MEASUREMENT AND SHUT-OFF SYSTEM FOR A LIQUID DISPENSING DEVICE

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ABSTRACT

Aspects of the invention relate to a measurement and shut-off system for a water dispensing device. The system includes a collection cup in which a float can reside. At least a part of the float can be magnetic. The cup is positioned within the coverage area of the dispensing device. Thus, as water from the dispensing device accumulates in the cup, the float begins to rise. The float can pass by a normally open switch that can be closed under the influence of a magnetic field. The switch can be positioned to correspond to the desired level of water accumulation. If the magnetic portion of the float approaches sufficiently near, the switch can close to complete a circuit that can activate a motor. The rotation of the motor shaft can be transmitted to close a valve so as to restrict the supply of water flow to the water dispensing device.
FIG. 10
MEASUREMENT AND SHUT-OFF SYSTEM FOR A LIQUID DISPENSING DEVICE

FIELD OF THE INVENTION

[0001] The invention relates in general to liquid dispensing devices and, more particularly, to a system for measuring the amount of a liquid deposited on an area by a liquid dispensing device.

BACKGROUND OF THE INVENTION

[0002] When applying a liquid substance to an area, there may be a preferred quantity of substance that should be deposited onto the area. For example, in the context of lawn and garden care, there may be a recommended amount of water that a consumer should apply to a lawn, such as a certain number of inches of water per square foot of lawn. However, a consumer typically does not have any way of measuring or sufficiently estimating the amount of water deposited. Moreover, a consumer is usually unable to account for any water that may already be in the soil from other sources, such as from recent rainfall. As a result, a consumer may over or under hydrate the lawn, which, in turn, can lead to an unhealthy lawn. Thus, there is a need for a system that can measure the amount of water or other liquid substance applied to a lawn or other area. There is also a need for a system that can restrict the output of liquid once the desired amount of liquid has been applied. Further, there is a need for a system that can prevent the dispensing of liquid during or shortly after a rainfall.

SUMMARY OF THE INVENTION

[0003] Aspects of the invention relate to a measurement and shut-off system for a liquid dispensing device. In one embodiment, the system includes a collection cup that receives a liquid; a float; a power source; an open first switch; and a motor. The float is provided within the collection cup. At least a portion of the float is magnetic and has an associated magnetic field. One or more of these individual components can be provided within a housing.

[0004] The open first switch is positioned proximate the collection cup. The switch is operatively connected to the power source. The switch is closable under the influence of a magnetic field. The position of the first switch can be adjusted in the substantially vertical direction.

[0005] The motor is operatively connected to the power source and the switch. The float rises in the collection cup as a liquid accumulates in the collection cup. The switch closes when the magnetic field of the float approaches sufficiently near the switch, which can complete an electrical circuit to activate the motor. In one embodiment, the system can include a second open switch disposed at a different elevation relative to the first switch. The first and second switches can be substantially vertically aligned. In instances where there are two or more switches, a selector can be operatively connected to the first and second switches. The selector allows a user to selectively determine which of the first and second switches is operatively connected to the power source and the motor to form an electrical circuit.

[0006] The system can also include a fluid conduit and a valve provided along the fluid conduit. The valve can be movable between an open position in which flow through the fluid conduit is substantially permitted and a closed position in which flow through the fluid conduit is substantially restricted. The motor can operatively engage the valve to move the valve between open and closed positions. In one embodiment, the motor can operatively engage the valve by a plurality of gears. The system can further include a motor end switch operatively connected between the power source and the first and second switch. The motor end switch can be operatively associated with one of the plurality of gears such that when the valve is moved into the closed position, the motor end switch opens and thereby deactivates the motor.

[0007] In another embodiment, the system includes: a liquid dispensing device, a collection cup, a float, a power source, a motor, a plurality of open switches and a selector. The collection cup, the float, the power source, the motor and the plurality of switches can be provided within a housing. Each of these components will be discussed in turn.

[0008] The liquid dispensing device can have an associated area of coverage over which liquid leaving the device is deposited. The liquid dispensing device can be, for example, a sprinkler, a sprayer, a mister or an irrigation tool. The collection cup is positioned in the area of coverage. Thus, the collection cup receives liquid from at least the liquid dispensing device. A screen can be disposed above the collection cup to discourage tampering with the collection cup while not substantially impeding the entry of liquid into the cup. The float is provided within the collection cup. All or only a portion of the float is magnetic so that it exerts a magnetic field. In one embodiment, a magnet can be attached to the float.

[0009] The power source can be one or more batteries. The motor is operatively connected to the power source. The plurality of open switches are positioned proximate the collection cup. Each switch is disposed at a different elevation relative to the other switches. Each of the switches is closable under the influence of a magnetic field. The position of one or more of the plurality of switches can be adjustable in the substantially vertical direction. In one embodiment, the plurality of switches can include three or more switches. The plurality of switches can be spaced substantially equally apart. Alternatively, at least one of the plurality of switches can be spaced unequally apart from the other switches. The plurality of switches can be substantially vertically aligned. A selector is operatively connected to the plurality of switches. The selector is moveable so that a user can select one of the plurality switches to be operatively connected to the power source and the motor so as to form an electrical circuit.

[0010] Again, the collection cup is positioned in the area of coverage of the liquid dispensing device. Thus, as liquid from the liquid dispensing device accumulates in the cup, the float rises in the cup. The selected one of the plurality of switches closes when the magnetic field of the float approaches sufficiently near the switch. When the selected switch closes, the electrical circuit is completed and the motor is activated.

[0011] The system can further include a fluid conduit. The fluid conduit can be connected to the liquid dispensing device. Thus, the fluid conduit can deliver liquid to the liquid dispensing device. A valve can be disposed along the fluid conduit. The valve can be movable between an open position in which liquid flow through the fluid conduit is substan-
tially permitted and a closed position in which liquid flow through the fluid conduit is substantially restricted. In one embodiment, a timer can be disposed along the fluid conduit and upstream of the valve.

[0012] The motor can operatively engage the valve such that, when activated, the motor moves the valve to the closed position. A valve gear can be operatively associated with the valve such that rotation of the valve gear moves the valve between open and closed positions. A motor gear can be operatively associated with the motor. The motor gear can operatively engage the valve gear such that rotation of the motor gear is transmitted to the valve gear.

[0013] The system can include a motor end switch that is operatively connected between the power source and the selected one of the plurality of switches. The motor end switch can operatively engage the valve gear such that when the valve is moved into the closed position, the motor end switch opens, thereby deactivating the motor.

[0014] Another system according to aspects of the invention includes a water source, a water dispensing device and a fluid conduit connecting the water source and the water dispensing device in fluid communication. The water dispensing device has an associated area of coverage over which water is deposited

[0015] A valve is disposed along the fluid conduit. The valve is movable between an open position in which flow through the fluid conduit is substantially permitted and a closed position in which flow through the fluid conduit is substantially restricted. In one embodiment, a timer can be disposed along the fluid conduit between the fluid source and the valve. A valve gear is operatively associated with the valve such that rotation of the valve gear moves the valve between open and closed positions.

[0016] The system further includes a collection cup for receiving a liquid. The collection cup is positioned in the area of coverage of the water dispensing device. A float is provided within the collection cup. The float is buoyant in water. At least a portion of the float is magnetic and has an associated magnetic field.

[0017] Additionally, the system includes a power source and a motor operatively connected to the power source. The motor has a rotatable shaft on which a motor gear is attached. The motor gear operatively engages the valve gear such that rotation of the motor gear is transmitted to the valve gear.

[0018] A plurality of open switches are positioned proximate the collection cup. Each switch is disposed at a different elevation relative to the other switches. Each of the switches is closable under the influence of a magnetic field. The position of one or more of the plurality of switches can be adjustable in the substantially vertical direction. A selector is operatively connected to the plurality of switches. The selector is movable to select one of the plurality switches to be operatively connected to the power source and the motor so as to form an electrical circuit.

[0019] As water from the dispensing device accumulates in the collection cup, the float will rise. The selected one of the plurality of switches closes when the magnetic field of the float approaches sufficiently near the switch. Thus, the electrical circuit is completed to activate the motor. The motor moves the valve to the closed position by way of the gears.

[0020] The system can further include a motor end switch operatively connected between the power source and the selected one of the plurality of switches. The motor end switch can operatively engage the valve gear such that, when the valve is moved into the closed position, the motor end switch opens, thereby deactivating the motor.

[0021] The valve, the collection cup, the float, the power source, the plurality of switches, and the selector can be provided within a housing. A screen can be disposed above the collection cup to discourage tampering with the system by animals or people while not substantially impeding the entry of water into the collection cup. The screen can be attached to the collection cup and/or to the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a partial schematic view of a liquid measurement system according to aspects of the invention.

[0023] FIG. 2 is an isometric view of the system according to aspects of the invention, wherein at least a portion of the system is provided within a housing.

[0024] FIG. 3 is a side elevational view of the housing for the system according to aspects of the invention, viewed from line 3-3 in FIG. 2.

[0025] FIG. 4A is a side elevational view of an indirect connection between the system according to aspects of the invention and a liquid dispensing device.

[0026] FIG. 4B is a side elevational view of a direct connection between the system according to aspects of the invention and a liquid dispensing device.

[0027] FIG. 5 is a side elevational view of a valve gear having an actuator portion according to aspects of the invention, wherein the actuator portion is a substantially circular ridge.

[0028] FIG. 6 is a plan view of the valve gear according to aspects of the invention, viewed from line 6-6 in FIG. 5.

[0029] FIG. 7 is a partial schematic view of the liquid measurement system having a reset system according to aspects of the invention.

[0030] FIG. 8A is a schematic view of the reset system in a first position according to aspects of the invention.

[0031] FIG. 8B is a schematic view of the reset system in a second position according to aspects of the invention.

[0032] FIG. 8C is a schematic view of the reset system in a third position according to aspects of the invention.

[0033] FIG. 8D is a schematic view of the reset system in a fourth position according to aspects of the invention.

[0034] FIG. 8E is a schematic view of the reset system in a fifth position according to aspects of the invention.

[0035] FIG. 9A is a schematic view of the reset system in a first position according to aspects of the invention.

[0036] FIG. 9B is a schematic view of the reset system in a second position according to aspects of the invention.
FIG. 9C is a schematic view of the reset system in a third position according to aspects of the invention.

FIG. 9D is a schematic view of the reset system in a fourth position according to aspects of the invention.

FIG. 9E is a schematic view of the reset system in a fifth position according to aspects of the invention.

FIG. 10 is a plan view of the valve gear according to aspects of the invention, showing a ridge arrangement to facilitate the electronic reset system.

FIG. 11A is a diagrammatic view of a conventional liquid dispensing system having a timer.

FIG. 11B is a diagrammatic view of a liquid dispensing system having a timer and further equipped with a liquid measurement system according to aspects of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Embodiments of the present invention can facilitate the measurement or estimation of the amount of a liquid substance applied to an area by a liquid dispensing device. Further, embodiments of the invention can restrict the supply of the liquid to the liquid dispensing device once a desired level of liquid has been deposited. Embodiments of the invention will be explained in the context of one possible system, but the detailed description is intended only as exemplary. Embodiments of the invention are shown in FIGS. 1-11, but aspects of the invention are not limited to the illustrated structure or application.

Aspects of the invention can be used in combination with a liquid dispensing device. Aspects of the invention are not limited to any particular liquid dispensing device. For example, the liquid dispensing device can be a sprinkler, a hose, a sprayer, a mister, an irrigation tool or a water dispensing device 10, as shown in FIG. 1. The liquid dispensing device can be almost any device that can be used to deposit a liquid substance onto a surface, which can be, for example; a lawn or the ground. The liquid dispensing device can have an associated coverage area; that is, that portion of the surface that actually receives liquid from the dispensing device. The coverage area can be any shape and size.

While especially suited for water-based systems, aspects of the invention can be used in connection with almost any substance in liquid form including, for instance, pesticides, fertilizers, vitamins and minerals. Therefore, it will be understood that the use of the terms “water” and “water dispensing device” herein is merely for convenience and is not intended to limit the scope of the invention to water-based applications and devices. Likewise, aspects of the invention are not limited to use in any specific application. However, it should be noted that aspects of the invention can be used in a wide-range of applications including lawn and garden care, landscaping, irrigation, farming and cleaning, just to name a few possibilities.

The water dispensing device 10 can be in fluid communication with a water source 12. The water source 12 can be, for example, a pressurized water distribution system. The water source 12 can provide a connector (not shown), such as an outdoor hose bib or faucet, to facilitate attachment to other water conduits. In one embodiment, one or more fluid conduits, such as a hose 14, can be used to connect the water dispensing device 10 and the water source 12 in fluid communication.

A system 16 according to aspects of the invention can include a variety of components, which will now be described. The system 16 can include a valve 18 to control the supply of water from the source 12 to the dispensing device 10. That is, the valve 18 can be used to selectively permit and prohibit the flow of water to the dispensing device 10. The valve 18 can be connected between the water source 12 and the water dispensing device 10. In one embodiment, the valve 18 can be disposed along the hose 14 connecting the water source 12 and the water dispensing device 10. The valve 18 can be almost any type of valve and, in one embodiment, the valve 18 can be a ball valve.

The system can further include a collection cup 20. The collection cup 20 can be any size and shape. In one embodiment, the collection cup 20 can be at least about 4 square inches in cross-section and at least about 2.5 inches deep. An upper end 22 of the collection cup 20 can be open. The collection cup 20 can be made of any of a number of materials. Preferably, the collection cup 20 is made of a durable, non-corrosive material, such as plastic. The collection cup 20 can be positioned so as to be within the coverage area of the water dispensing device 10. Thus, a portion of the water 24 exiting the device 10 can enter and accumulate in the cup 20 when the dispensing device 10 is in operation. In one embodiment, the collection cup 20 can be attached to at least a portion of the valve 18.

A float 26 can reside within the collection cup 20. The float 26 can be made of almost any material, but it is preferably made of a durable non-corrosive material like plastic. In one embodiment, the float can be made of polyfoam. In addition, the float 26 can be made of a material that is buoyant in the water 24 or whatever liquid substance is being collected in the cup 20. Thus, as the water 24 collects in the cup 20, the float 26 can rise, remaining substantially on top of the water 24. It will be appreciated that the float 26 can have various configurations, and aspects of the invention are not limited to any particular configuration. As an example, the float 26 can have a base portion 28, which can provide stability, with an elongated rod 30 extending substantially upward from the base portion 28.

At least a portion of the float 26 can be magnetic. The float 26 can be made magnetic in numerous ways. For instance, all or a portion of the float 26 can be made of a magnetic material. In one embodiment, a magnet 32 can be mounted on the float 26, such as at the end of the rod 30. In another embodiment, at least a portion of the magnet 32 can be embedded in the float 26. For instance, the entire magnet can be embedded within the float 26. Such an arrangement can minimize concerns of magnet corrosion by substantially preventing the magnet from contacting the water collecting in the cup. There are numerous ways in which the magnet 32 can be attached to the float 26 including, for example, mechanical engagement, fasteners, and adhesives, just to name a few possibilities. Alternatively, at least a portion of the float 26 can be coated with a magnetic substance, such as magnetic paint. The magnet 32 can be almost any type of magnet 32 and can be almost any type of magnetic material.
can be used. The magnet 32 can be sized and shaped as needed to exert a sufficient magnetic field, as will be discussed later.

[0051] The system 16 can include one or more switches 34, which, for convenience, will be referred to herein as height switches. The height switch 34 can be almost any type of switch. The height switch 34 can be normally open. The height switch 34 can be influenced by a magnetic field. Specifically, the height switch 34 can close under the influence of the magnetic field of the float. The height switch 34 can remain closed for as long as the magnetic field is exerted on the height switch 34.

[0052] The height switch 34 can be mounted substantially proximate the collection cup 20. The height switch 34 can be located slightly above the collection cup 20 as well. The switch 34 can be positioned to correspond to a certain amount of float travel based on the accumulation of a certain level of water 24 in the collection cup 20. In one embodiment, the position of the height switch 34 can be adjusted by a user to correspond to a desired amount of water 24 accumulation in the collection cup 20. For example, the height switch 34 can be moved up or down in the substantially vertically direction. To that end, the height switch 34 can be slidably mounted on another component or structure, such as a post (not shown) or a housing 66.

[0053] Thus, as the float travels, the magnetic portion of the float 20 can eventually come sufficiently close to the height switch 34 so as to exert a magnetic field to close the height switch 34. In one embodiment, such as when the magnetic portion of the float 26 does not protrude beyond the open end 22 of the cup 20 once the desired level is reached, the magnet field can be sufficiently strong so as to penetrate the walls of collection cup 20 to close the height switch 34. However, the cup 20 may be relatively shallow so that, the magnetic portion of the float 26 extends outside of the cup 20 for at least a portion of the range of travel of the float 26.

[0054] Again, aspects of the invention are not limited to a height single switch 34. Aspects of the invention also include systems having two or more height switches 34. In such case, the height switches 34 can be disposed at different elevations relative to each other. The different elevations can correspond to different amounts of float travel. In one embodiment, there can be four height switches 34. The height switches 34 can be mounted such that a first switch 34a can be actuated after about ½ inch of float travel. A second switch 34b can be actuated after about 1 inch of float travel. A third switch 34c and a fourth switch 34d can be actuated after about 1½ inches and about 2 inches of travel, respectively. Again, these elevations are provided merely as an example. The total distance between the lowermost height switch and the uppermost height switch can vary from application to application, and aspects of the invention are not limited to any particular distance. Further, the spacing between the individual height switches 34 can be substantially equal or at least one of the switches 34 can be provided at unequal spacing relative to the other switches 34. The two or more height switches 34 can be substantially vertically aligned. In one embodiment, the position of at least one of the height switches 34 can be adjusted, as discussed previously.

[0055] When the system 16 includes multiple height switches 34, a selector 36 can be provided to determine which of the height switches 34 is used to form a circuit 38, which will be described in detail later. In one embodiment, the selector 36 can be a switch. The selector 36 can be in operative engagement with the two or more height switches 34 so that a user can select the desired level of water to be applied. The selector 36 can be directly manipulated by a user, or it can be indirectly manipulated by providing a user knob 40 operatively connected to the selector 36 to facilitate user engagement of the selector 36.

[0056] The system 16 can include a motor 42, which can be an electric motor. The motor 42 can which can be used to close the valve 18 once the desired amount of water 24 has been applied to the lawn. To that end, the motor 42 can be operatively engage the valve 18. The operative engagement between the motor 42 and the valve 18 can be achieved in various ways. For instance, the motor 42 can have a rotatable shaft 44 on which a gear 46 can be attached. The motor gear 46 can engage a gear 48 connected to the valve 18 such that rotation of the valve gear 48 can move the valve 18 between open and closed positions. In one embodiment, the valve gear 48 and the motor gear 46 can directly engage each other. In another embodiment, the valve gear 48 and the motor gear 46 can be indirectly engaged, such as by one or more intermediate gears (not shown) that can transmit the motion of the motor gear 46 to the valve gear 48. Preferably, the motor 42 has sufficient torque to close the valve 18. Increases in torque can be gained through gear reduction. Again, it will be appreciated that gears are just one of several ways in which the motor 42 can be used to manipulate the valve 18.

[0057] The system 16 according to aspects of the invention can include a power source 50. The power source 50 can be, for example, one or more batteries or any other suitable power source. The power source 50 can be used to power the motor 42. The power source 50, in addition to the at least one height switch 34, the selector 36 and the motor 42, can form the circuit 38. As shown in FIG. 1, the motor 42 can be operatively connected to receive energy from the power source 50. The motor 42 can be operatively connected to the at least one height switch 34, which, in turn, can be operatively connected to the selector 36, if provided. Depending on the arrangement, the height switch 34 and/or selector 36 can be operatively connected to the power source 50. Operative connection of the above-described components can be achieved by, for example, conductors 52.

[0058] When the valve 18 is fully closed, the system 16 can be configured to deactuate the motor 42. In one embodiment, the motor 42 can be deactivated by creating an open condition in the circuit 38, thereby terminating current flow to the motor 42. To that end, the system 16 can include a motor end switch 54, which can form a part of the circuit 38. When the motor end switch 54 is in the closed position, the circuit 38 is complete, allowing the motor 42 to operate. When the motor end switch 54 is in the open position, the circuit 38 is open, cutting off current flow to the motor 42. In one embodiment, the motor end switch 54 can be a normally open.

[0059] There are various ways to move the motor end switch 54 between the open and closed positions. For example, the motor end switch 54 can be manipulated manually by a user, or it can be manipulated automatically. In one embodiment, the valve gear 48 can include an
The actuator portion 56. The actuator portion 56 can be molded into the valve gear 48, or it can be attached to the valve gear 48 by mechanical engagement, fasteners and/or adhesives, just to name a few possibilities. The actuator portion 56 can engage the motor end switch 54, which can include, for example, a micro-switch with a roller at one end for engaging the actuator portion 56. The actuator portion 56 can maintain the motor end switch 54 in the closed position for at least a portion of the range of travel of the valve gear 48.

The engagement between the actuator portion 56 and the motor end switch 54 can be configured such that once the valve 18 is in the closed position, the motor end switch 54 opens to break the circuit 36. As a result, current can no longer flow to the motor 42, thereby deactivating the motor 42.

In one embodiment, the actuator portion 56 can be a pin (not shown) extending from the valve gear 48. In another embodiment, the actuator portion 56 can be a substantially circular ridge 58 extending from the valve gear 48, as shown in FIGS. 5 and 6. The ridge 58 can engage the motor end switch 54 to maintain the motor end switch 54 in the closed position. To open the motor end switch 54, the ridge 58 can include one or more interruptions, such as notches 60. The notches 60 can be partial or complete interruptions in the ridge 58. Further, the notches 60 can be almost any shape including, for example, parabolic, rectangular, semi-circular and triangular. When an interruption is encountered, the actuator portion 56 can disengage from the motor end switch 54, allowing the motor end switch 54 to move to the open position. Alternatively, the motor end switch 54 and the actuator portion 56 can remain engaged, but the switch 54 is otherwise allowed to move to an open position. The motor end switch 54 can remain in the open position until reset by a user.

The system 16 can further be configured to allow a user to reset the system 16 after water flow to the water dispensing device 10 has been restricted and the motor 42 is deactivated. Resetting the system 16 can be achieved in a number of ways. In one embodiment, a shaft 62 can extend from the valve gear 48. A user knob 64 can be mounted on one end of the shaft 62 to facilitate manipulation by a user. The other end of the shaft 62 can engage the valve 18. Thus, it will be appreciated that the knob 64 is operatively connected to the valve gear 48 and the valve 18 by way of the shaft 62. After a watering cycle is completed, as described above, the knob 64 can point to the "off" position (see FIG. 3) in which the switch 54 is open and the valve 18 is closed. A user can manually turn the knob 64 to the "on" position. Movement of the knob is transmitted by way of the shaft 62 to open the valve 18. Further, the movement of the knob is transmitted to the valve gear by way of the shaft. By turning the knob 64 to the "on" position, the actuator portion 56 of the valve gear 48 can reengage the switch 54 so as to close the switch 54. Now the system 16 is ready to be used again.

Another embodiment of a reset configuration for the system 16 according to aspects of the invention is shown in FIG. 7. As shown, the circuit 38 can have a branch 80 connected in parallel with the portion of the circuit 38 that includes the height switches 54 and the motor end switch 54. The branch 80 can include a valve open switch 82 and a reset switch 84. Use of the terms "valve open" and "reset" in connection with the switches 82, 84 in the branch 80 is merely for convenience to facilitate discussion. These terms are not intended to limit the scope of the invention.

The reset switch 84 can be almost any kind of switch or other suitable device such as a relay. The reset switch 84 can be operatively connected to a user button or dial (not shown) such that a user can operate the reset switch 84. The button or dial can be provided on the exterior of the housing 66.

Like the motor end switch 54, the valve open switch 82 can directly or indirectly operatively engage the valve gear 48 in any of the manners discussed above. In one embodiment, each of the motor end switch 54 and the valve open switch 82 can have an associated roller micro-switch (not shown), which in turn can engage the valve gear 48. The valve gear 48 can include one or more actuator portions 56 for engaging the roller micro-switches. In one embodiment, the actuator portion 56 can be a set of four ridges 88 provided on the valve gear 48. One arrangement of the four ridges is shown in FIG. 9. There is a first ridge 88a, a second ridge 88b, a third ridge 88c and a fourth ridge 88d. The previous discussion regarding ridge 58 can apply equally to the four ridges 88. The first and third ridges 88a, 88c can be substantially on a first diameter D1; the second and fourth ridges 88b, 88d can be substantially on a second diameter D2. The first and second diameters D1, D2 can be unequal. Thus, during a complete revolution of the valve gear 48, the valve open switch 82 can operatively engage the second and fourth ridges 88b, 88d whereas the motor end switch 54 can operatively engage the first and third ridges 88a, 88c.

To facilitate discussion, it should also be noted that there are various positions associated with the valve gear 48 and the ridges 88, which will be designated P1, P2, P3 and P4, as shown in FIG. 10.

The operation of such a reset system will now be explained in connection with FIGS. 8A-8E, which show a simplified view of the circuit 38 having the branch portion 80. FIG. 8A shows the system as it is ready to be used for watering. The motor end switch 54 and the valve open switch 82 are generally at position P1 of the valve gear 48. The height switch 34 is open, and the motor end switch 54 is closed by its operative engagement with the first ridge 88a. In the branch 80, the valve open switch 82 is open and the reset switch 84 is open.

Once the desired amount of water has been imparted onto the lawn, the magnet associated with the float 26 can close height switch 34, which, as described above, activates the motor 42 to close the valve 18. In one embodiment, the motor 42 can turn the valve gear 48 approximately one quarter turn to close the valve 18. This movement of the valve gear 48 places the motor end switch 54 and the valve open switch 82 generally at position P2 of the valve gear 48. In position P2, the motor end switch 54 can be open because, for example, the motor end switch 54 can be disengaged from the first ridge 88a, thereby deactivating the motor 42. Also in position P2, the valve open switch 82 can engage the second ridge 88b, thereby causing the valve open switch 82 to close. However, the reset switch 84 is still open because the user has yet to engage the reset switch 84. Such a condition is shown in FIG. 8B. After the user empties the accumulated water 24 from the collection cup 20, the height switch 34 opens, as shown in FIG. 8C, because the float 26 will fall to the bottom of the cup 20.
The user can now close the reset switch 84 by manipulating the provided interface, which can be, for example, a knob, dial, or button (not shown). After it is moved into the closed position by a user, the reset switch 84 can be held in the closed position. Again, the valve open switch 82 is closed because of its engagement with the second ridge 88b. Thus, as shown in FIG. 8D, the circuit 38 is completed and the motor 42 is activated. In one embodiment, the motor 42 can turn approximately one quarter turn. When the valve open switch 82 disengages the second ridge 88b, the valve open switch 82 can open, thereby causing an open condition in the circuit 38 and deactivating the motor 42. The reset switch 84, which can be a relay, can open such as under its own bias due to the interruption in power. However, the motor end switch 54 can be closed because it is in operative engagement with the third ridge 88c. Such a condition is shown in FIG. 8E. It is noted that the condition of the circuit 38 is the same as the condition shown in FIG. 8A. Thus, it will be appreciated that the system 16 is ready to be used again at this point, and the above cycle can repeat.

In another reset system, the reset switch 84 can be a normally open switch that can be influenced by a magnetic field, similar to the height switch 34 described earlier. The reset switch 84 can be positioned substantially at or near the bottom end 23 of the collection cup 20 or otherwise positioned such that when there is no liquid in the collection cup 20, the reset switch 84 is sufficiently within the magnetic field of the float 26 such that the switch 84 closes. In one embodiment, the reset switch 84 can be a reed switch.

The operation of such a reset system is shown in FIGS. 9A-9E. Referring to FIG. 9A, the system 16 is ready for use. The valve open switch 82 and the motor end switch 54 engage the valve gear 48 at position P1 such that the valve open switch 82 is open and the motor end switch 54 is closed. Because there is no water in the collection cup 20, the float 26 can reside at the bottom of the cup 20. Thus, the height switch 34 is open because it is out of the magnetic field of the float 26, but the reset switch 84 is closed because it is under the influence of the magnetic field of the float 26.

As water 24 collects in the cup 20, the float 26 rises and eventually the reset switch 84 will be out of the magnetic field associated with the float 26. In such case, the reset switch 84 can open under its own bias or otherwise. If enough water 24 accumulates in the cup 20, the float 26 will rise such that the height switch 34 is sufficiently within the magnetic field of the float 26, thereby causing the height switch 34 to close. The motor end switch 54 remains closed and the valve open switch 82 remains open because the valve gear 48 has not moved from position P1. The condition of the circuit 38 is shown in FIG. 9B. Because the height switch 34 and the motor end switch 54 are closed, the circuit 38 is completed. As discussed previously, the motor 42 can run to close the valve 18 and turn the valve gear 48. At position P2, the motor end switch 54 opens and the valve open switch 82 closes, which is shown in FIG. 9C. It will be appreciated that the circuit 38 is open and the motor 42 is deactivated.

To reset the system, the user can empty the cup 20, causing the float 26 to fall to the bottom of the collection cup 20. Thus, the reset switch 84 can close under the influence of the magnetic field associated with the float 26. In addition, the height switch 34 opens because it is no longer sufficiently within the magnetic field of the float 26. Such a condition is shown in FIG. 9D. Because the reset switch 84 and the valve open switch 82 are both closed, the circuit 38 is completed and the motor 42 can be activated. The motor 42 can move the valve gear 48 to position P3 such that the motor end switch 54 closes and the valve open switch 82 opens, as described above. Movement of the valve gear 48 can also move the valve 18 to the open position. The height switch 34 remains open and the reset switch 84 remains closed as the float 26 rests at the bottom of the cup 20. At this point, the circuit 38 appears as shown in FIG. 9E, and is ready for use. It will be appreciated that the condition of the circuit 38 in FIG. 9E is identical to the condition of the circuit 38 in FIG. 9A.

Instead of a user manually emptying the collection cup 20, the water 24 in the cup 20 can simply be allowed to evaporate. The rate of evaporation of the water in the cup should be approximately the same as the rate of evaporation of the water in the ground. Thus, when the water 24 in the collection cup 20 evaporates such that the cup 20 is empty or near empty, the ground will need to be watered. The float 26 will be near the bottom of the cup 20, affecting the circuit 38 as described above as if the user emptied the cup 20. Thus, it will be appreciated that the system can be substantially self-sustaining with little or no user input required after set-up.

During the operation life of the power source 50, there may be times when the voltage of the power source 50 decreases and is no longer sufficient to operate the motor 42 and/or close the valve 18, as may occur near the end of the operational life of the power source 50. In such cases, the valve 18 may not close, and water can continue to be supplied to the water dispensing device 10. Consequently, a lawn or area being watered can become floodaded, and the consumer may have expensive water utility bills. To minimize such concerns, aspects of the invention can include a low voltage feature such that, when the voltage of the power source 50 falls below a certain voltage, the valve 18 is closed and the reset function, including any of those described above, is disabled until a new power source 50 is installed.

It should be noted that when a system 16 according to aspects of the invention are used to water a lawn, there may be instances in which an animal, such as a dog or cat, may drink accumulated water 24 from the collection cup 20. It will be appreciated that such water consumption can adversely affect the operation of the system 16 according to aspects of the invention. To prevent such occurrences, a screen 90 can be placed over the upper end 22 of the collection cup 20. In instances where the cup 20 is provided within the housing 66, the screen 90 can be provided on and attached to the housing 66, as shown in FIG. 2. The screen 90 can be attached to the housing 66 in numerous ways including, for example, by welding, fasteners, mechanical engagement, adhesives. The screen 90 can be made of any material. The screen 90 can be flat, or it can include one or more raised areas. Ideally, the mesh of the screen 90 is sufficiently sized to deter animals from drinking the water 24 from the collection cup 20 while not substantially interfering with water entry and accumulation in the cup 20.

The components of the system can be located in various places. For instance, some of the components can be located above or below ground in or near the area to be
watered. In such case, the conductors 52 of the circuit 38, such as the conductors connecting between the motor 42 and the height switches 34, can extend across a yard or can be routed underground.

[0076] Alternatively or in addition, at least some of the components of the system can be provided inside a housing 66. In one embodiment, all of the system components can be consolidated within the housing 66, as shown in FIG. 2. When the collection cup 20 is provided inside of the housing 66, the housing 66 can include an open top 68 to allow water to enter the collection cup 20. At least some of the individual components of the system can be mounted to the housing 66. For instance, the height switches 34 can be mounted inside the housing 66 at different elevations. Some of the individual components of the system can reside in the housing 66 without being attached to the housing 66. The on/off user knob 64 and the selector user knob 40 can be provided on the outside of the housing 66, as shown in FIG. 3. Further, the housing 66 can include exterior markings 70 to designate switch positions. The housing 66 can also provide connectors 72 adapted to attach to hoses, liquid conduits or the water dispensing device 10. The connectors 72 can be connected to the valve 18. Alternatively, the housing 66 can include openings to allow hoses, liquid conduits or the water dispensing device 10 to be routed inside of the housing 66 and/or to connect to any of the components inside of the housing 66, such as the valve 18.

[0077] The housing 66 can be made of any of a number of materials. Preferably, the housing 66 is made of a durable non-corrosive material like plastic. Such an arrangement is well suited for instances in which a user intends on using the system 16 in various locations and/or applications.

[0078] Having described the individual components of the system according to aspects of the invention, one example of the operation of such a system according to aspects of the invention will now be described. For purposes of discussion, the example will concern a user interested in watering a lawn. Further, it will be assumed that the water dispensing device, such as a sprinkler, is provided in a single housing. In addition, the system 16 has four height switches 34a, 34b, 34c, 34d provided at approximately ½, 1, 1½ and 2 inches, respectively.

[0079] The user can connect a first hose 74 between the water source 12 and the valve 18. Next, the user can connect a second hose 76 from the valve 18 to the water dispensing device 10. The system 16 can be positioned within the range of the water dispensing device 10 to collect water exiting the device 10.

[0080] Using the provided knob 40, the user can move the selector 36 to the indicated position of the desired level of water. It will also be assumed that the user has selected 1 inch. Next, the user can turn the on/off knob 64 to the “on” position. Thus, the valve gear 48 is turned to the on position, which opens the valve 18 and closes the motor end switch 54 by way of the actuator portion 56. At this point, the circuit 38 is only interrupted by the height switches 34 being open. The user can open the water faucet to allow water to flow to the water dispensing device 10 to begin irrigating the lawn.

[0081] As noted earlier, the system 16 including the water collection cup 20 is placed in the range of the water dispensing device 10. Thus, a portion of the water 24 exiting the dispensing device 10 can fall into and collect in the cup 20. As water 24 accumulates in the cup 20, the float 26 can begin to rise. After about ½ inch of water 24 accumulates, the magnetic portion of the float 26 can pass sufficiently close to the first switch 34a such that the first switch closes 34a under the influence of the magnetic field. But, because of the user settings, the first switch 34a does not form a part of the motor activation circuit 38 and the motor activation circuit remains 38 open. As a result, the motor 42 remains inactive. When the water 24 in the cup accumulates to about 1 inch, the magnetic portion of the float 26 can sufficiently proximate the second switch 34b such that the magnetic field closes the second switch 34b. As a result, the circuit 38 is completed because the second switch 34b is the remaining open component of the circuit 38.

[0082] With the circuit 38 activated, current can flow from the power source 50 to the motor 42. The rotation of the motor shaft 44 can turn the motor gear 46. The motor gear 46 can directly or indirectly turn the valve gear 48, which can turn the valve 18. When the valve 18 is moved into the closed position, water flow to the water dispensing device 10 is substantially restricted. In addition, the turning of the valve gear 48 moves the actuator portion 56 such that the motor end switch opens 54, thereby causing an open circuit condition and deactivating the motor 42. Thus, it will be appreciated that once the irrigation process has begun, the user does not need to constantly or even periodically monitor the watering, freeing time to attend to other tasks.

[0083] It will be appreciated that the system 16 according to aspects of the invention can take into account any water in the soil due to recent rainfall. For example, if the system 16 was in a yard during a rainfall, then collection cup 20 would accumulate rain water. If a user wishes to water the lawn shortly after the rain, the user can simply operate the system 16 as outlined above, leaving the rain water in the collection cup 20. Thus, the water deposited by the recent rain will be taken into account by the system 16.

[0084] It should be noted that many liquid dispensing systems include an automated timer like in a conventional home watering system. Embodiments of the invention can be used in connection such timer-based systems. FIG. 11A shows an example of a conventional watering system 100. A timer 102 can be disposed anywhere between the fluid source 12 and the water dispensing device 10. For example, the timer 102 can be disposed along a hose 14 or other fluid conduit connecting the fluid source 12 and the water dispensing device 10 in fluid communication. Alternatively, the timer 102 can be directly attached to one of the fluid source 12 and the water dispensing device 10.

[0085] The timer 102 can include a controller 104 and a valve 106. The controller 104 can be operatively associated with the valve 106 and can control the opening and closing of the valve 106. The controller 104 can be electronic or mechanical, and the controller 104 can be programmed by a user for the desired operation. Thus, when instructed, the controller 104 can open the valve 106 and allow water to flow from the source 12 to the water dispensing device 10. It should be noted that most timers 102 are adapted to only measure time with respect to the day and time of when to water and the duration of the watering. Few timers 102 are adapted to account for any recent watering by, for example,
a natural rainfall. As a result, such timer-based systems would water a lawn even during or shortly after a natural rainfall.

[0086] Such unnecessary watering that occurs in some timer-based systems can be minimized or prevented by embodiments of the system 16 according to aspects of the invention. FIG. 11B shows a general arrangement of a system 16 according to aspects of the invention used in combination with a conventional timer-based watering system 100. The system 16 can be positioned downstream of the timer 102. After a recent watering, the system 16 according to aspects of the invention would have already collected water in the collection cup 20 and closed the valve 18, as already described above. Thus, it will be appreciated that even if the controller 104 opens the timer valve 106, the system valve 18 is closed, thereby substantially restricting water flow to the water dispensing device 10.

[0087] The foregoing description is provided in the context of various possible liquid measurement systems. It will be appreciated that aspects of the invention can be applied in connection with various applications. It will of course be understood that the invention is not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the invention as defined in the following claims.

What is claimed is:

1. A system comprising:
   a collection cup for receiving a liquid;
   a float provided within the collection cup, at least a portion of the float being magnetic and having an associated magnetic field;
   a power source;
   an open first switch positioned proximate the collection cup, the switch being operatively connected to the power source, the switch being closable under the influence of a magnetic field; and
   a motor operatively connected to the power source and the switch,

   wherein the float rises as a liquid accumulates in the collection cup, wherein the switch closes when the magnetic field of the float approaches sufficiently near the switch, whereby an electrical circuit is completed and the motor is activated.

2. The system of claim 1 wherein at least one of the cup, the float, the power source, the switch and the motor is provided within a housing.

3. The system of claim 1 further including:
   an open second switch disposed at a different elevation relative to the first switch; and
   a selector operatively connected to the first and second switches, wherein the selector selectively determines which of the first and second switches is operatively connected to the power source and the motor to form an electrical circuit.

4. The system of claim 3 wherein the first and second switches are substantially vertically aligned.

5. The system of claim 1 further including:
   a fluid conduit; and
   a valve provided along the fluid conduit, the valve being movable between an open position in which flow through the fluid conduit is substantially permitted and a closed position in which flow through the fluid conduit is substantially restricted, wherein the motor operatively engages the valve to move the valve between open and closed positions.

6. The system of claim 5 wherein the motor operatively engages the valve by a plurality of gears.

7. The system of claim 6 further including a motor end switch operatively connected between the power source and the first and second switch, wherein the motor end switch is operatively associated with one of the plurality of gears such that when the valve is moved into the closed position, the motor end switch opens, thereby deactivating the motor.

8. The system of claim 1 wherein the position of the first switch is adjustable in the substantially vertical direction.

9. A system comprising:
   a liquid dispensing device, the liquid dispensing device having an associated area of coverage over which liquid is deposited;
   a collection cup for receiving a liquid, wherein the collection cup is positioned in the area of coverage;
   a float provided within the collection cup, at least a portion of the float being magnetic so as to exert a magnetic field;
   a power source;
   a motor operatively connected to the power source;
   a plurality of open switches positioned proximate the collection cup, wherein each switch is disposed at a different elevation relative to the other switches, wherein each of the switches is closable under the influence of a magnetic field; and
   a selector operatively connected to the plurality of switches, wherein the selector is movable to select one of the plurality switches to operatively connected to the power source and the motor so as to form an electrical circuit,

   wherein the float rises as a liquid from the liquid dispensing device accumulates in the collection cup, wherein the selected one of the plurality of switches closes when the magnetic field of the float approaches sufficiently near the switch, whereby the electrical circuit is completed and the motor is activated.

10. The system of claim 9 wherein the liquid dispensing device is one of a sprinkler, a sprayer, a mister or an irrigation tool.

11. The system of claim 9 wherein the float includes a magnet attached thereto.

12. The system of claim 9 wherein the plurality of switches includes at least three switches.

13. The system of claim 12 wherein the plurality of switches are spaced substantially equally apart.

14. The system of claim 12 wherein at least one of the plurality of switches is spaced unequally apart from the other switches.
15. The system of claim 9 wherein the plurality of switches are substantially vertically aligned.

16. The system of claim 9 wherein the collection cup, the float, the power source, the motor and the plurality of switches are provided within a housing.

17. The system of claim 9 wherein the power source is at least one battery.

18. The system of claim 9 further including:
   a fluid conduit connected to the liquid dispensing device, whereby the fluid conduit delivers liquid to the liquid dispensing device; and
   a valve disposed along the fluid conduit, the valve being movable between an open position in which liquid flow through the fluid conduit is substantially permitted and a closed position in which liquid flow through the fluid conduit is substantially restricted, wherein the motor operatively engages the valve such that, when activated, the motor moves the valve to the closed position.

19. The system of claim 18 further including:
   a valve gear operatively associated with the valve such that rotation of the valve gear moves the valve between open and closed positions; and
   a motor gear operatively associated with the motor, wherein the motor gear operatively engages the valve gear such that rotation of the motor gear is transmitted to the valve gear.

20. The system of claim 19 further including:
   a motor end switch operatively connected between the power source and the selected one of the plurality of switches, wherein the motor end switch operatively engages the valve gear such that when the valve is moved into the closed position, the motor end switch opens, thereby deactivating the motor.

21. The system of claim 18 further including a timer disposed along the fluid conduit and upstream of the valve.

22. The system of claim 9 wherein the position of at least one of the plurality of switches is adjustable in the substantially vertical direction.

23. The system of claim 9 further including a screen disposed above the collection cup.

24. A system comprising:
   a water source;
   a water dispensing device, the water dispensing device having an associated area of coverage over which water is deposited;
   a fluid conduit connecting the water source and the water dispensing device in fluid communication;
   a valve disposed along the fluid conduit, the valve being movable between an open position in which flow through the fluid conduit is substantially permitted and a closed position in which flow through the fluid conduit is substantially restricted;
   a valve gear operatively associated with the valve such that rotation of the valve gear moves the valve between open and closed positions;
   a collection cup for receiving a liquid, wherein the collection cup is positioned in the area
   a collection cup for receiving a liquid, wherein the collection cup is positioned in the area of coverage;
   a float provided within the collection cup, the float being buoyant in water, wherein at least a portion of the float being magnetic and having an associated magnetic field;
   a power source;
   a motor operatively connected to the power source, the motor having a rotatable shaft;
   a motor gear attached to the motor shaft, wherein the motor gear operatively engages the valve gear such that rotation of the motor gear is transmitted to the valve gear.
   a plurality of open switches positioned proximate the collection cup, wherein each switch is disposed at a different elevation relative to the other switches, wherein each of the switches is closable under the influence of a magnetic field; and
   a selector operatively connected to the plurality of switches, wherein the selector is movable to select one of the plurality switches to be operatively connected to the power source and the motor so as to form an electrical circuit, wherein the float rises as water from the water dispensing device accumulates in the collection cup, wherein the selected one of the plurality of switches closes when the magnetic field of the float approaches sufficiently near the switch, thereby completing the electrical circuit to activate the motor, wherein the motor moves the valve to the closed position by way of the gears.

25. The system of claim 24 further including a motor end switch operatively connected between the power source and the selected one of the plurality of switches, wherein the motor end switch operatively engages the valve gear such that when the valve is moved into the closed position, the motor end switch opens, thereby deactivating the motor.

26. The system of claim 24 wherein the valve, the collection cup, the float, the power source, the plurality of switches, and the selector are provided within a housing.

27. The system of claim 24 further including a screen disposed above the collection cup.

28. The system of claim 27 wherein the screen is attached to the housing.

29. The system of claim 24 wherein the position of at least one of the plurality of switches is adjustable in the substantially vertical direction.

30. The system of claim 24 further including a timer disposed along the fluid conduit between the fluid source and the valve.