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Nesbitt

[11] **3,736,698**

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[54] AMUSEMENT DEVICE

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[52] **U.S. Cl.** **46/41**, 356/216
[51] **Int. Cl.** **A63h 29/10**
[58] **Field of Search** 35/15; 46/41, 51, 46/124; 250/219; 356/216

[56] **References Cited**

UNITED STATES PATENTS

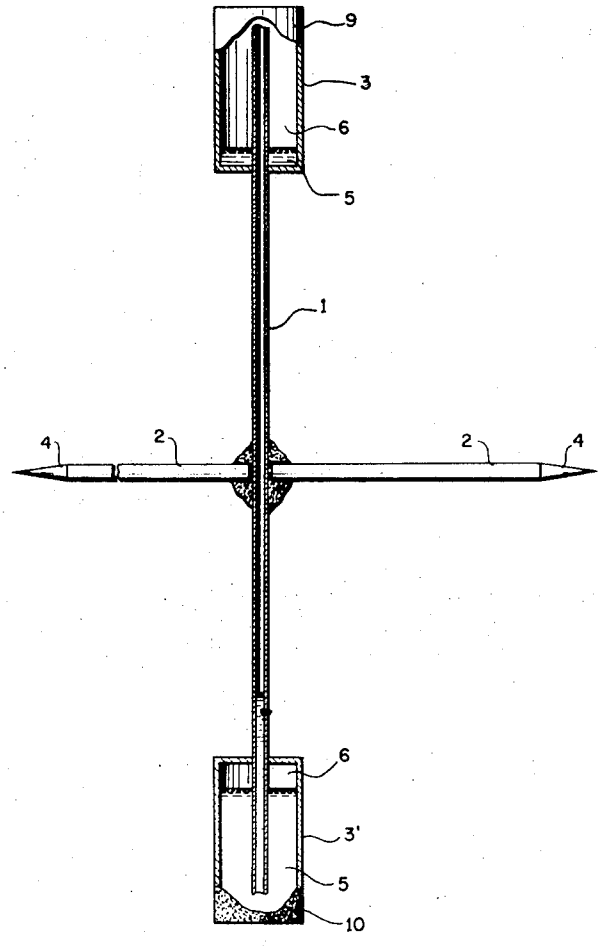
2,402,463	6/1946	Sullivan	46/124
2,999,943	9/1961	Geer	250/215
3,570,765	3/1965	de Gast	46/41

Primary Examiner—Antonio F. Guida
Assistant Examiner—Robert F. Cutting
Attorney—Marcus B. Finnegan, Douglas B. Henderson, Ford F. Farabow, et al.

[57] **ABSTRACT**

An amusement device is disclosed that operates on a scientific principle of pressure differential produced by heat which causes a rotor to turn. The rotor is constructed of at least one elongated tubular member having a reservoir secured around each end thereof in a liquid tight relationship. The tubular member may be provided with a pair of pivot pins centrally located along its length with one pivot pin extending outwardly from opposite sides of the member to provide an axis of rotation. Likewise, one or more rotors may be surrounded by a rim with a rolling motion being imparted to the rim during rotation of the rotor or rotors. A liquid that exhibits a high vapor pressure is provided in the reservoirs and tubular member with the remaining space therein being filled with the vapor of the liquid. Each reservoir is provided with heat collection means, the heat collection means on one reservoir being positioned on the opposite side from the heat collection means of the other reservoir. One reservoir selectively receives heat from a source which increases the vapor pressure in the particular reservoir and displaces liquid to the opposite reservoir. Displacement of the liquid to the top reservoir produces imbalance in the rotor, causing the rotor to overturn around the pivot axis.

16 Claims, 5 Drawing Figures



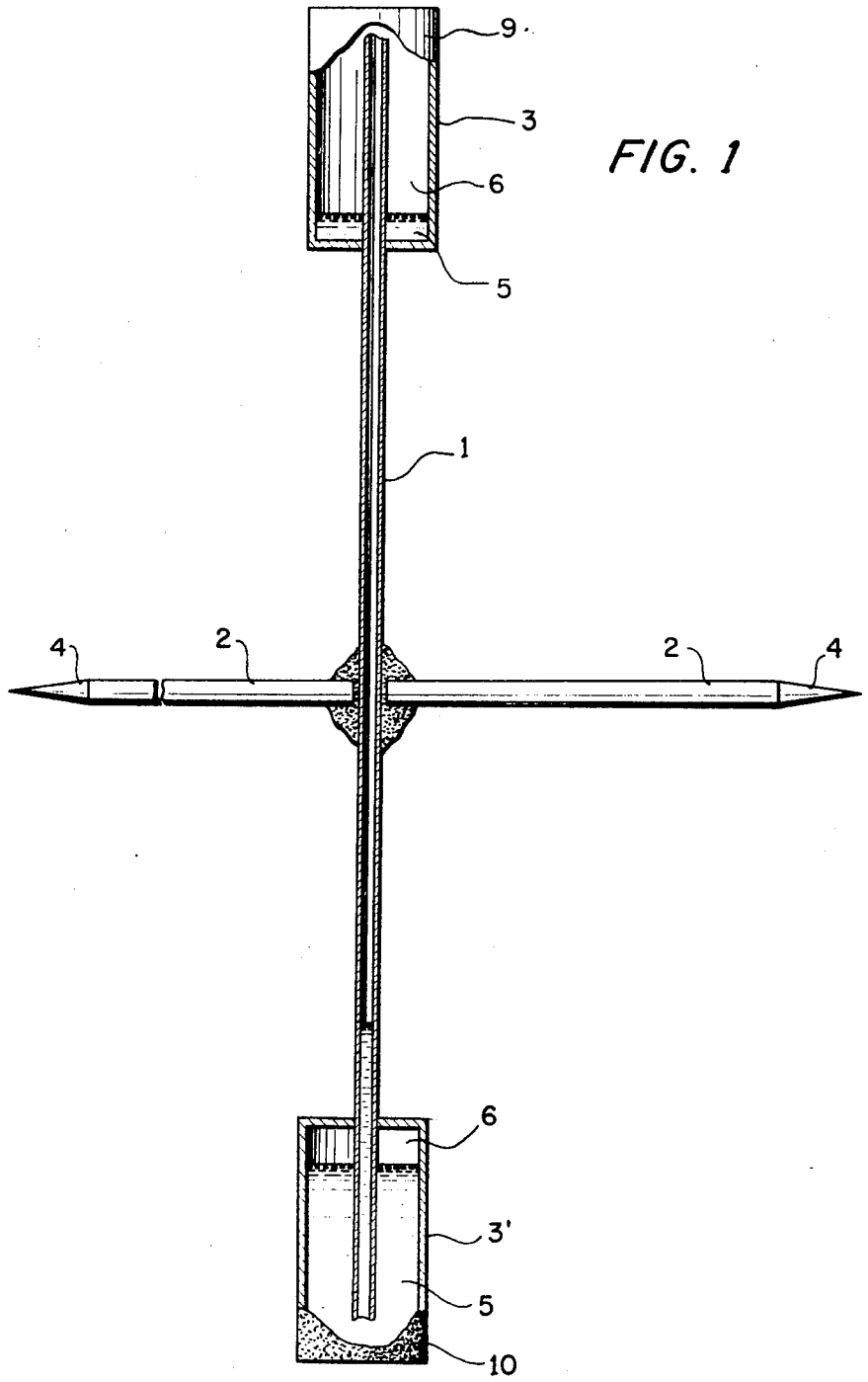


FIG. 1

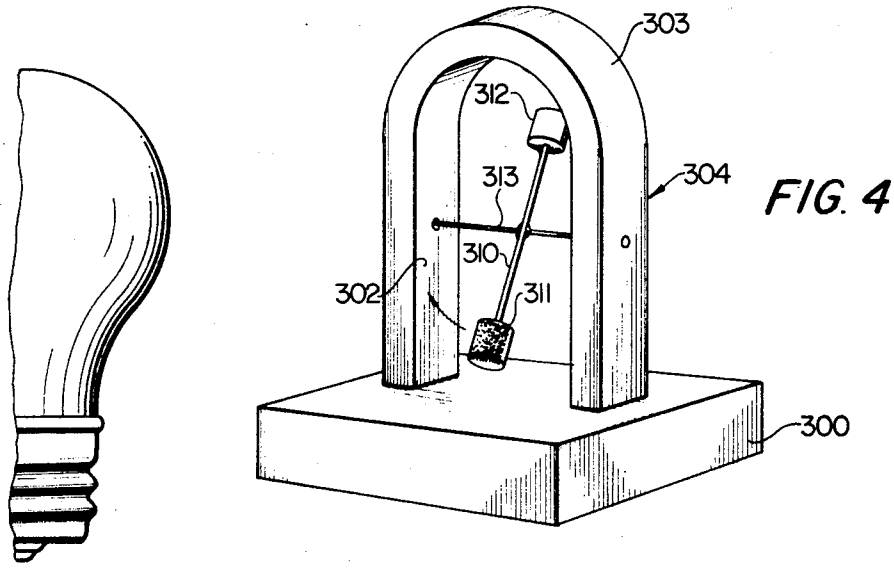


FIG. 4

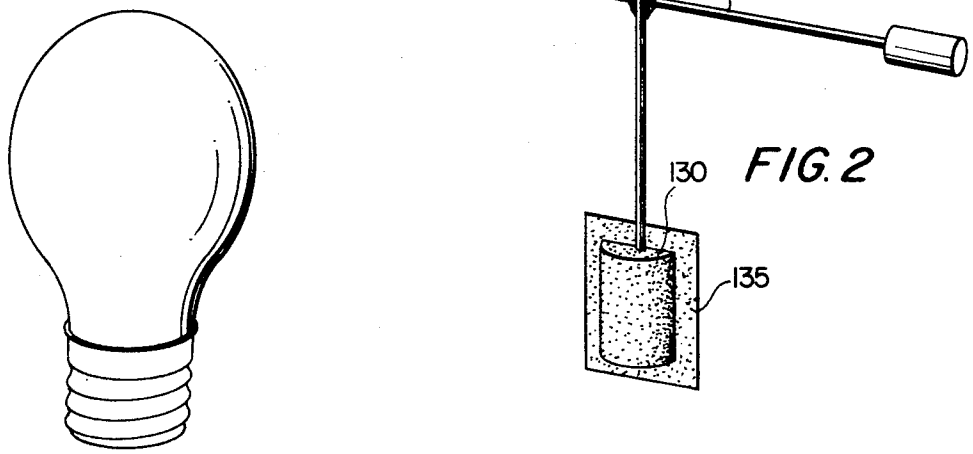


FIG. 2

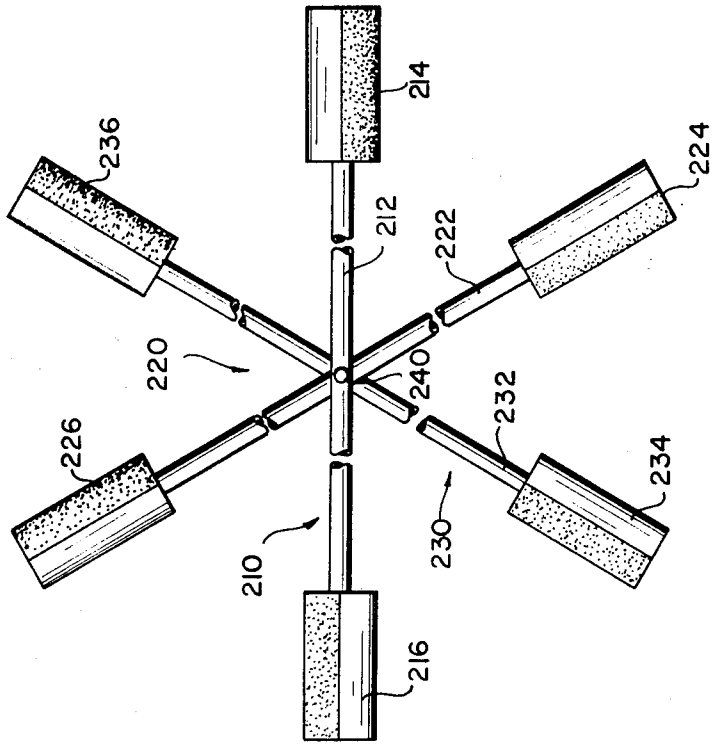

214
236
224
212
222
220
240
232
226
234
210
230
216

FIG. 3

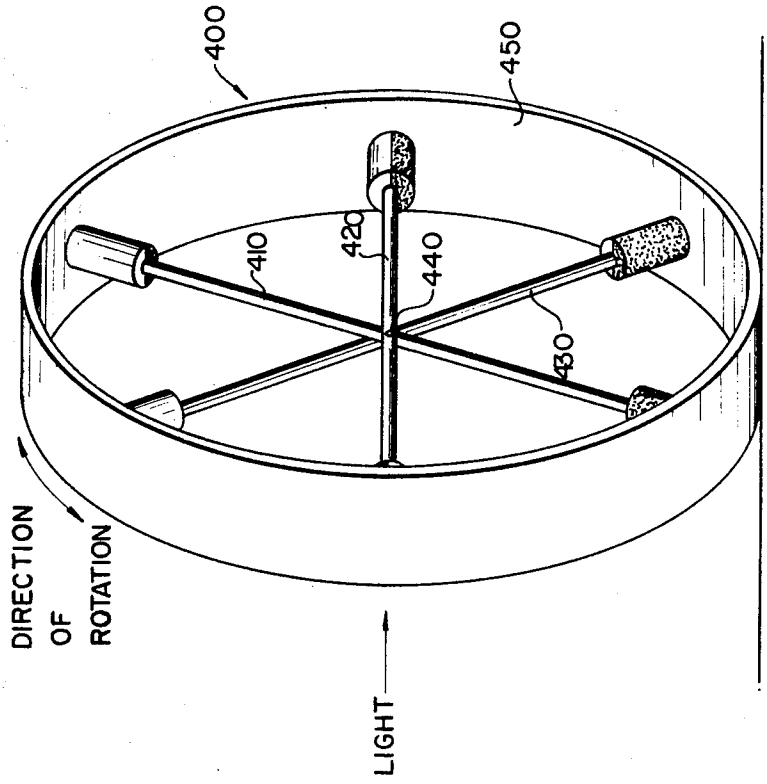

400
450
410
420
440
430
DIRECTION OF ROTATION
LIGHT

FIG. 5

AMUSEMENT DEVICE

BACKGROUND OF THE INVENTION

Numerous devices have heretofore been conceived for amusement or utilitarian purposes whose operation is based on a scientific principle. The present invention is yet another device that, depending upon the surrounding environment, may be employed as an amusement device or may serve a utilitarian purpose.

Liquid displacement to produce an intended result has heretofore been utilized in prior art devices. For example, devices have been designed to rock, to self adjust, and the like when stimulated by a pressure change, by displacement of a liquid therein or the like. No prior use of liquid displacement is known to have been used to produce rotational movement for aesthetic or utilitarian purposes as described herein. The present invention thus provides a new and novel device utilizing displacement of liquid as a stimulus for operation of a novel device.

The prior art is devoid of any teaching or suggestion of the device of the present invention. Exemplary of the prior art are U.S. Pat. Nos. 2,402,463 to Sullivan and 2,999,943 to Geer.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved amusement device.

Another object of the present invention is to provide an improved rotor, rotatably responsive to differential heating thereof.

Still another object of the present invention is to provide an improved device based on scientific principles that may be used for amusement or utilitarian purposes.

Generally speaking, the device of the present invention comprises a tubular member, a reservoir secured around said tubular member at opposite ends thereof, said reservoirs being sealed around said member to define a closed system, said reservoirs and member further containing a predetermined amount of a liquid that exhibits a high vapor pressure and the remainder of said system containing vapor of said liquid, each said reservoir further having preferential heat collection means thereon, and rotatable support means associated with said tubular member.

More specifically, the device of the present invention comprises at least one tubular member, preferably at least one capillary tubular member, having a reservoir sealed in liquid tight relation around each end thereof. Pivot support means such as pins or the like may be secured at the mid point of the tubular member and extend outwardly from opposite sides thereof. The pivot pins thus support the tubular member and reservoirs for free rotation about an axis through said pins.

Likewise, a rim may be placed around the outer ends of the reservoirs as the support means. Rotation of the reservoirs thus produces rolling movement of the rim. The tubular member and reservoirs thus define a rotor that may be supported for rotation.

A liquid that exhibits a high vapor pressure is received in approximately half of the closed system with vapor of the liquid filling the remainder of the system. Liquid is present in all reservoirs, with one of the reservoirs of each pair containing more liquid than the other reservoir of the pair. When the device is supported by the pivot pins or a rim, the heaviest reservoir will thus

reside at the lower end of a circle defined by the vertical plane of rotation of said device.

Each reservoir is provided with preferential heat collection means on one side thereof. Heat collector means on one reservoir are located on the side of the reservoir opposite the heat collector means on the other reservoir. Hence, at any one time, heat from a particular source is preferentially absorbed by the heat collector means on the bottom reservoir to provide a differential heat transfer to the liquid in the two reservoirs.

Capillary attraction draws the liquid at least part way up the tubular member. Heat supplied to the bottom reservoir increases the vapor pressure of the liquid therein which applies additional force against the liquid. Once the applied vapor pressure force overcomes surface tension opposition of the liquid at the outlet of tubular member in the upper reservoir, liquid flows through the tubular member into the upper reservoir. Once the liquid weight in the upper reservoir overcomes the weight in the lower reservoir, the rotor overturns, with the reservoirs swapping positions.

This process continues so long as the heat differential between the lower reservoir and the upper reservoir causes displacement of liquid to institute and maintain a periodic overturning or even rotary motion of the rotor. Preferably, the rotor is freely rotatably supported with very little damping when pivot pins are employed. As such, the rotor remains in nearly continuous pendular motion between the periodic overturning motions.

The rotor is approximately balanced without consideration of liquid mass, having almost equal weights at opposite ends thereof. It is thus necessary to displace only a small amount of liquid to institute the rotating motion to the rotor, and a long heating period is not required after each overturn of reservoirs to displace liquid from the newly presented reservoir.

Preferential heat collector means located on the reservoirs may take any form so long as use thereof permits pressure differential across the reservoirs sufficient to allow passage of liquid therebetween. As such, the preferential heat collector means may quite appropriately be represented by light absorptive coatings on opposite sides of the reservoirs with light reflective coatings on the sides opposite the absorptive coatings.

Moreover, the surface area on the preferential heat collective sides of the reservoirs may be increased by fins, and the like which will conduct a greater amount of heat to the liquid than the opposite side of the reservoir. Likewise, a heating element, such as an electric heater or small gas jet, may be employed to heat the lower chamber. Similarly, peripheral fins or vanes may be provided that extend outwardly from the center line of the reservoir with the fins being coated as mentioned above. Means may also be employed to cool the upper chamber or to shadow it from a radiant heat source.

The above heat collector means are only by way of example and others may also be successfully employed. As mentioned above, the preferential heat collector means on one reservoir is on the opposite side to that of the other reservoir. Thus, only one reservoir of each pair preferentially receives heat at any one time, whereby a heat differential exists between the bottom and top reservoirs so as to permit displacement of the liquid.

A further preferred embodiment of the present invention utilizes a tubular member that is a poor heat

conductor. A greater heat differential is thus realized since heat will not be conducted from the bottom to the top reservoir via the tubular member. A steel capillary tube of small diameter is preferred, although glass or plastic tubular members may also be used because of their low heat conductivity.

A supporting base for the rotor of the present invention may be provided when the rotor is equipped with pivot pins for rotary motion thereabout. Such bases may take any desired form. For an amusement device, a base may take a very simple form, adding to the mystique of operation of the device, or may be quite decorative for the enjoyment of small children. In an environment where the device is used for utilitarian purposes, such as an indicator for heat radiation, the design and style of the base will be dictated by the particular objectives of the device. In any event, rotatable support of the rotor of the present invention about a pivot axis should provide free movement for a more complete rotary motion, though rotation may be dampened by conventional means if desired.

A further embodiment of the present invention utilitizes a plurality of independent rotors joined at their mid points. The plural rotors may be supported by pivot pins at the junction point or may have a rim secured around the outer ends of the reservoirs for rolling motion across a surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view of a rotor according to the teachings of the present invention.

FIG. 2 is an isometric view of a rotor according to another embodiment of the present invention.

FIG. 3 is a side elevational view of a further rotor embodiment according to the teachings of the present invention.

FIG. 4 is an isometric view of an amusement device according to the teachings of the present invention.

FIG. 5 is an isometric view of a further amusement device according to the teachings of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the figures, preferred embodiments of the present invention will now be described in detail. In FIG. 1, there is shown a tubular member 1 having reservoirs 3 and 3' secured around opposite ends thereof. Reservoirs 3 and 3' should be substantially the same dimension and weight and should be similarly placed along tubular member 1 for reasons to be described hereinafter.

Securement of reservoirs 3 and 3' around tubular member 1 should accomplish a liquid tight, closed system where the interior of reservoir 3 is in communication with the interior of reservoir 3' through tubular member 1, with tubular member 1 extending into reservoirs 3 and 3' for a substantial distance. Support means in the form of a pair of pins 2 are secured to tubular member 1 at the mid point thereof, each pin 2 having a tapered or pointed end 4 for engagement with a further support member or the like to afford free rotational capability to tubular member 1 and reservoirs 3 and 3'. Hence, with the rotor described above, engagement between pins 2 and a base or the like at pointed outer ends 4 permits tubular member 1 and reservoirs 3 and 3' to rotate through a vertical plane about an axis taken through pins 2.

Without consideration of other features, the device just described is for all practical purposes balanced about pivot pins 2. When, however, a liquid 5 that exhibits a high vapor pressure is placed within the closed system, a larger amount of liquid resides in one reservoir whereby this particular reservoir 3', as shown in FIG. 1, seeks the lower end of the rotational plane. The remaining space within the tubular member 1 and reservoirs 3 and 3' is filled with a vapor 6 of liquid 5.

Once heat is supplied to reservoir 3' as depicted in FIG. 1, vapor pressure of liquid 5 in reservoir 3' increases. As pressure within reservoir 3' increases, force is applied against liquid 5 which seeks to move up tubular member 1. Once the pressure of vapor 6 becomes sufficient to overcome surface tension of liquid 5 within tubular member 1, the liquid moves upwardly through tubular member 1. As the pressure continues to increase, liquid continues to move through tubular member 1 and eventually passes into reservoir 3. As the process continues, sufficient liquid will be displaced from reservoir 3' into reservoir 3 to overcome the weight of reservoir 3' and thus cause reservoir 3 to seek the lower level in the rotational plane. Reservoir 3 thus pivots around pivot pins 2 and replaces reservoir 3' at the lower end of the rotational plane.

The heat source for heating liquid 5 may be of any suitable type for either utilitarian application or for use as an amusement device. It is important that greater heating be experienced in the bottom reservoir than in the top reservoir whereby liquid 5 is displaced into the top reservoir by vapor pressure within the bottom reservoir. Hence, using the illustration of FIG. 1, the preferential heat collector means should be found adjacent the side of reservoir 3' nearest the heat source. Such heating may be accomplished by an electric resistance heater positioned adjacent reservoir 3'; by a heat source directed at reservoir 3'; by radiant heat from sunlight, artificial light, or the like.

Liquids used within the device are thus preferably low boiling liquids or azeotropic mixtures that exhibit low boiling points. Acetone, ethyl chloride and carbon disulfide are suitable. Particularly useful are halogenated hydrocarbons such as 1,2-dichloro 1,1,2,2-tetrafluorethane. The use of lower boiling point liquids reduces the heat requirements for causing the rotor to turn.

Since it is suitable in many cases to utilize an omnidirectional heat source, it is preferred to equip the reservoirs with means to preferentially collect heat at the lower reservoir. As such, upper reservoir 3 may be provided with a light reflective coating 9 as shown, while the opposite side of the reservoir may be provided with a light absorptive coating 10 (not shown). Conversely, the side of reservoir 3' seen in FIG. 1 may have a light absorptive coating 10' thereon while the opposite side (not shown) would have a reflective coating 9' thereon. In this manner, the absorptive surface is exposed to the light source at the bottom of the rotational plane while the upper reservoir will always expose a reflective surface to the light source.

A heat differential is thus created across the reservoirs sufficient to cause the device to rotate. Instead of utilizing the reflective coatings and absorptive coatings just described, it is also suitable to utilize other means such as fins, vanes or the like on the heat receptive side

of the reservoirs, with nothing on the opposite sides. The heat receptive side of the reservoirs thereby exhibit additional surface area through which heat may be conducted to liquid **5**.

FIG. **2** illustrates a further embodiment of the heat collector means of the present invention. Tubular member **100** has reservoirs **130** and **140** secured around opposite ends thereof. Pivot pins **120** extend outwardly from opposite sides of the mid point of tubular member **100**. Reservoirs **103** and **140** are shown to have a vane **135** and **145**, respectively, secured thereabout and extending outwardly therefrom. Vanes **135** and **145**, like reservoirs **130** and **140**, are preferably provided with a reflective surface on one side thereof and an absorptive surface on the opposite side thereof. It is most preferable for both the reservoirs and the vanes to be provided with the reflective and absorptive surfaces, thus further adding to the heat differential between the reservoirs. Hence, reservoir **130** and vane **135** are preferably provided with a heat absorptive surface on one side (the side illustrated, for example), while the same side of reservoir **140** and vane **145** are provided with a heat reflective surface. Opposite sides of reservoirs **130** and **140** and vanes **135** and **145** would have the opposite types of surfaces to those discussed above.

A further embodiment of the present invention is illustrated in FIG. **3**. A plurality of rotors **210, 220** and **230** are united at their centers to provide a common pivot **240** therefor. Rotors **210, 220** and **230** comprise tubular members **212, 222** and **232**, respectively, with the tubular members having reservoirs **214, 216, 224, 234**, and **236**, respectively. As illustrated, the rotors are equally spaced around pivot **240** to thus provide a smooth turning motion. Moreover, there is no interconnection between rotors. Instead, each rotor functions independently of the other rotors. Placement of a plurality of rotors about a common pivot, with all of the rotors being evenly spaced, tends to produce continual rotation in one direction or the other, depending upon the direction of initial rotation. Use of one rotor, however, permits overturn in either a forward or rearward direction, the direction of overturn normally changing during continued operation.

Referring to FIG. **4**, an amusement device according to the teachings of the present invention is shown. FIG. **4** thus illustrates a base **300** having a pair of supports **301** and **302** secured thereto and extending upwardly therefrom with supports **301** and **302** forming an arch **303** at the upper ends thereof. Positioned between support member **301** and **302** and under arch **303** is a rotor generally illustrated as **304**. Rotor **304** includes a tubular member **310** having reservoirs **311** and **312** secured at opposite ends thereof.

As shown in FIG. **4**, reservoir **311** is provided with a heat absorptive surface on the side illustrated, while reservoir **312** is provided with a heat reflective surface on its visible side. As such, high intensity light directed at reservoir **311** will cause the liquid (not shown) to voltalize whereby the vapor pressure increases and the liquid is displaced into reservoir **312**. Rotor **304** is suspended between supports **301** and **302** by pivot pins **313**. Hence, as the liquid is displaced from reservoir **311** into reservoir **312**, rotor **304** will overturn in a vertical plane around an axis through pivot pins **313**. This brings reservoir **312** to the bottom position, with its heat absorptive surface exposed to the light (heat) source and the operation is repeated. As long as the reservoir in the bottom position continues to receive heat sufficient to displace liquid from that reservoir into the top reservoir, the device of the present invention will continue to rotate.

FIG. **5** illustrates a device **400** that encompasses yet another embodiment of the present invention. A plurality of rotors **410, 420** and **430** are secured together in evenly spaced relation at a common point **440**. As mentioned above, each rotor comprises a tubular member having a reservoir secured around opposite ends thereof and containing a low boiling liquid. Rotors **410, 420** and **430** are not supported for rotation about a common pivot point, but instead have a rim **450** that surrounds the rotors and is secured to the outer ends of the reservoirs of the various rotors. Reservoirs of rotors **410, 420** and **430** are also provided with preferential heat collector means. Thus, when device **400** is placed on a supporting surface (not shown) such as a table, floor, or the like, device **400** will roll across the surface when actuated by a heat source.

The device of the present invention has been described in simple form. Obviously, such a device could take numerous shapes, could receive decorative elements around the reservoirs so as to add to the aesthetic, amusement qualities of the device, or the like. Moreover, any suitable type base or support means may be employed that will enable the device to receive heat at the lower reservoir and to rotate around the support.

Having described the present invention in detail, it is obvious that one skilled in the art will be able to make variations and modifications thereto without departing from the scope of the invention. Accordingly, the scope of the present invention should be determined only by the claims appended hereto.

What is claimed is:

1. A rotatable device comprising:

a. a tubular member;

b. a reservoir secured around said tubular member at each end thereof, said reservoirs being sealed around said member to define a closed system; said reservoirs further containing a predetermined amount of a liquid exhibiting a high vapor pressure and the remainder of said system containing vapor of said liquid; said reservoirs further having preferential heat collectors on opposite sides thereof such that only one of said collector means is exposed to a fixed heat source at any one time; and

c. rotatable support means associated with said tubular member and reservoirs.

2. A rotatable device as defined in claim **1**, wherein said tubular member is a capillary tube.

3. A rotatable device as defined in claim **1**, wherein said support means are secured to said tubular member and extend outwardly from opposite sides thereof, and wherein said reservoirs are of like size and are secured along said tubular member at like locations on opposite ends thereof.

4. A rotatable device as defined in claim **3**, wherein support means comprise a pair of pivot pins, said pins being secured to said tubular member at approximately the mid point thereof, said pins having tapered outer ends for free rotational support.

5. A rotatable device as defined in claim **1**, wherein preferential heat collector means comprise a heat absorptive surface on one side of each reservoir only, the

absorptive surface on one reservoir being opposite the absorptive surface on one reservoir.

6. A rotatable device as defined in claim 5, wherein a heat reflective surface is present on an opposite side of the same reservoir to the heat absorptive surface.

7. A rotatable device as defined in claim 6, wherein each reservoir has said absorptive surface longitudinally along one side thereof and said reflective surface longitudinally along an opposite side thereof, the arrangement for one of said reservoirs being opposite to the other of said reservoirs.

8. An amusement device comprising a base, said base having a plurality of support secured thereto and extending upwardly therefrom and at least one rotatable device as defined in claim 1 rotatably suspended between said supports.

9. An amusement device as defined in claim 8, wherein a plurality of independent rotatable devices are interconnected and suspended as a unit between said supports.

10. A rotatable device as defined in claim 1, wherein said rotatable support means comprises a circular rim extending around said reservoirs and being secured thereto.

11. A rotatable device as defined in claim 1, wherein said reservoirs further have a vane secured longitudinally therearound and extending outwardly therefrom.

12. A rotatable device as defined in claim 11, wherein said vanes further have preferential heat collector means on one side thereof.

13. An amusement device comprising:

a. a tubular member;

b. a reservoir received around each end of said tubular member, and secured thereto to define a liquid tight system, said reservoirs being in communication with each other through said tubular member;

c. a predetermined amount of a liquid that exhibits a high vapor pressure being received within said liquid tight system;

d. a predetermined amount of vapor of said liquid being received in said system, liquid and vapor being present in both reservoirs;

e. light reflective means being secured to each said reservoir around a portion thereof;

f. light absorptive means being secured to each said reservoir around a portion thereof, said absorptive means on one of said reservoirs being placed in a location opposite the absorptive means on said other reservoirs; and

g. rotatable support means associated with said tubular member and said reservoirs.

14. An amusement device as defined in claim 13, wherein said rotatable support means comprise a pair of pivot pins secured to said tubular member on opposite sides of the mid point thereof and a base freely and rotatingly receiving said pivot pins.

15. An amusement device as defined in claim 12, wherein said base comprises a platform having a pair of vertical supports thereon, said pivot pins being received by said supports.

16. An amusement device as defined in claim 15, wherein said supports form an arch at the upper ends thereof.

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