial inner section to a substantially tangential outer section. Examples of this type of top are disclosed in U. S. Patent Nos. 561,944 and 1,349,226. These structures are both reaction turbines and Hero's turbines.

The first technique limits the rotational acceleration of the top in that the acceleration is directly proportional to the force applied to the top, i.e., the flow of air against a structure or surface on the top and most of the energy in the air flow is wasted.

The second technique limits the air volume which enters the air passages by the size of the openings in the entrance barrel wall, thereby reducing the turbine effect created by the curved air passages. These tops are characterized by very poor internal air flow efficiency. These tops basically rely on the jet principle of air exiting tangentially from ports at the periphery of the top to impart rotation.

An increase in the efficient use of air flow to initiate rotational acceleration is desirable for air-driven tops. A top with increased efficiency would require less exertion by a person delivering air through a tube to the top to achieve sufficient rotational velocity for the top to remain spinning for a long period of time.

Furthermore, it is desirable to produce a top which produces a whistling sound when sufficient rotational velocity is achieved. Additionally, it is desirable to produce a top capable of rotating on axial points, either above or below the main body of the top. In this manner, the top may be inverted and yet remain rotating. Also, it is desirable to produce a top which is inexpensive to build.

Summary of the Invention

According to the present invention, there is provided a top comprising a turbine chamber wherein downwardly axially introduced air is gradually directed radially and then tangentially to discharge through ports along the periphery of the top.

The top comprises an upper section bonded to a lower section, thereby creating a turbine chamber between the sections.

The upper section includes an axial entrance barrel forming an axial passage for temporarily receiving an air delivery tube for delivery of air to the turbine chamber. It also has an upper wall which slopes downwardly and radially outwardly from the bottom of the entrance barrel, preferably forming a wall that becomes increasingly horizontal as the radial distance between the upper wall and the axis of the top increases.

The lower section comprises a lower wall which extends radially at the periphery and preferably has a raised central region for smoothly deflecting downwardly axially introduced air to a radial direction.

The turbine chamber comprises a plurality of vertical turbine vanes between the upper and lower walls and integral with one of the walls. The turbine vanes have a substantially radial inner end adjacent the axial passage and extend in a spiral path to the periphery so that at the periphery the vanes have a major tangential component and only a minor radial component. The vanes divide the chamber into air passages which are in communication with the axial passage and with air discharge ports around the periphery.

The top further comprises means for forming an axial point below the lower wall. Embodiments include a bottom wall extending from the periphery of the lower wall downwardly and radially inwardly to form an axial point and an axial rod extending below and attached to the lower wall.

Brief Description of the Drawings

These and other features and advantages of the present invention will be better understood by reference to the following detailed descrition when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is an isometric view of the game apparatus with two air delivery tube supports removed and two attached and with a top and an air delivery tube in position to initiate top rotation;

FIG. 2 is a fragmentary cross-section of the game apparatus through an air delivery tube support, an air-driven top, and an air delivery tube in position to initiate rotation of the top;

FIG. 3 is a side exploded view partly cut away of the components of a preferred embodiment of the top;

FIG. 4 is a bottom view of the upper section with turbine vanes integral thereto;

FIG. 5 is a bottom view of a top comprising a bottom wall;

FIG. 6 is a side view of a top in cross-section; and

FIG. 7 is a side view of a top partly cut away showing alternate whistle arrangement.

Detailed Description

FIG. 1 is an isometric view of a game apparatus incorporating a top 10 constructed according to the principles of this invention. The game apparatus has an arena 11 in which one or more rotating tops can move laterally. Typically, two or more tops rotate on the playing surface 12 of the arena and may contact each other. Such a collision creates the possibility that one of the tops may be ejected from the arena over a low wall 13 at the perimeter of the playing surface or impact against one of the air delivery tube supports 14, hereinafter described in greater detail. Either of these events can cause one of the tops to be knocked over and cease rotating. In such a game, the winning top is the one that remains rotating in the arena the longest time.

A particularly preferred top for use in this game is powered by an air turbine. The top is assembled from three injection molded plastic parts shown in the side exploded view of FIG. 3 with portions cut away in cross-section.

The upper section 16 of the top includes an upwardly extending generally cylindrical entrance barrel 17 which forms an axial passage 18 for temporarily receiving an air delivery tube 19. The diameter of the entrance barrel is such that an ordinary drinking straw may be used as the air delivery tube. An upper wall 21 extends from the lower end of the entrance barrel downwardly and radially outwardly to the circular periphery of the top. The upper wall has a slope that gradually becomes more horizontal as the radial distance between the axis of the top and the wall increases.

The top also has a lower section 22 which includes a generally circular lower wall 23. The lower wall has a raised central area 24 wherein the wall slopes downwardly and radially outwardly from its apex to an outer generally flat horizontal area 26 which extends to the periphery.

As herein used, "periphery" means the cylindrical region of the top which is at the greatest radial distance from the axis of the top and comprises the outer perimeters of the upper and lower walls, the outer ends of the turbine vanes, and the air discharge ports.

The upper and lower sections are joined so as to form a turbine chamber 27 therebetween. The means for joining the two sections are eight turbine vanes 28 as shown in a bottom view of the upper section in FIG. 4, although as few as two may be used. The vanes are of uniform thickness and extend from the upper wall to, or almost to, the lower wall. The vanes are made with uniform thickness for maximizing the cross-section of air passages 32 between adjacent vanes for minimizing pressure drop and maximizing air flow and rotational velocity. In this preferred embodiment, the vanes are integral with the upper wall. Each of the turbine vanes has an inner end 29 near the axial passage 18 that extends from the top of the entrance barrel to the lower wall. The inner ends of the vanes have a principally radial direction. The vanes extend from their inner ends in a spiral pattern to the outer ends 31 at the periphery. The outer ends have a substantial tangential component. The outer ends are not, however, exactly tangential.

As herein used, "a substantial tangential component" means a horizontal direction in which the tangential component is greater than the radial component.

The vanes subdivide the turbine chamber into air passages 32 between adjacent vanes. The air passages are continuous with the axial passage 18 and, like the vanes, the direction of the air passages adjacent to the axial passage is principally radial. The air passages extend between adjacent vanes to the periphery of the top where they are continuous with air discharge ports 33. The direction of the air discharge ports is, like the outer ends of the vanes, substantially tangential. It has been found that higher rotational velocity can be achieved if the air passages adjacent to the discharge ports have a minor radial component in addition to a major tangential component as compared with entirely tangential passages.

The vertical height of the vanes decrease as the radial distance from the axis to the vanes increases. Near the periphery, the vanes extend to the flat area 26 of the lower wall and form a means for attachment thereto. Attachment may be by plastic cement, solvent glue, ultrasonic welding, or the like.

To facilitate quick and accurate assembly, the upper section includes eight studs 34 extending downwardly from the bottom of the vanes. The lower wall engages the studs by means of an alignment channel 36 in the lower wall. The studs and alignment channel are located such that when they are engaged, the upper and lower sections are coaxial.

Assembly of the upper and lower section is further facilitated by means of a short axial rod 37 extending below the lower wall and integral with the lower wall. The rod is of sufficient thickness and stiffness so as to act as a handle during the assembly of the upper and lower sections. In one assembly technique, for example, the upper section is inverted in a fixture on a wheel. A lower section is gripped by the rod 37, dipped onto an annular glue source, and set onto the upper section so that the studs fit into the channel. The wheel gradually rotates for setting of the glue before the next assembly step.

Near the axial passage, the vanes do not extend all the way to the lower wall. This leaves a gap 38 below the vanes and adjacent to the raised central region of the lower wall. The height of the gap decreases as the radial distance between the inner ends of the vanes and the gap increases until the vanes contact the lower wall at a location approximately midway between the axial passage and the periphery of the top.

In part, the gap is incidental to manufacture of the top. The lower wall is curved in its central region and flat nearer the periphery. The vanes are flat in the same region that the lower wall is flat for bonding. The inner portions of the vanes are generally conical to provide clearance from the curved portion of the lower wall. This permits assembly without interference. This geometry is less costly than making the inner ends of the vanes with curvature matching that of the lower wall and avoids mismatches that could lead to assembly problems. Air pressure in the passages on each side of the narrow resultant gap is substantially equal so that little, if any, air leakage occurs. No effect on rotational velocity of the top due to such gaps has been detected.

The inner ends of adjacent turbine vanes are at different radial distances to the axis of the top. Half of the inner ends of the vanes are adjacent the axial passage. The inner ends of these vanes give support in addition to that given by the entrance barrel to an air delivery tube which is temporarily introduced to the axial passage during delivery of air to the top. The inner ends of the other vanes are at a greater radial distance from the axis. This minimizes obstruction near the axial passage to the air flow as it is being directed from an axial direction to a radial direction.

The top generates initial rotational acceleration by a combination of two mechanisms. As the air flow is directed through the air passages, the air produces a reactive force against the entire length and width of the vane. Furthermore, the top utilizes the jet principle of air exiting tangentially from ports at the periphery of the top to accelerate rotation. Both techniques are enhanced by an internal increase in effeciency of air flow within the air passages.

Loss of efficiency occurs due to abrupt changes in the direction of the air flow. By having the upper and lower walls of the turbine chamber curved, transition of air flow from axial to radial can be obtained while minimizing the loss of momentum of the air flow due to abrupt directional changes. Effeciency can be further increased by maximizing the volume of air entering the turbine chamber since energy transferred to the top depends on the mass of air flowing through it. It is also desirable to maximize velocity of air within the air passages and at the exit ports. This occurs as both the height and width of the air passages gradually decrease toward the periphery, thereby gradually reducing the cross-section of the air passages. The relatively large inlets to the air passages and small cross-section of the air passages at the discharge ports provide smooth acceleration of air. By having both the height and width of the passages converging, pressure drop can be minimized while still maximizing exit velocity of the air.

The initial rotational acceleration is also dependent upon the mass of the top. The acceleration can be maximized by minimizing the mass of the top, hence the use of plastic for constructing the top.

By maximizing the efficiency of the air flow within the top and minimizing the mass of the top, the initial rotational acceleration is maximized. This has the advantage of allowing a person, by blowing air into the top through a tube, to accelerate the top to sufficient rotational velocity to enable the top to remain rotating for a long period of time while minimizing the person's effort, i.e., it requires fewer and less strenuous puffs to achieve the desired rotational velocity.

The top also includes a means for forming an axial point which supports the top while rotating. The preferred embodiment of this invention utilizes a bottom wall 39 as shown in FIG. 3. The bottom wall slopes upwardly and radially outwardly from the axial point to the perimeter of the lower wall, thus forming a first cone which extends to a location between the axis and the periphery of the top and there extending in a second cone, having a greater horizontal component than the first cone, to the periphery.

The bottom wall engages the lower section at the perimeter of the lower wall (which, in this embodiment, could also be considered an intermediate section) by means of a first short cylindrical wall 41 extending upwardly at the periphery of the bottom wall and a second short cylindrical wall 42 extending downwardly from the lower wall. The outside diameter of the second cylindrical wall is approximately equal to the inside diameter of the first cylindrical wall so that the first cylindrical wall can fit tightly over the second cylindrical wall, so that the two pieces are coaxial. The pieces may be permanently attached by means of plastic cement, solvent glue, ultrasonic welding, or the like. Such assembly can be at a subsequent station on the rotating wheel. Automatic assembly can also be used.

The first cylindrical wall includes two outwardly extending bumps 43. The bumps provide greater reaction to contact between the rotating top and a stationary object or another rotating top than a top without the bumps. Preferably, the bumps are symmetrically located to maintain balance of the top and are gently rounded for minimizing discomfort when a person grasps a rapidly spinning top. This is not a minor consideration since the effective design of the turbine gives very high rotational velocities. Speeds as high as 25,000 RPM have been measured and grasping a top with non-smooth bumps at such speed can be rather painful.

When the bottom wall is attached to the lower section, there is a space between the bottom wall and the lower wall which serves as a whistling chamber 44. As shown in FIG. 5, the bottom wall comprises a pair of openings 46 which induce resonant pressure variations in the whistle chamber during rotation of the top, thereby causing the top to emit a whistling sound. By varying the locations of the holes, the top can be made to whistle at different velocities.

The description given is of one preferred embodiment of a top constructed according to principles of the invention. There are, however, many other embodiments which incorporate such principles. For example, the upper and lower sections may be molded so that the turbine vanes are integral with the lower section, instead of the upper section. In such a case, the studs would extend upwardly from the upper side of the vanes and engage an alignment channel in the upper wall.

Alternatively, the studs, whether integral with the upper or lower sections, may engage corresponding alignment holes or slots in the upper or lower wall instead of an alignment channel. The use of a channel instead of holes or slots is to increase the flexibility of molding parameters. The molding of a section that incorporates holes or slots may be subject to stress of distortion from molding "sinks" more than a molding that incorporates a uniform symmetrical channel.

Tops made according to the principles of this invention are particularly suited to a game apparatus, as briefly described above. To play the game, a top is situated directly below a vertical cylindrical hole 48 in the upper end of an air delivery tube support 14 that overhangs the playing surface 12 of the arena 11 so that the axial point of the top is located in a dimple 50 on the playing surface of the arena, as shown in FIGS. 1 and 2. FIG. 1 shows the arena with two air delivery tube supports attached. The supports are removable and two additional supports may be attached to the pedestals 53. The hole in the upper end of the support is of large enough diameter to allow the passage of an air delivery tube through the hole and into the entrance barrel of the top.

The air delivery tube has a bellows 51 which serves two functions. First, the bellows is of greater diameter than the hole in the upper end of the support. The bellows thus acts as a stop for the air delivery tube so that the air delivery tube may extend below the hole in the support and engage the entrance barrel and turbine chamber of the top without making contact with the lower wall of the top. The bellows further provides a means for bending the air delivery tube away from the center of the playing surface to facilitate access to several tubes by a group of players.

Rotation of the top is initiated by a player blowing into the air delivery tube re plural puffs. Once sufficient rotational velocity has been achieved, the player withdraws the air delivery tube from the top and the holder and the tops are free to acquire lateral momentum.

The playing surface is slightly concave so that the tops tend to migrate toward the center of the playing surface. In addition, the playing surface has four spiral ridges 52 extending from a location near the periphery to a location between the periphery and the center of the playing surface. The ridges have two functions. First, the ridges direct slowly laterally moving tops toward the center, yet will allow a rapidly laterally moving top to ride over the ridge without knocking the top down. Secondly, the ridges tend to divide the playing surface into sections. The tops then are caused to rotate within their own sections until the ridges and the slope of the playing surface causes the tops to migrate toward the center. When the tops migrate to the central area, there is a possibility of contact between the tops. The bumps on the periphery of the top provide substantial reaction to contact between the tops. One or more of the tops may be knocked down or deflected over the arena wall due to such contact. In addition, the bumps provide that contact between a rotating top and a stationary object such as the air delivery tube supports may cause the top to be knocked down or ejected from the playing surface.

The wall of the arena is at a sufficiently low height that the periphery of the top may overhang the arena wall and contact such an air delivery tube support. In addition, the height of the wall is such that a rapidly moving top impacting against the wall will be ejected from the arena, but that a slowly moving top impacting against the wall will be deflected back into the arena.

The game continues until all of the tops have been knocked over or ejected from the arena except for one. The last top rotating on the playing surface is the winner.

FIGS. 6 and 7 illustrate another embodiment of a top constructed according to the principles of this invention. In this embodiment, the top comprises an upper section and a lower section with a turbine chamber therebetween.

The upper section 116 of the top includes an upwardly extending generally cylindrical entrance barrel 117 which forms an axial passage 118 for temporarily receiving an air delivery tube 19. An upper wall 121 extends from the lower end of the entrance barrel downwardly and radially outwardly to the circular periphery of the top. The upper wall comprises a slope that gradually becomes more horizontal as the radial distance between the axis of the top and the wall increases.

The lower section 122 includes a generally circular lower wall 123. The lower wall has a raised central area 124 in which the wall slopes downwardly and radially outwardly from its apex to an outer generally flat horizontal area 126 which extends to the periphery.

The upper and lower sections are joined so as to form a turbine chamber 127 therebetween. The means for joining the two sections are eight turbine vanes 128. The vanes are of uniform thickness and extend from the upper wall to, or almost to, the lower wall. Each of the turbine vanes has an inner end near the axial passage 118 that extends from the upper wall substantially to the lower wall. The inner ends of the vanes have a substantially radial direction. The vanes extend from their inner ends in a spiral pattern to the outer ends at the periphery. The outer ends have a substantial tangential component, but the outer ends are not, however, exactly tangential.

The vanes subdivide the turbine chamber into air passages 132 between adjacent vanes. The air passages are continuous with the axial passage 118 and, like the vanes, the direction of the air passages adjacent to the axial passage is substantially radial. The air passages extend between adjacent vanes to the periphery of the top where they are continuous with air discharge ports 133. The direction of the air discharge ports is substantially tangential.

The inner ends of adjacent turbine vanes are at different radial distances to the axis of the top. Half of the inner ends of the vanes are adjacent to the axial passage. The inner ends of these vanes give support, in addition to that given by the entrance barrel, to an air delivery tube which is temporarily introduced to the axial passage during delivery of the air to the top. The inner ends of the other vanes are at a greater radial distance from the axis. This minimizes obstruction near the axial passage to air flow as it is being directed from an axial direction to a radial direction.

The means for forming an axial point in this embodiment is an axial rod 45. The axial rod extends below the lower section and is attached thereto. The rod, as shown in cross-section in FIG. 6, can also extend upward from the lower wall, through the turbine chamber and entrance barrel, thereby forming an axial point above the upper section. An axial rod extending upwardly from the lower wall through the turbine chamber and entrance barrel may also be incorporated in an embodiment which utilizes a bottom wall for forming an axial point below the lower wall. The embodiment, as shown in FIG. 6, has the advantage of enabling the top to remain rotating while inverted. This may be accomplished by introducing an air delivery tube to the axial chamber such that the axial rod extending through the turbine chamber and entrance barrel is inserted in the air delivery tube. The top is inverted and stabilized by the air delivery tube. Air is delivered to the top through the air delivery tube upwardly through the axial passage and into the air passages, thereby imparting rotation to the top. The top can then be flipped off of the air delivery tube onto a horizontal surface wherein rotation will continue. This feature can provide additional amusement to one playing a game which incorporates these tops or simply to anyone playing with the tops.

An alternate whistle arrangement, as shown in cross-section in FIG. 7, may be employed. This comprises a pair of horizontal circular plates 47 inside the entrance barrel and integral with the entrance barrel. The plates have central openings 48 so that air flowing through the openings while the top is rotating produces a whistling sound.

WHAT IS CLAIMED IS:

1. An air powered top comprising:

a generally round upper section bonded to a generally round lower section with a turbine chamber therebetween;

the upper section comprising an axial entrance barrel having an axial passage for temporarily receiving an air delivery tube, and an upper wall sloping downwardly and radially outwardly from the entrance barrel;

the lower section comprising a lower wall extending radially at the periphery of the top and having a raised central region for gradually deflecting air flow from such an air delivery tube from an axial direction to a radial direction, and a means for forming an axial point below the lower wall for supporting the top when rotating; and

a plurality of turbine vanes in the chamber between the upper wall and lower wall and integral with one of said walls, said vanes each curving in a spiral path from an inner end adjacent to the axial passage to an outer end at the periphery of the top, the outer ends of the vanes extending with a substantially tangential direction, and being spaced apart for forming a plurality of air exit ports around the periphery of the top, the vanes each having a substantially uniform thickness.

2. A top as recited in claim 1 wherein the inner ends of alternate vanes are different radial distances from the axis of the top so that the inner ends of half the vanes are relatively nearer the axis and that the inner ends of the other half of the vanes are relatively further from the axis.

3. A top as recited in claim 1 wherein the means for forming an axial point comprises a bottom wall sloping downwardly and radially inwardly from the periphery of the lower wall.

4. A top as recited in claim 3 wherein the space between a lower wall and a bottom wall forms a whistle chamber, and wherein the bottom wall comprises at least a pair of openings for inducing resonant pressure variations in the whistle chamber during rotation of the top.

5. A top as recited in claim 1 wherein the means for forming an axial point comprises an axial rod extending below the lower wall and attached thereto.

6. A top as recited in claim 1 wherein the lower section comprises an axial rod extending upward through the turbine chamber and the entrance barrel, thereby forming an axial point which can support the top during rotation when the top is inverted.

7. A top as recited in claim 1 wherein the entrance barrel comprises a pair of horizontal circular plates, the diameter of said plates being equal to the inside diameter of the entrance barrel, and integral therewith, said plates each comprising a central opening through which air flow during rotation creates a whistling sound.

8. A top as recited in claim 1 comprising at least one bump extending radially outwardly from the periphery of the top.

9. A top as recited in claim 1 wherein the upper section comprises at least two studs extending downwardly from the bottom of the vanes and the lower section comprises an alignment channel in the lower wall which engages the studs during assembly of the top so that the upper and lower sections are coaxial.

10. A top as recited in claim 1 wherein the lower section comprises an axial rod extending below the lower wall and integral thereto, said rod being of sufficient diameter and stiffness to act as a handle for the lower section during assembly of the top.

11. An air-driven top comprising:

an upper circular wall;

a lower circular wall spaced apart from the upper wall, thereby forming a turbine chamber, the distance between the upper and the lower walls being greater nearer the axis of the top than nearer the periphery of the top, the upper and lower walls being curved from a partially axial direction nearer the axis toward a substantially radial direction nearer the periphery;

a plurality of vanes in the turbine chamber, each having an inner end having a substantially radial component and curving toward an outer end having a substantially tangential component defining a plurality of air flow passages between the adjacent vanes for diverting air flow from a radial direction adjacent the axis of the top toward a tangential direction adjacent the periphery of the top;

a cylindrical entrance barrel extending above the center of the upper circular wall for receiving an axially downward flow of air and directing said air flow into the turbine chamber;

a plurality of air discharge ports around the periphery of the top, each discharge port communicating with an air flow passage for discharging air from the turbine chamber; and

a means for forming an axial point below the lower wall for supporting the top during rotation.

12. A top as recited in claim 11 wherein the inner ends of alternate vanes are different radial distances from the axis of the top so that the inner ends of half of the vanes are relatively nearer the axis and the inner ends of the other half of the vanes are relatively further from the axis.

13. A top as recited in claim 11 wherein the inner ends of alternate vanes are at different radial distances from the axis of the top and wherein the inner ends of half of the vanes nearest the axis are adjacent to the axial air passage.

14. A top as recited in claim 11 wherein the means for forming an axial point below the lower wall comprises a bottom wall sloping downwardly and radially inwardly from the perimeter of the lower wall.

15. A top as recited in claim 14 wherein the space between the bottom wall and the lower wall creates a whistle chamber wherein said bottom wall comprises at least a pair of openings for inducing resonant pressure variations in the whistle chamber during rotation of the top.

16. A top as recited in claim 11 wherein the means for forming axial point comprises an axial rod extending below the lower wall and attached thereto.

17. A top as recited in claim 11 wherein the lower section comprises an axial rod extending through the turbine chamber and entrance barrel, thereby forming an axial point above said entrance barrel for supporting the top during rotation such that the top can rotate while inverted.

18. A top as recited in claim 11 wherein the entrance barrel comprises a pair of circular horizontal plates of diameter equal to the inside diameter of the barrel and integral therewith, said plates each comprising a central opening wherein air flowing through the openings during rotation of the top creates a whistling sound.

19. A top as recited in claim 11 comprising at least one bump extending radially outwardly from the periphery of the top.

20. A top as recited in claim 11 wherein the upper sections comprise at least two studs extending downwardly from the bottom of the vanes and the lower section comprises an alignment channel in the lower wall which engages the studs during assembly of the top so that the upper and lower sections are coaxial.

21. A top as recited in claim 11 wherein the lower section comprises an axial rod extending below the lower wall and integral thereto, said rod being of sufficient diameter and stiffness so as to act as a handle for the lower section during assembly of the top.

22. An air-driven top comprising:

a substantially circular upper section comprising an outwardly and downwardly sloping upper wall, an axial circular aperture of lesser radius than the radius of the periphery of the upper section, wherein the wall of the upper section at the aperture extends upward and generally parallel to the axis for forming an axial cylindrical barrel above and integral with the upper wall, thereby providing an opening for introduction of air;

a substantially circular lower section comprising a substantially circular lower wall with a maximum radius substantially the same as the maximum radius of the upper section, said lower section being bonded to the upper section such that the upper and lower sections are coaxial and there is formed a turbine chamber between said sections;

a plurality of vertical turbine vanes between the upper and lower walls extending in a spiral path from the inner end adjacent the axial passage to an outer end at the periphery of the top; and

a means for forming an axial point below the lower section for supporting the top during rotation.

23. A top as recited in claim 22 wherein the lower wall comprises a raised central area for gradually deflecting downward axially introduced air to a radial direction.

24. A top as recited in claim 22 wherein the upper wall extends downwardly and radially outwardly and is curved so that the wall becomes increasingly horizontal as the radial distance between the upper wall and the axis of the top increases.

25. A top as recited in claim 22 wherein the inner ends of alternate vanes are at different radial distances from the axis of the top so that the inner ends of half of the vanes are relatively nearer the axis and adjacent to the axial passage and the inner ends of the other half of the vanes are relatively further from the axis.

26. A top as recited in claim 22 wherein the means for forming an axial point comprises a bottom wall sloping downwardly and radially inwardly from the periphery of the lower wall.

27. A top as recited in claim 26 wherein the space between the bottom wall and the lower wall creates a whistle chamber and wherein the bottom wall comprises at least a pair of openings for inducing resonant pressure variations in the whistle chamber during rotation of the top.

28. A top as recited in claim 22 wherein the means for forming an axial point comprises an axial rod extending below the lower wall and attached thereto.

29. A top as recited in claim 22 wherein the lower section comprises an axial rod extending through the turbine chamber and entrance barrel, thereby forming an axial point above said entrance barrel for supporting the top during rotation when inverted.

30. A top as recited in claim 22 wherein the entrance barrel comprises a pair of horizontal circular plates of diameter equal to the inside diameter of the entrance barrel and integral therewith, said plates each comprising a central opening whereby air flowing through the openings during top rotation creates a whistling sound.

31. A top as recited in claim 22 comprising at least one bump extending radially outwardly from the periphery of the top.

32. A top as recited in claim 22 wherein the upper sections comprise at least two studs extending downwardly from the bottom of the vanes and the lower section comprises an alignment channel in the lower wall which engages the studs during assembly of the top so that the upper and lower sections are coaxial.

33. A top as recited in claim 22 wherein the lower section comprises an axial rod extending below the lower wall and integral thereto, said rod being of sufficient diameter and stiffness so as to act as a handle for the lower section during assembly of the top.

34. An air-driven top comprising:

an upper section bonded to a lower section with a turbine chamber therebetween and means for forming an axial point wherein:

the upper section comprises a vertical cylindrical entrance barrel forming an axial passage, in a generally circular upper wall which slopes outwardly and radially downwardly from the bottom of the entrance barrel to the circular periphery of the top, and curves in a manner so as to become increasingly horizontal at a greater radial distance from the axis of the top than at a lesser radial distance;

the lower section comprises a generally circular lower wall haivng a raised central region which slopes downwardly and radially outwardly from its apex and is integral with a generally horizontal outer region that extends from the central region to the circular periphery of the top; and

the turbine chamber comprises a plurality of turbine vanes of uniform thickness extending vertically between the upper and lower wall and integral with the upper wall, and having a substantially flat bottom wherein the inner ends of the vanes are at a location near the axial passage and have a substantially radial component, said vanes extending in a spiral pattern to the outer ends of the vanes at the periphery of the top, said outer ends of the vanes having a substantially tangential component, and wherein air passages are formed between adjacent vanes, said air passages being continuous with the axial passage and extending in a spiral to the periphery of the top where said air passages are continuous with air discharge ports, the air passages converging to a smaller cross-section as the radial distance from the axial passage increases, thereby providing a means for accelerating air flow through the air passages, said vanes above the central region of the lower wall extending downwardly from the upper wall a distance less than the distance between the upper wall and lower wall so as to provide a gap adjacent the lower wall above the central region, wherein the height of said gap decreases as the radial distance from the axis of the top to the gap increases until the vanes contact the lower wall near the horizontal region of the lower wall for attachment thereto.

35. A top as recited in claim 34 wherein the inner ends of alternate vanes are different radial distances from the axis of the top so that the inner ends of half of the vanes are relatively nearer the axis and adjacent the axial passage and the inner ends of the other half of the vanes are relatively further from the axis.

36. A top as recited in claim 34 wherein the means for forming an axial point comprises a bottom wall extending upwardly and radially outwardly from the axial point, thus forming a first cone which extends to a location between the axis and the periphery of the top, and there extending upwardly and radially outwardly to the periphery of the top, thereby forming a second cone, the wall of said second cone having a greater horizontal component than the wall of said first cone, the wall of said second cone at the periphery being attached to the perimeter of the lower wall.

37. A top as recited in claim 36 wherein the space between the lower wall and the bottom wall creates a whistle chamber and wherein the bottom wall comprises at least a pair of openings such that at sufficient rotational velocity the top creates a whistling sound.

38. A top as recited in claim 34 wherein the means for forming an axial point comprises an axial rod extending below the lower wall and attached thereto.

39. A top as recited in claim 34 comprising an axial rod extending from the apex of the central region of the lower wall through the turbine chamber and entrance barrel, thereby forming an axial point above the entrance barrel on which the top may rotate.

40. A top as recited in claim 34 wherein the entrance barrel comprises a pair of horizontal circular plates of diameter equal to the inside diameter of the entrance barrel and integral therewith, said plates each comprising a central opening whereby air flowing through the openings during top rotation creates a whistling sound.

41. A top as recited in claim 34 comprising at least one bump extending radially outwardly from the periphery of the top.

42. A top as recited in claim 34 wherein the upper sections comprise at least two studs extending downwardly from the bottom of the vanes and the lower section comprises an alignment channel in the lower wall which engages the studs during assembly of the top so that the upper and lower sections are coaxial.

43. A top as recited in claim 34 wherein the lower section comprises an axial rod extending below the lower wall and integral thereto, said rod being of sufficient diameter and stiffness so as to act as a handle for the lower section during assembly of the top.

FIG.1

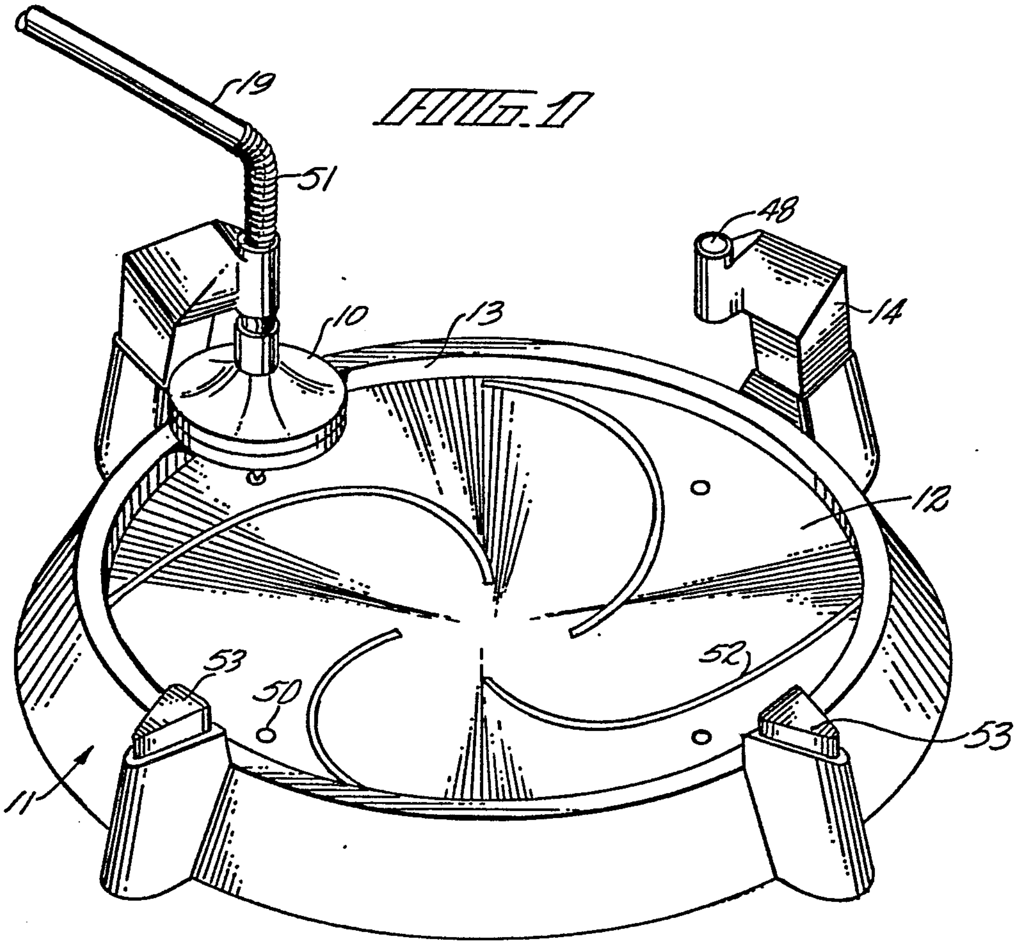

FIG.2

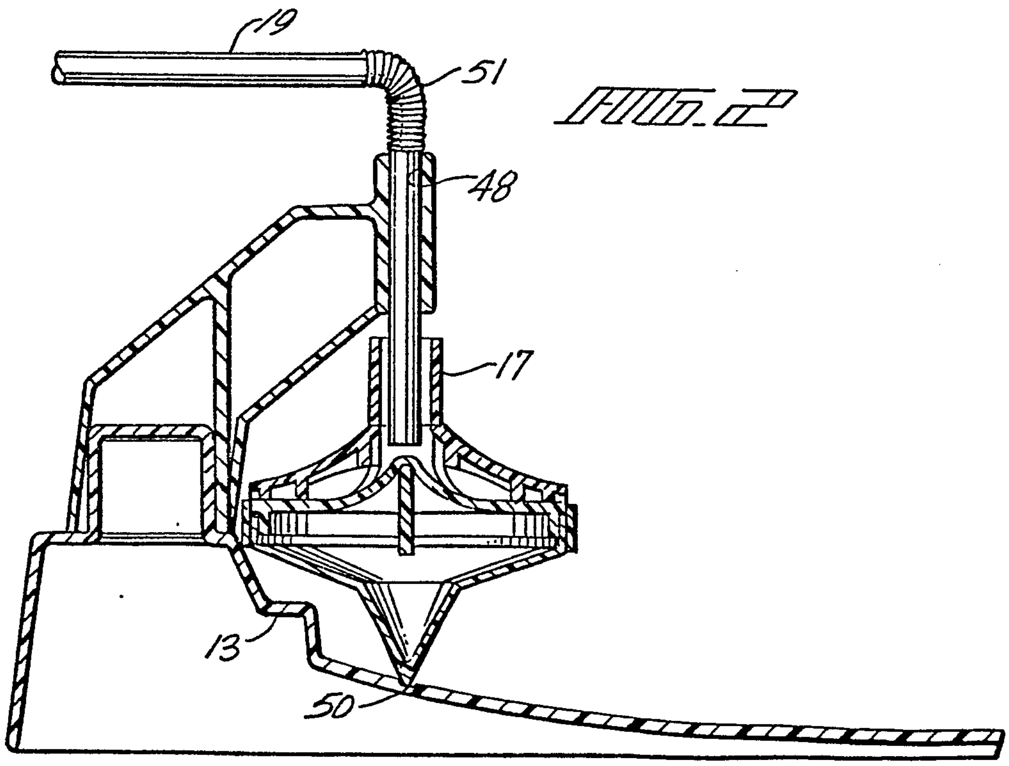

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FIG. 3

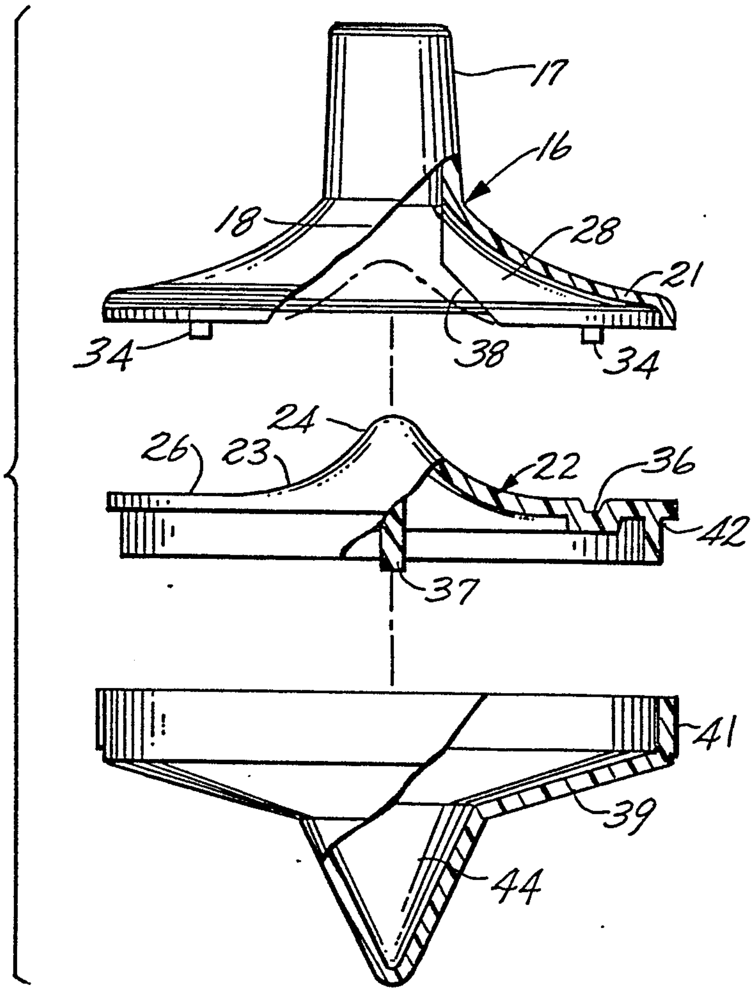

FIG. 4

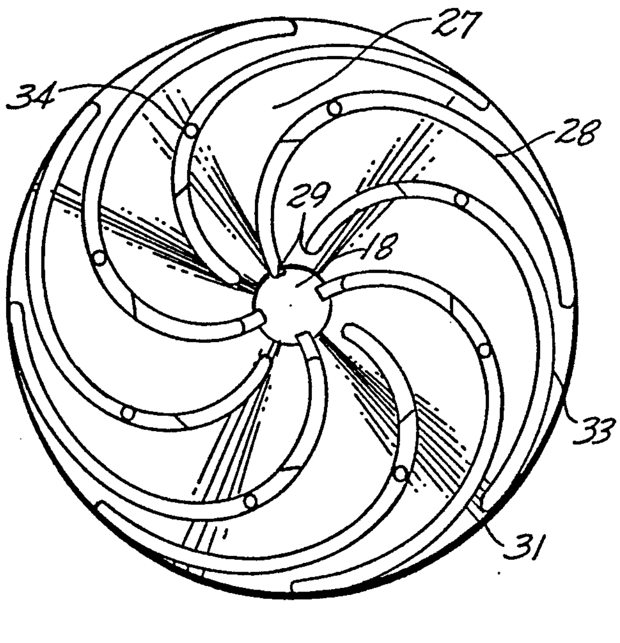

FIG. 5

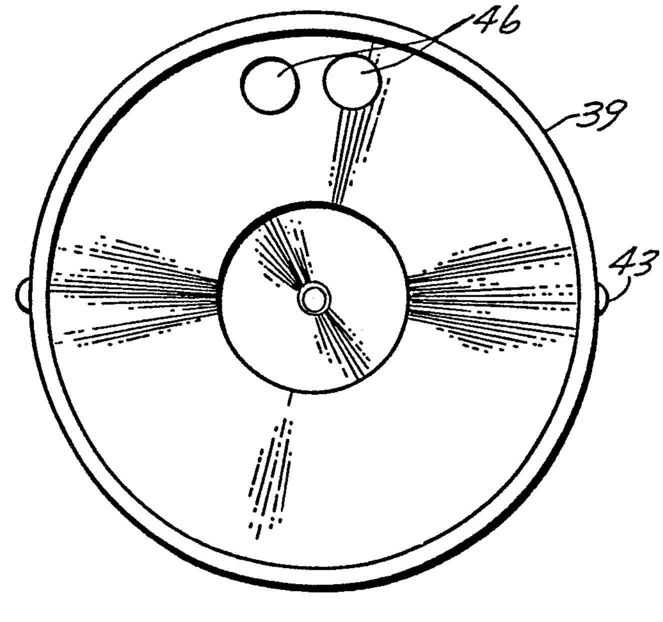

FIG. 6

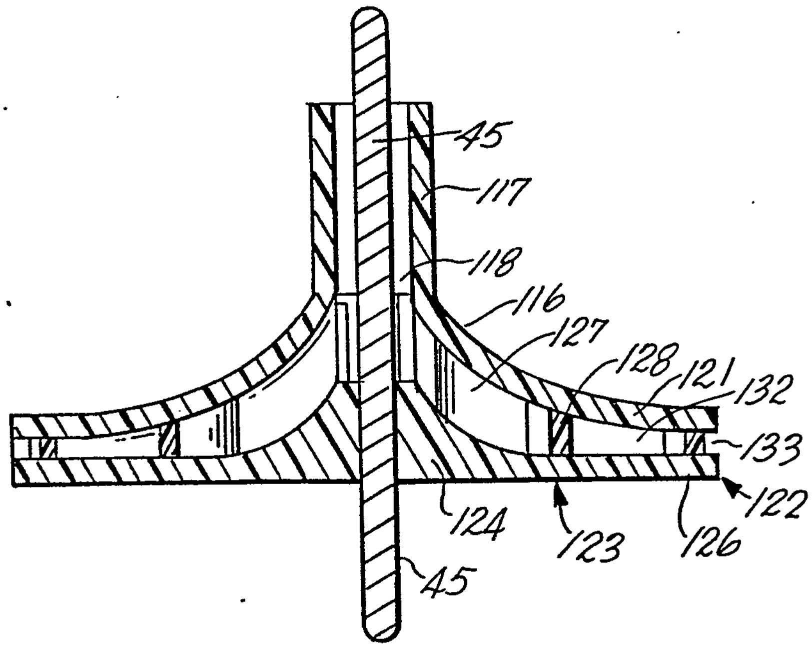

FIG. 7