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(54) **LIQUID CONTROL STRUCTURE**

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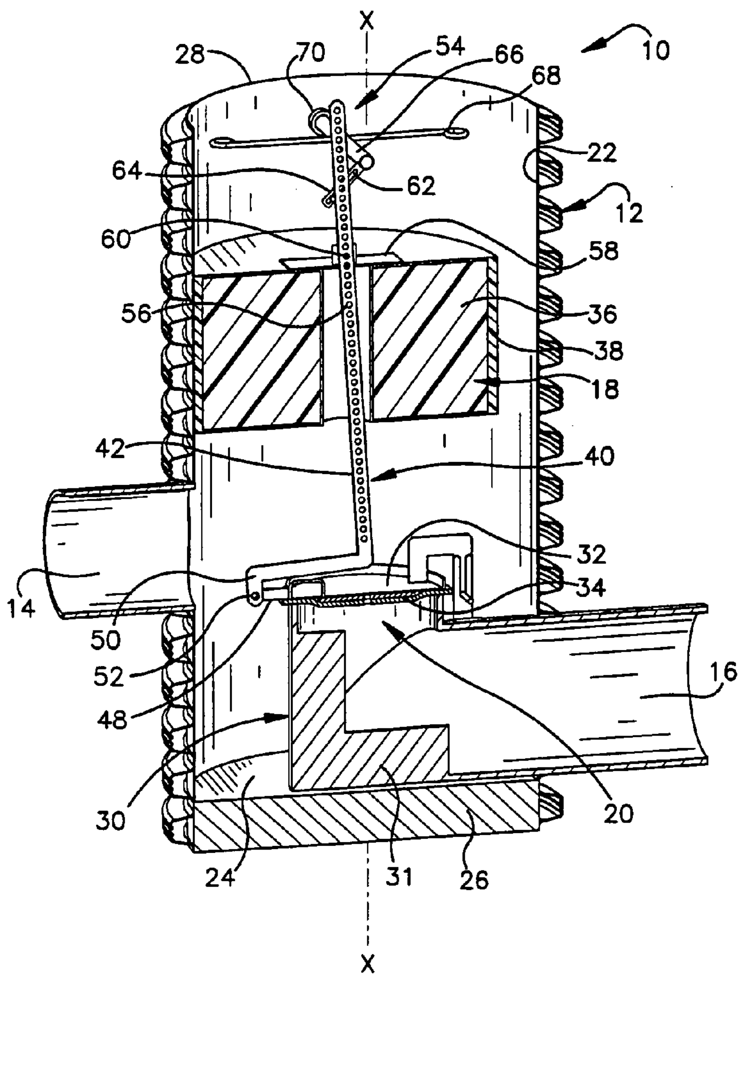
(57) **ABSTRACT**

A flow control structure is provided for the selective control of a liquid flow from an external body of liquid or for liquid and/or solid separation. The flow control structure includes a container, a float, and a valve. The container has an inlet, an outlet, and a closed bottom surface. The float is buoyantly positioned within the container and rises and falls in response to the level of liquid in the container. A valve is positioned inside the container and is coupled to the float by a linkage so that the valve opens when the float rises above a preselected height and the valve closes when the float falls to the preselected height within the container. The length of the linkage between the valve and the float determines the height of liquid required to open the valve. The valve may be positioned at an angle relative to the horizontal.



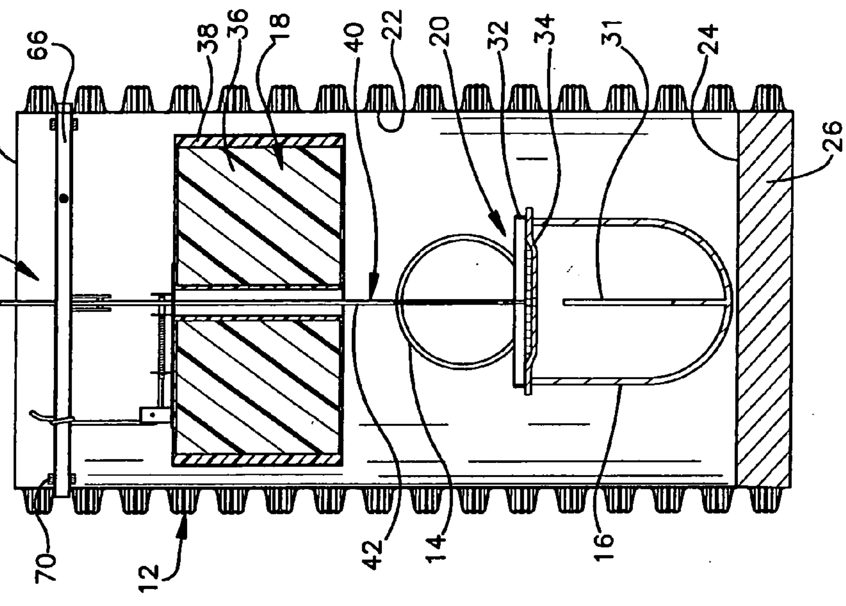

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Fig.2

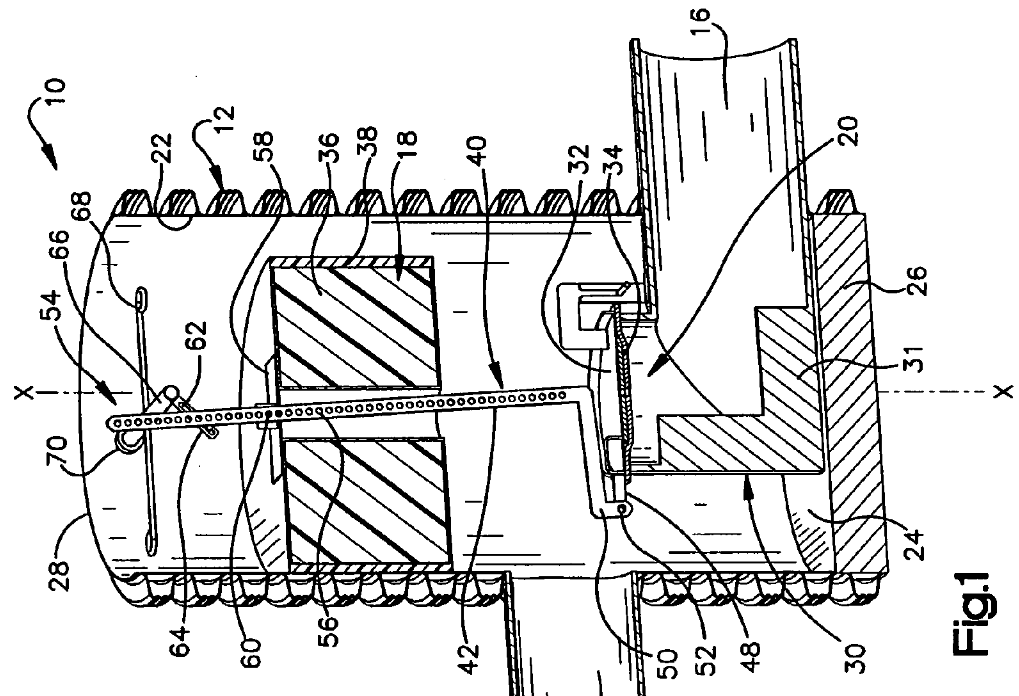
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Fig.1

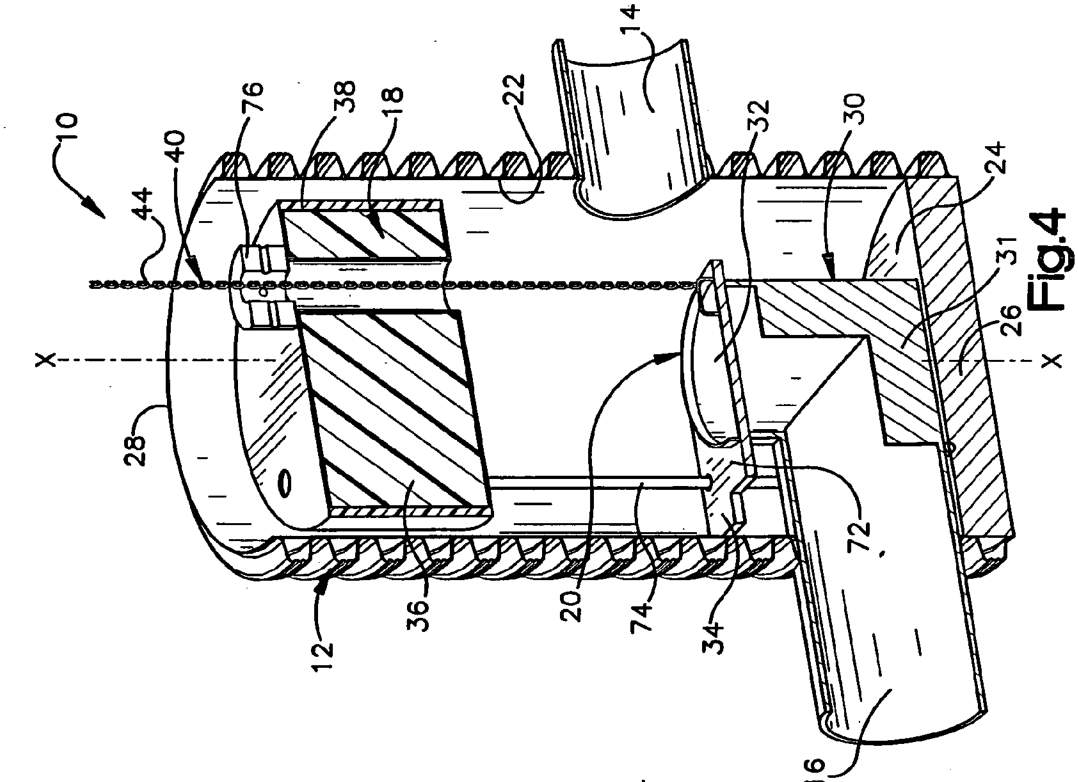
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Fig.4

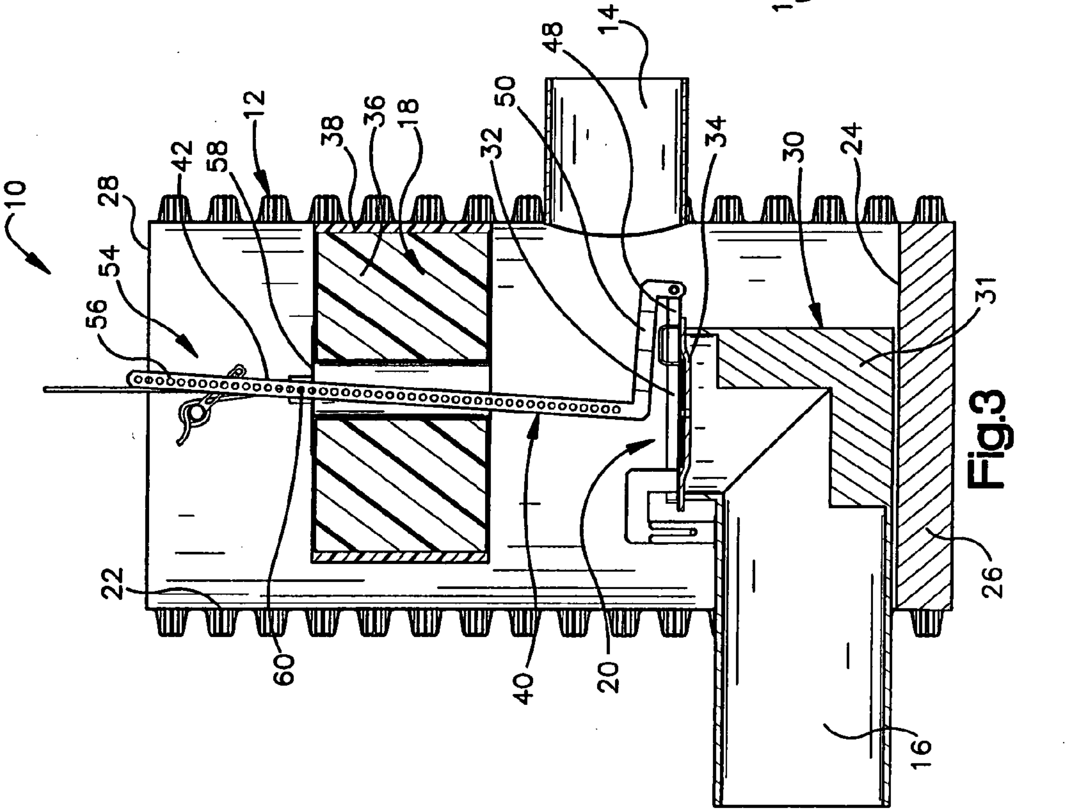
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Fig.3

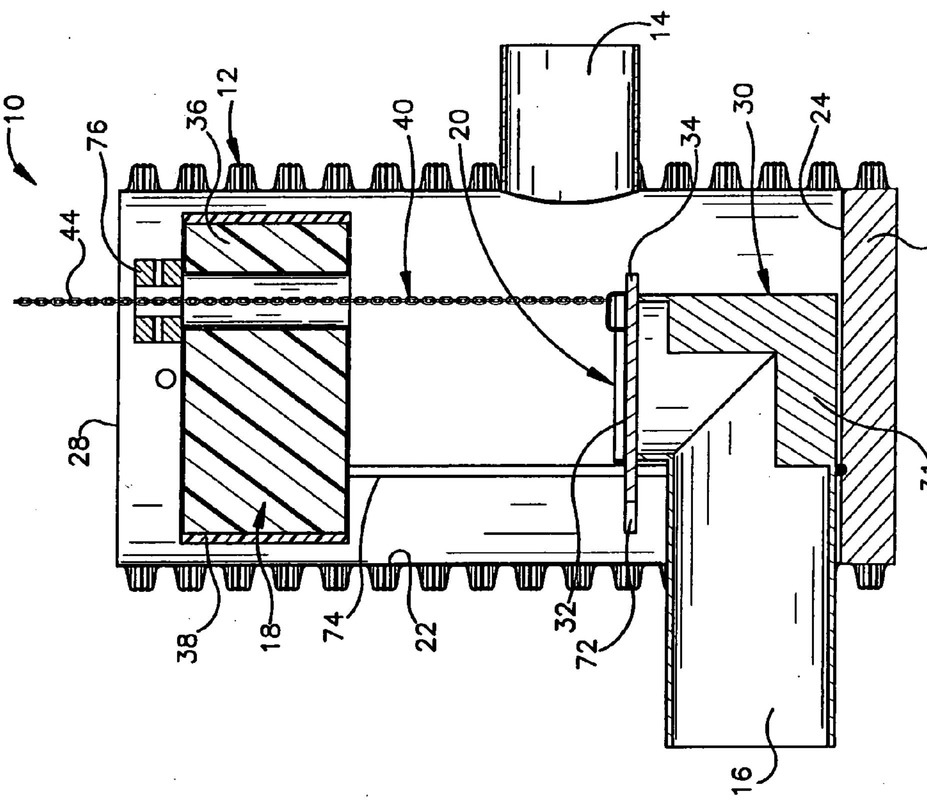
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Fig.6

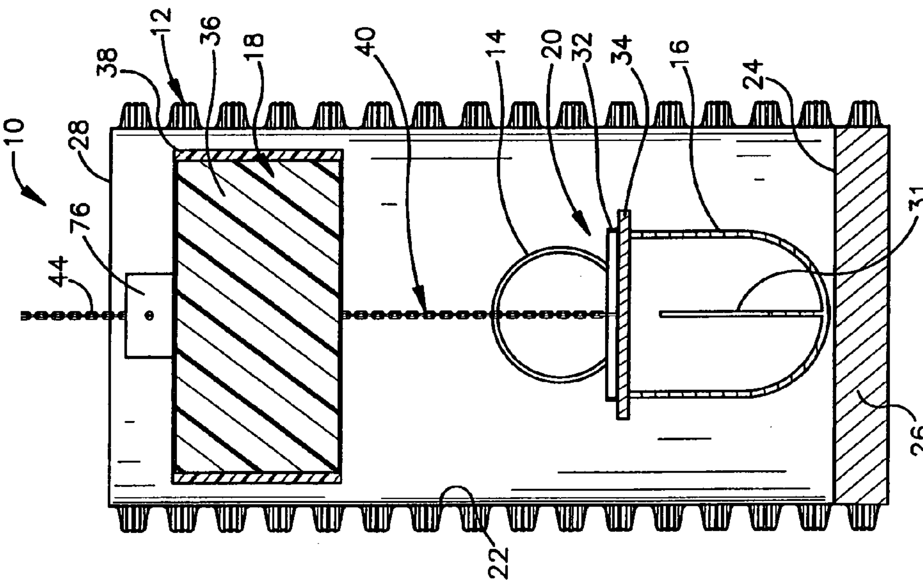
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Fig.5

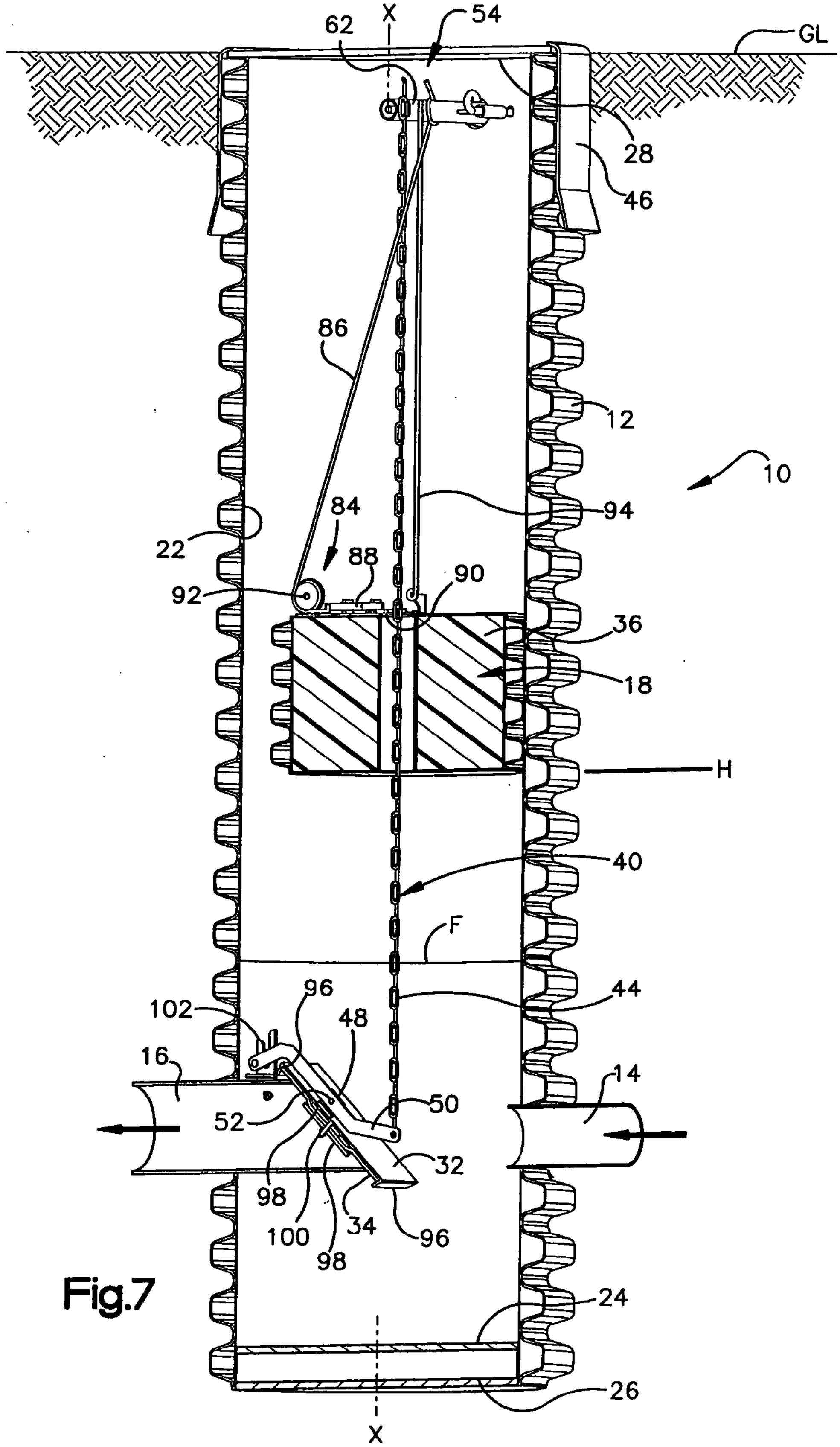
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Fig.7

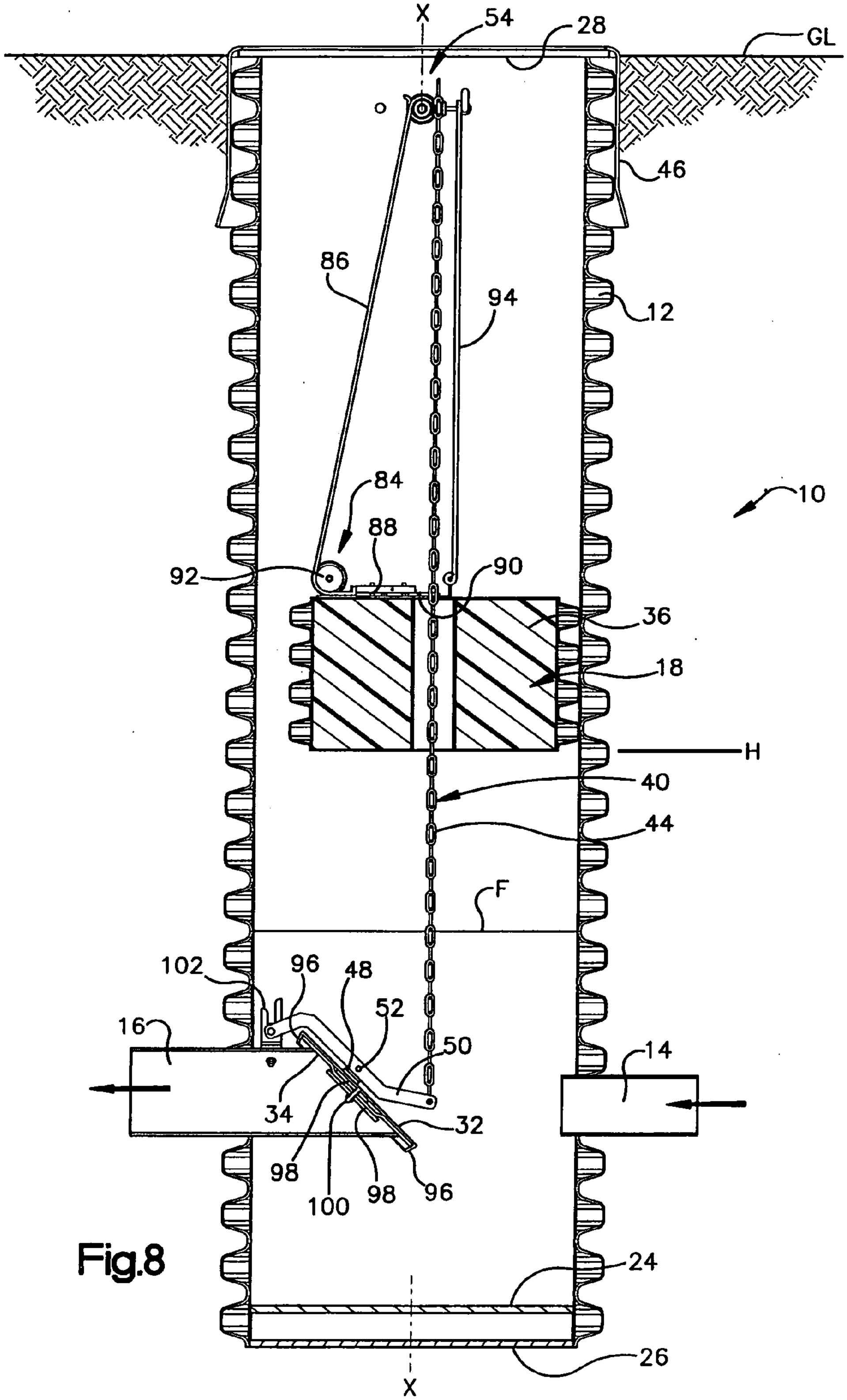
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Fig.8

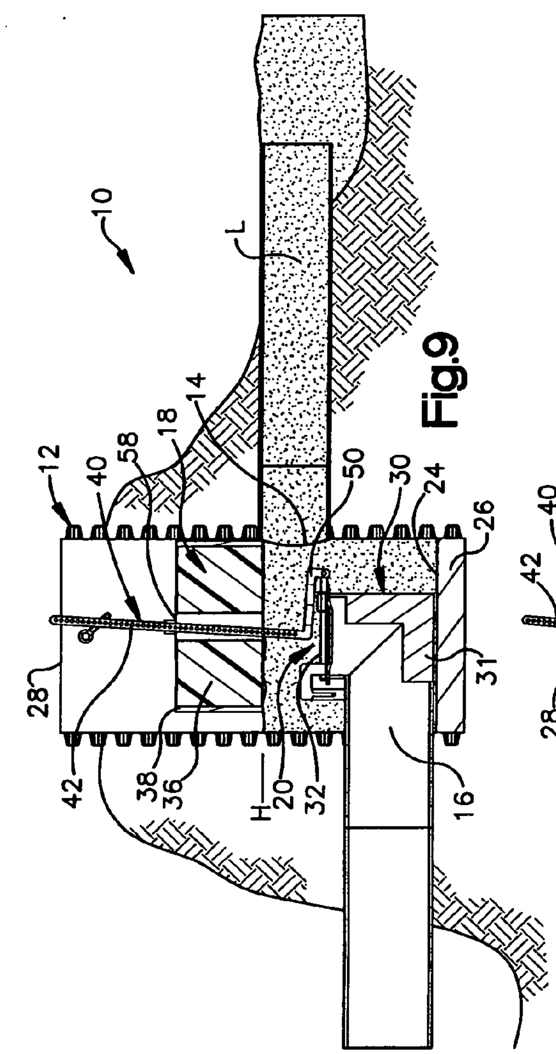
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Fig.9

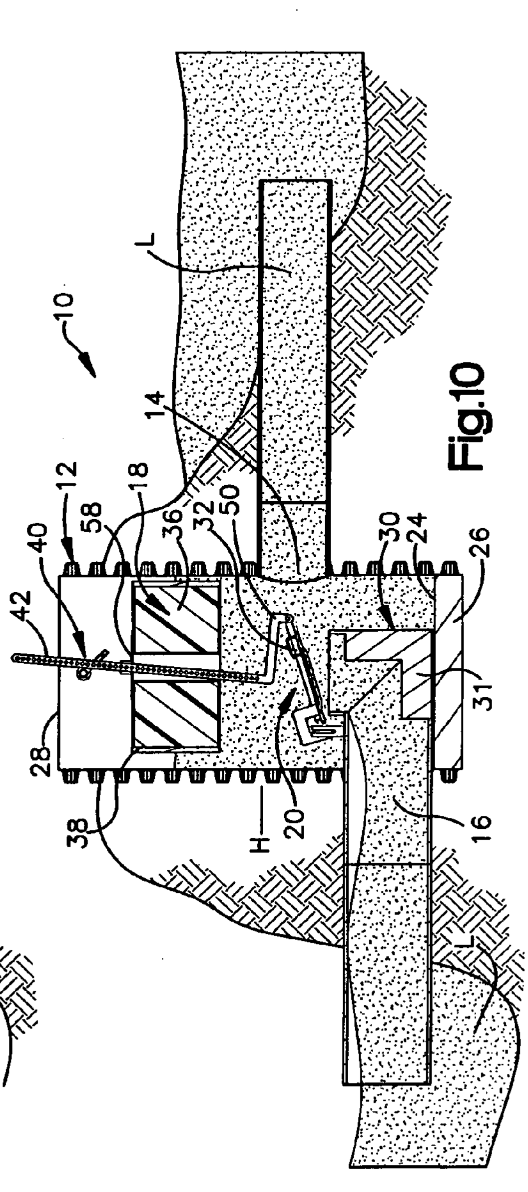
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Fig.10

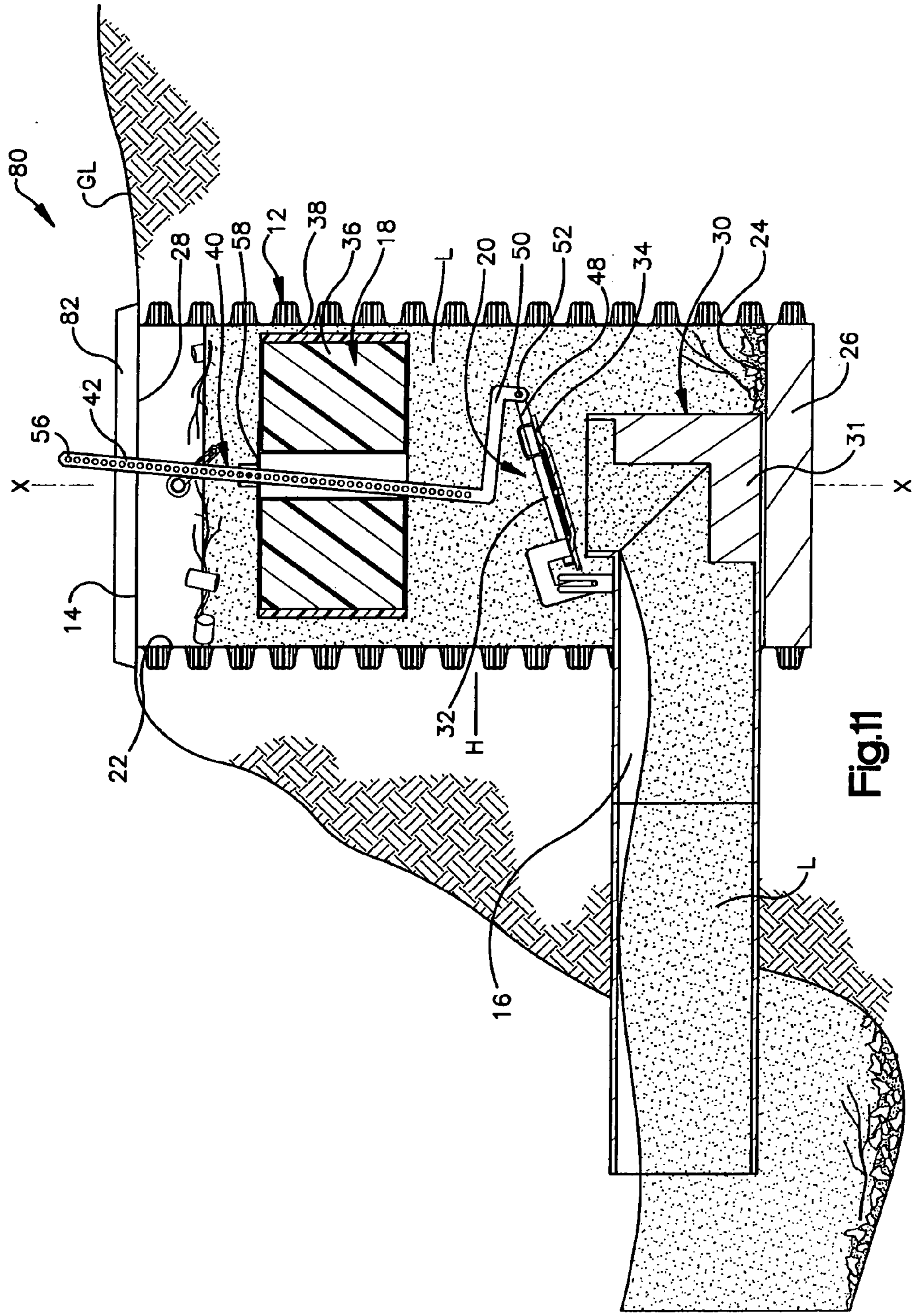
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Fig.11

LIQUID CONTROL STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 60/491,396, filed Jul. 31, 2003.

FIELD OF THE INVENTION

[0002] The present invention relates to a liquid control structure for controlling liquid flow from an external body of liquid. The invention also concerns a liquid control structure that is utilized as a separator of liquids and/or solids from a base liquid.

BACKGROUND

[0003] Liquid control structures are used in environmental settings to control the level and/or direction of a flow of an external body of liquid for purposes such as irrigation, drainage, water level control in wetlands, and water quality control. Such structures typically utilize a riser having an inlet and an outlet. Water collects in the riser. When the water reaches a certain height within the riser, it is allowed to exit the riser through the outlet. Prior devices, for example, use dams in the form of weir segments positioned inside the riser. The weir segments are horizontally positioned between the inlet and outlet. Once water reaches the top of the weir segments, it is allowed to flow over the segments to exit the riser. The height of the outlet or weir segments is utilized to establish a water table height within the associated field, or body of water.

[0004] Liquid control structures are also utilized to separate solids and liquids from water. Environmental Executive Order 13148, defined as "Greening the Government Through Leadership in Environmental Management," addresses the United States government's need for environmental devices that may be utilized as separators. It is desirable to separate solid debris from the liquid flow, including such substances as silt, rocks, and sticks. It is also desirable to separate liquids from other liquids. For example, flow control structures may be utilized to separate oil from water.

SUMMARY

[0005] In a first embodiment of the invention, a device for the selective control of a liquid flow from an external body of liquid or liquid and/or solid separation includes a container, a float, and a valve. The container has an inlet for the intake of a liquid into the container from an external body of liquid, an outlet for the discharge of the liquid from the container, and a closed bottom surface. The float is buoyantly positioned within the container and configured to rise and fall in response to the level of liquid within the container. The valve is positioned inside the container in association with the outlet. The valve is coupled to the float such that the valve opens when the float rises above a preselected height within the container and the valve closes when the float falls to the preselected height within the container. The distance between the float and the valve when the float is positioned at the preselected height determines a height of liquid required to open the valve.

[0006] In another embodiment, a flow control device comprises a riser, a float and a valve. The riser has an inlet for the intake of a fluid, an outlet for the exit of a fluid, and a closed bottom surface. The float is positioned inside the riser and configured to travel in response to a fluid level in the riser. The valve is positioned inside the riser and is coupled to the float. The valve is movably response to the travel of the float and is coupled to the outlet. The valve is oriented at an angle relative to horizontal.

[0007] In another embodiment, a method for controlling liquid flow from an external body of liquid includes providing a container having an inlet and an outlet within the container, disposing a valve between the inlet and the outlet, and coupling a float to the valve. The float is buoyantly responsive to liquid that enters the container such that the valve opens when the float rises above a preselected height within the container and the valve closes when the float sinks to the preselected height within the container. The distance between the float and the valve when the float is positioned at the preselected height determines a height of liquid required to open the valve. A method for separating liquids and/or solids from a base liquid is also provided.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0008] **FIG. 1** is a perspective cross-sectional view of a first embodiment of a liquid control structure according to the invention;

[0009] **FIG. 2** is a cross-sectional view of the structure of **FIG. 1** taken at a position that is rotated 90° relative to the view shown in **FIG. 1**;

[0010] **FIG. 3** is a cross-sectional view of the structure of **FIG. 1** taken at a position that is rotated 180° relative to the view shown in **FIG. 1**;

[0011] **FIG. 4** is a perspective cross-sectional view of a second embodiment of a liquid control structure according to the invention;

[0012] **FIG. 5** is a cross-sectional view of the structure of **FIG. 4** taken at a position that is rotated 90° relative to the view shown in **FIG. 4**;

[0013] **FIG. 6** is a cross-sectional view of the structure of **FIG. 4**;

[0014] **FIG. 7** is a perspective cross-sectional view of another embodiment of a liquid control structure according to the invention;

[0015] **FIG. 8** is a cross-sectional view of the structure of **FIG. 7**;

[0016] **FIG. 9** is a cross-sectional view of the structure of **FIG. 1** in operation showing the valve in a closed position;

[0017] **FIG. 10** is a cross-sectional view similar to that of **FIG. 9**, but with the valve in an open position; and

[0018] **FIG. 11** is another embodiment of the flow control structure according to the invention shown with the valve in an open position, with solid debris floating on the surface of the liquid inside the structure and solid debris resting on the bottom of the structure.

DETAILED DESCRIPTION

[0019] Referring to **FIGS. 1-8**, the flow control structure **10** of the invention includes a container **12**, an inlet **14**, an outlet **16**, a float **18**, and a valve **20** positioned inside the container **12**. The valve **20** is positioned adjacent the outlet **16** to control flow from the container **12**. The flow control structure **10** may be used to control the level of liquid and/or the direction of flow of a liquid for irrigation, drainage, wetlands, leach fields, septic systems, or water quality purposes. The flow control structure **10** may also be used to separate oil, gases, and suspended solids from a base liquid, slurries, and sludge. Applications include onsite waste management and highway drainage, among others.

[**0020**] The flow control structure **10** described herein accomplishes the functions of a water control gate, stop valve, valve structure, gate valve, oil/water separator, and other structures that provide water level control for wetlands, drainage, and irrigation applications. For example, the structure **10** may be used as a water control gate for maintaining the water level of a field or an animal feed lot. This is advantageous, for example, for reducing nitrate release into the ground water. Nitrates are found in such things as animal waste and fertilizers. They serve to fertilize soil and are useful for agricultural purposes. Nitrates are very soluble. As a result, they may easily flow into ground water. Elevated nitrate levels in ground water may pose a risk to human health. Water control gates are used to maintain the water level in the ground instead of allowing water, and the dissolved nitrates, to flow into the water supply.

[**0021**] The term liquid, as used herein, refers to a fluid that may or may not have suspended therein oils, gases, solids, chemicals and nutrients. The term liquid, as used herein, also may include more than one type of liquid, such as liquids having differing densities or compositions that are combined together in a solution. A liquid will typically include a base liquid, such as water. Additions to the base liquid may include silt, oil, debris, or other materials.

[**0022**] The container **12** of the invention, which is also known as a riser **12**, is typically buried in the ground. The riser **12** includes a side wall **22**, a bottom inner surface **24**, a floor support structure **26**, and a top opening **28**. The top opening **28** of the riser **12** is positioned at ground level GL and the container **12** extends downwardly into the ground such that a longitudinal axis X-X of the container **12** is preferably perpendicular to the ground surface. The shape and or orientation may vary from the structures **10** shown in the drawings, the invention not being limited to the shapes or orientations shown.

[**0023**] The inlet **14** of the riser **12** is connected to an external body of liquid. Depending upon the application, the external body of liquid may be a pond or lake, or underground piping associated with a wetland or field, among other external bodies of liquid. In the embodiments shown in **FIGS. 1-8**, the inlet **14** is in the form of a pipe that is associated with an external body of liquid at one end and the container **12** at the other. The inlet may alternatively be associated with a conduit that has any type of desired cross-section.

[**0024**] The riser **12** serves as a storage container for liquid that enters through the inlet **14**. Liquid that enters the riser **12** first falls against the bottom surface **24** of the riser **12** and collects within the riser **12** until it is allowed to exit through the outlet **16**.

[**0025**] The outlet **16** of the riser **12** is also a pipe that is positioned inside the container **12** at one end and extends outwardly from the container **12** at the other end. The outlet pipe **16** may extend to a stream or other run off, such as a leaching field. As shown in **FIGS. 1-6**, the outlet pipe **16** includes an elbow **30** at the container end. A preferred elbow **30** has a bend of about 90°. The elbow **30** is positioned inside the riser **12** and the opening of the elbow **30** faces upwardly. In a preferred embodiment, a vortex plate **31** is positioned in the outlet **16** and serves to break up any vortices that are formed in the output flow as liquid enters the outlet **16**. The outlet **16** shown in **FIGS. 7 and 8** is a pipe that extends into the riser **12**. It does not utilize an elbow or a vortex plate. While the outlet **16** is depicted as being associated with a round pipe, it may alternatively be associated with a conduit that has any type of desired cross-section.

[**0026**] The inlet **14** and outlet **16** of the riser **12** are preferably positioned at a height that is above the height of the bottom surface **24** of the riser **12**. By having the height of the inlet **14** and outlet **16** elevated above the bottom surface **24**, solids or liquids having a density that is greater than the density of the base liquid may sink to the bottom surface **24** of the riser **12** and solids or liquids having a density that is less than the density of the base liquid may rise to the top of the base liquid.

[**0027**] The inlet **14** and outlet **16** pipes are shown in the figures as having a different diameter. It is preferred that the outlet **16** have a cross-sectional dimension, such as a diameter, that is larger than that of the inlet **14** in order to allow the riser **12** to drain properly and to close the valve **20** once drained. However, there may be instances where it is desirable to have an inlet **14** and outlet **16** that are the same dimension.

[**0028**] A valve **20** is coupled to the outlet **16** within the riser **12**. In a preferred embodiment, the valve **20** is a flapper valve that is hinged at one side and opens at the other. In **FIGS. 1-6**, the flapper valve **20** is positioned over the opening that forms the outlet **16** in the elbow **30**. In **FIGS. 7-8**, which do not utilize an elbow, the flapper valve **20** is positioned over the pipe opening **16**. The opening is preferably open and free of obstructions such that liquid may freely flow into the outlet **16** once the flapper valve **20** is opened.

[**0029**] In a preferred embodiment, as shown in **FIGS. 1-8**, the flapper valve **20** includes a top plate **32** and a flexible seal **34** that is attached to the top plate **32**. The flapper valve **20** is shown installed in a horizontal orientation in **FIGS. 1-6** and at a 45° angle relative to horizontal in **FIGS. 7 and 8**. As shown, the flapper valve **20** may be oriented at an angle other than horizontal, such as at an angle of about 0° to 60° relative to the horizontal. In a preferred embodiment, the flapper valve **20** is oriented at an angle of 35° to 55° relative to the horizontal. All of these orientations are referred to herein as recumbent.

[**0030**] The valve **20** is coupled to a float **18** that is positioned above the valve **20**. The float **18** has a buoyancy that is the same as that of air and is responsive to liquid level within the riser **12**. In a preferred embodiment, the float **18** includes a closed cell inner foam core **36** and a plastic outer liner **38** that is sealed around the inner foam core **36**. A preferred type of material for the foam core **36** is polystyrene, although other types of foam or materials may also be used. Other types of floats may also be utilized, the invention not being limited to a particular type of float. For example, the float may be formed of a pipe section that is filled with foam (not shown).

[0031] In a preferred embodiment, the float **18** has a sliding fit in relation to the inner wall surface **14** of the container **12**. In designing the float **18**, it is important to provide a float that has a buoyancy sufficient to raise the flapper valve, taking into account the head pressure applied to the valve **20** by the liquid in the riser **12**.

[0032] As the liquid level in the riser **12** increases, the vertical position of the float **18** rises within the riser **12**. As the liquid level in the riser **12** decreases, the vertical position of the float **18** within the riser **12** falls. The position of the valve **20** is tied to the position of the float **18** via a linkage **40** between the valve **20** and the float **18**. The valve **20** opens when the float **18** rises above a preselected height H and the valve **20** closes when the float **18** falls to the preselected height H within the container **12**.

[0033] The linkage **40** between the float **18** and the valve **20** may be rigid, such as the bar **42** shown in **FIGS. 1-3**. Alternatively, the linkage **40** may be flexible, such as the chain **44** shown in **FIGS. 4-8**. Other types of linkages may also be utilized such as a rope, a cord, or a flexible bar, among other types of linkages. The linkage connects the valve **20** to the float **18** and the length of the linkage **40** is adjustable based upon the liquid level desired within the riser **12** before the valve **20** opens. The length of the linkage **40** between the float **18** and the valve **20** determines a height of the liquid required inside the riser **12** before the valve **20** will open.

[0034] A head pressure is applied to the valve **20** as the liquid level rises in the riser **12**. The amount of pressure that is applied to the valve **20** may be adjusted by adjusting the float **18** height via the linkage length. The length of the linkage **40** may be adjusted, for example, with the use of a chain latching mechanism **84**, an example of which is shown best in **FIGS. 7 and 8**. The chain latching mechanism **84** is positioned on top of the float **18** and includes a first cord **86** that is coupled to a latch **88**. The latch **88** includes an engaging part **90** for engaging the chain **44**. One end of the first cord **86** extends around a pulley **92** and is connected to the latch **88**. The other end of the first cord **86** may be tied off around the winch arm **62**. The latch **88** has an engaged position and an unengaged position, which are determined based upon a pulling force applied by the first cord **86** and a spring (not shown) positioned inside the latch **88** which biases the engaging part **90** into engagement with the chain **44**. When the first cord **86** is pulled by a user, the engaging part **90** of the latch **88** disengages from the chain **44**. When the first cord **86** is released, the latch engaging part **90** is biased by the spring within the latch **88** to engage the chain **44**.

[0035] The position of the float **18** at height H may be set by pulling on a second cord **94** that is attached to the top of the float **18**. The second cord **94** is secured around the winch arm **62** at the top of the riser **12**. In order to position the float **18** at a desired height H, the user pulls up on the first cord **86** to disengage the latch **88**. The user then pulls on the second cord **94** to move the float **18** to a desired position. When the float **18** is at the desired position, the first cord **86** is released to engage the chain **44**. Preferably, during this process, the chain **44** remains taut.

[0036] In operation, liquid enters the riser **12** through the inlet **14**. As the liquid level in the riser **12** increases, the float **18** rises with the level of liquid. When the float **18** rises above a preselected height H, force applied from the linkage **40** pulls the valve **20** open to release the flow of liquid to the outlet **16**. When used as a separator, the materials in the liquid that have a density greater than the density of the base liquid sink to the bottom surface **24** of the riser. These materials may include both solids and liquids. The solids and liquids having a density less than that of the base liquid rise to the top of the base liquid. These materials may also include solids and liquids. In the embodiments shown in **FIGS. 1-10**, the top opening **28** of the container **12** is closed with a cap **46** that is positioned at or near ground level GL. The cap **46** may be removed in order to clean the riser **12** of any sediments that sink to the bottom or debris that floats on the base liquid. In addition, the user may remove liquids, such as oil that float on top of the base liquid, or suction out liquids that sink below the base liquid.

[0037] **FIGS. 1-3** show a first embodiment of the invention where the flapper valve **20** utilizes a mechanical hinge and the linkage **40** between the valve **20** and the float **18** is a rigid bar **42**. The valve **20** includes a flexible seal **34** that is attached to a top plate **32**, as previously discussed. In a preferred embodiment, the top plate **32** is made of a rigid material, such as stainless steel. Other materials may also be utilized as long as the materials can withstand the force of the liquid in the riser **12** and operate properly. It is preferred, however, that any materials used be corrosion resistant. The top plate **32** may have ribs (not shown) to help support the flexible seal **34**, if so desired. A gasket (not shown) may be provided at the outlet **16**, if so desired, and the flexible seal **34** may seat against the gasket in a conventional manner to provide extra sealing power when the valve **20** is closed.

[0038] In **FIGS. 1-3**, the top plate **32** is attached to a top plate attachment arm **48**, which is attached to a valve control lever **50** via a valve control lever pin **52**. The valve control lever **50** extends from the valve **20**, through the float **18** and to a winch assembly **54** positioned near the top **28** of the riser **12**. The valve control lever **50** is utilized to open and close the valve **20** in response to the movement of the float **18**.

[0039] The valve control lever **50** includes a series of adjustment holes **56**, which allow the lever length, and hence the distance between the valve **20** and the float **18**, to be adjusted. A locking pin plate **58** is attached to the top surface of the float **18** to connect the valve control lever **50** to the float **18**. A locking pin **60** is inserted through both the locking pin plate **58** and the adjustment holes **56** of the valve control lever **50** in order to fix the distance between the valve **20** and the float **18**. When the float **18** rises or lowers, the valve control lever **50** rises and lowers with the float **18**.

[0040] The upper end of the valve control lever **50** is attached to a winch assembly **54** via the adjustment holes **56** in the valve control lever **50**. The winch assembly **54** includes a winch arm **62**, a winch pin **64**, a winch **66**, a winch lever **68**, and a winch collar **70**. The winch pin **64** attaches the winch assembly **54** to the valve control lever **50**. The winch arm **62**, winch **66**, winch pin **64**, winch lever **68**, and winch collar **70** rotate with the valve control lever **50** as a result of the winch pin **64** being attached to the valve control lever **50**.

[0041] Operation of the embodiment of **FIGS. 1-3** is shown in **FIGS. 9 and 10**. **FIG. 9** shows the valve **20** in a closed position while **FIG. 10** shows the valve **20** in an open position. Liquid L enters the riser **12** through the inlet **14**. As the liquid L enters the riser **12**, it initially falls to the bottom surface **24** or floor of the riser **12** and begins to accumulate. Before the liquid L reaches the level of the float **18**, the valve **20** is in a closed position so that the liquid L may not exit the riser **12**, as shown in **FIG. 8**. Once the liquid level reaches the level of the float **18**, the buoyancy of the float **18** causes the float **18** to lift the valve control lever **50**. As the valve control lever **50** rises, the lever **50** lifts the top plate attachment arm **48**, which lifts the top plate **32** and flexible seal **34** to open the valve **20**. The valve **20** opens when the float **18** reaches a preselected height H within the riser **12**, as shown in **FIG. 10**.

[**0042**] The winch arm **62**, winch **66**, winch pin **64**, winch lever **68**, and winch collar **70** rotate with the valve control lever **50** as the float **18** rises and lowers. The valve **20** opens through levering because of the hinge action created between the top plate **32** and the valve control lever **50**. As a result, the amount of force necessary to open the valve **20** is reduced. The winch assembly **54**, in combination with the float **18** and locking pin plate **58** provide the levering effect to open the seal **34**. As the valve **20** opens, liquid rushes into the outlet **16** and lowers the liquid height within the riser **12**, thereby lowering the height of the float **18** to the preselected height H, where it closes the valve **20**. When the float **18** is below or at the preselected height H, the valve **20** will remain closed. When the float **18** is above the preselected height H, the valve is open.

[**0043**] A second embodiment of the flow control structure **10** is shown in **FIGS. 4-6**. This embodiment uses a linkage **40** that is flexible and a living hinge **72** instead of a mechanical hinge at the valve **20**. In particular, **FIGS. 4-6** depict a valve **20** having a flexible seal **34** and a top plate **32**. In a preferred embodiment, the top plate **32** is rigid and is made of stainless steel, although other embodiments provide for the use of other materials and for a non-rigid top plate. The flexible seal **34** is formed as a sheet of elastomeric material that provides an integral flexible living hinge **72**. A rod **74** extends through the elastomeric material of the seal **34** to hold the seal **34** in position and the rod **74** extends upwardly through the float **18** to maintain a lateral position of the float **18** within the riser **12**.

[**0044**] The linkage **40**, as shown in **FIGS. 4-6**, is a flexible chain **44**. The float **18** includes a float holder **76** that is positioned on the upper surface of the float. The chain **44** extends upwardly through the float **18** and the float holder **76**. The chain **44** is connected to the float **18** at the float holder **76** via a pin (not shown) such that a length between the valve **20** and the float **18** is established by locking the chain **44** to the float holder **76** at a given height. The top end of the chain **44** is attached to a winch assembly **54** (not shown in **FIGS. 4-6**) that is similar to that shown and described in connection with **FIGS. 1-3**. Other types of winch assemblies may also be used.

[**0045**] In operation, as liquid enters the riser **12** through the inlet **14**, the liquid flows to the bottom surface **24** of the riser **12** and begins to rise while the valve **20** is still closed. As the liquid accumulates, the float **18** begins to rise and lifts the linkage chain **44**. When the float **18** hits a preselected height H, the linkage chain **44** becomes taut and lifts the top plate **32** of the valve **20**. As the chain **44** lifts the top plate **32**, the seal **34** separates from the outlet opening **16** with a hinge action from the living hinge **72**. The linkage **40** provides a levering action to open the valve **20**, thereby resulting in a reduced force to open the valve **20**.

[**0046**] In both of the embodiments shown in **FIGS. 1-6**, the inlet **14** pipe enters the riser **12** at a height that is greater than the height of the outlet pipe **16**.

[**0047**] As shown in **FIGS. 7 and 8**, a third embodiment of the flow control structure utilizes inlet and outlet pipes **14**, **16** that are positioned at the same height such that the bottom of each pipe lies in the same plane. It is desirable from an installation standpoint to have the inlet and outlet pipes **14**, **16** at the same height so that a contractor installing the riser **12** underground only needs to prepare a single grade. The embodiment of **FIGS. 7 and 8** includes a valve **20** that is positioned at an angle relative to the horizontal. A preferred angle of 45° is shown, although other angles may also be used, as discussed above.

[**0048**] The flapper valve **20** in **FIGS. 7 and 8** utilizes a mechanical hinge and the linkage **40** between the valve **20** and the float **18** is a flexible chain **44**. The valve **20** includes a rigid top plate **32** that has arms **96** at both ends that bend downwardly to trap a flexible seal **34** in position under the plate **32**. The seal **34** includes a sheet of rubber that extends over part of the surface of rigid plate **32**. The valve also includes two plastic washers **98**, which are positioned near the center of the seal **34** and which together sandwich the seal **34**. A fastener **100**, such as a screw and bolt extends through the washers **98**, seal **34**, and rigid plate **32** to hold the seal **34** in place. More than one fastener **100** may be used. The washers **98** also serve to create a conical-type surface on the seal **34**, which improves the sealing characteristics of the seal **34** by providing a positive sealing surface against the outlet **16**.

[**0049**] The top plate **32** is attached to a top plate attachment arm **48**, which is attached to a valve control lever **50** via a valve control lever pin **52**. One end of the valve control lever **50** is connected to a hinge **102** and the other end of the valve control lever **50** is connected to the chain **44**.

[**0050**] The upper end of the chain **44** is attached to the winch assembly **54**. The winch assembly **54** is used to open the valve **20** manually by rotating the winch arm **62** in a conventional manner. As the winch arm **62** is rotated, the chain **44** wraps around the winch arm **62** to draw the top plate **32** upwardly and open the valve **20**.

[**0051**] **FIG. 11** shows an alternative embodiment of the invention in the form of a catch basin **80**. The catch basin **80** has an open top that is covered by a grate **82**. Liquid enters the catch basin **80** through the open top **28** and the grate **82** is utilized to block large debris from entering the catch basin **80**. The catch basin **80** shown utilizes the valve **20** of **FIGS. 1-3**, but, alternatively, may use the valve **20** of **FIGS. 4-6** or **7-8**.

[**0052**] Operation of the catch basin **80** is similar to the prior embodiments, except that the catch basin **80** utilizes the open top end **28** as the inlet **14**. Liquid flows into the catch basin **80** through the inlet **14**. Once the liquid level, and hence the float **18**, within the basin **80** raises past the preselected height H, the valve **20** will open and allow liquid to exit through the outlet **16**.

[0053] The container **12** may be formed from a class of rigid materials that include, but are not limited to plastic, fiberglass, concrete, or metal. A preferred type of plastic is high density polyethylene (HDPE). In one embodiment, the container **12** is formed from a corrugated pipe having a smooth walled liner, although the container **12** alternatively may be smooth-walled pipe. The inlet **14** and outlet **16** pipes may also be corrugated or smooth-walled pipes, although smooth-walled pipes are shown as preferred in the drawing figures. The inlet **14** and outlet **16** pipes may be welded to the container **12**. Alternatively, the entire unit may be formed as a one piece molding through known molding techniques, such as roto molding.

[0054] In installing the liquid control structure **10** in the ground, the container **12** may be made of a tubing that can be cut off at a desired length once the unit is installed in the ground. In this way, the same liquid control structure **10** can be used with differing depth projects.

[0055] The container **12** may be provided in any desirable dimensions. For example, the riser **12** can be provided in a diameter of 24 or 36 inches. For a 24 inch diameter riser, the inlet diameter can be 8 inches and the outlet diameter 10 inches. For a 36 inch diameter riser, the inlet diameter can be 15 inches and the outlet diameter 18 inches. These dimensions are provided for illustration purposes only, the invention not being limited to a particular size of tubing.

[0056] The flexible seal **34** of the flapper valve **20** may be formed of any type of flexible material. A preferred embodiment utilizes gum rubber. The rigid plate **32**, top plate attachment arm **48**, valve control lever **50**, valve control lever pin **52**, hinge **102** and linkage **40** are all preferably made of a corrosion resistant material, such as stainless steel. The winch assembly **54** and float parts **18**, **84** may also preferably be made of a corrosion resistant material, such as stainless steel. In a preferred embodiment, the chain **44** is made of nickel cadmium plated steel. Other types of materials may also be utilized without departing from the invention.

[0057] The above invention has been discussed as utilizing a float **18** in order to open the valve **20** in response to the liquid level in the riser **12**. Alternatively, the float **18** may be replaced with a solar or electric powered motor that utilizes a sensor (not shown) to gauge the height of liquid within the riser **12**. Thus, as used herein, the term float **18** is understood to include other devices that serve to open the valve **20** when the liquid in the riser **12** raises past the preselected height H.

[0058] While various features of the claimed invention are presented above, it should be understood that the features may be used singly or in any combination thereof. Therefore, the claimed invention is not to be limited to only the specific embodiments depicted herein. In addition, the term substantially, as used herein, is used as an estimation term.

[0059] Further, it should be understood that variations and modifications may occur to those skilled in the art to which the claimed invention pertains. The embodiments described herein are exemplary of the claimed invention. The disclosure may enable those skilled in the art to make and use embodiments having alternative elements that likewise correspond to the elements of the invention recited in the claims. The intended scope of the invention may thus include other embodiments that do not differ or that insubstantially differ from the literal language of the claims. The scope of the present invention is accordingly defined as set forth in the appended claims.

1. A device for the selective control of a liquid flow from an external body of liquid or liquid and solid separation comprising:

a container having an inlet for the intake of a liquid into the container from an external body of liquid, an outlet for the discharge of the liquid from the container, and a closed bottom surface;

a float buoyantly positioned within the container and configured to rise and fall in response to the level of liquid within the container; and

a valve positioned inside the container in association with the outlet, said valve coupled to the float such that the valve opens when the float rises above a preselected height within the container and the valve closes when the float falls to the preselected height within the container, wherein the distance between the float and the valve when the float is positioned at the preselected height determines a height of liquid required to open the valve, wherein the valve is oriented at an angle that ranges from an angle greater than zero to about a 60° angle relative to horizontal.

2. The device of claim 1, wherein the inlet comprises an inlet pipe and the outlet comprises an outlet pipe, with the inlet and outlet pipes being positioned in the same plane; and the valve is positioned at a height that is spaced from the closed bottom surface of the container.

3. The device of claim 1, wherein the inlet has a dimension and the outlet has a dimension, and the inlet dimension is smaller than the outlet dimension.

4. The device of claim 1, wherein the container is a riser and the valve is a flapper valve.

5. The device of claim 4, wherein the flapper valve comprises a rigid plate adjoined to a flexible seal, with the rigid plate being coupled to the float.

6. The device of claim 1, wherein the float comprises a closed-cell foam enclosed in a plastic outer shell.

7. The device of claim 6, wherein a linkage is positioned between the float and the valve and the linkage is adjustable in length.

8. The device of claim 7, wherein the linkage between the float and the valve is at least one of a flexible member and a rigid member, said flexible or rigid member including a cord, a string, a bar, and a chain, said bar including a plurality of adjustment holes positioned at spaced locations along the length of the bar.

9. The device of claim 4, wherein the flapper valve includes a hinge at one end and is coupled to the float at the other end such that the flapper valve opens around the hinge when the float rises above the preselected height, with the hinge being one of a living hinge or a mechanical hinge.

10. The device of claim 4, wherein the flapper valve is oriented in a recumbent position within the riser.

11. (Cancelled)

12. The device of claim 10, wherein the recumbent position is about 45° relative to the horizontal.

13. The device of claim 10, wherein liquid flows into the outlet in a direction that is substantially perpendicular to a movement direction of the flapper valve.

14. The device of claim 1, further comprising a vortex plate positioned in the outlet.

15. The device of claim 1, wherein the container is a catch basin having an open top and the inlet comprises the open top.

16. The device of claim 15, further comprising a removable grate structure positioned over the open top.

17. The device of claim 1, wherein the container, inlet and outlet are molded as one piece.

18. The device of claim 1, wherein the container, inlet, and outlet are comprised of one of plastic, concrete, fiberglass, or metal.

19. The device of claim 1, wherein the container comprises a corrugated pipe having a base structure forming the bottom surface and an open top end, and the inlet and outlet both comprise a conduit, each of which is affixed to the corrugated pipe of the container, with the open top end of the container being covered by a cap.

20. The device of claim 1, wherein the container and valve are together configured to separate solids from liquids within the container.

21. The device of claim 1, wherein the container and valve are together configured to separate liquids and solids within the container from a base liquid, with liquids and solids having a greater density than a density of the base liquid sinking to the bottom surface of the container and liquids and solids having a lesser density than the density of the base liquid floating on top of the base liquid.

22. A flow control device comprising:

a riser having an inlet for the intake of a fluid, an outlet for the exit of a fluid, and a closed bottom surface;

a float positioned inside the riser and configured to travel in response to a fluid level in the riser; and

a valve positioned inside the riser coupled to the float, said valve being movably responsive to the travel of the float, wherein the valve is coupled to the outlet and is oriented at an angle ranging from greater than zero to about 60 degrees relative to horizontal.

23. The device of claim 22, wherein the angle is about 45° relative to horizontal.

24. The device of claim 22, further comprising a linkage positioned between the float and the valve; and

a linkage latching mechanism for fixing the length of the linkage between the float and the valve.

25. The device of claim 24, further comprising a means for raising the float height.

26. A method for controlling liquid flow from an external body of liquid comprising:

providing a container having an inlet and an outlet within the container;

disposing a valve between the inlet and the outlet within the container;

coupling a float to the valve, said float being buoyantly responsive to liquid that enters the container such that the valve opens when the float rises above a preselected height within the container and the valve closes when the float sinks to the preselected height within the container, wherein the distance between the float and the valve when the float is positioned at the preselected height determines a height of liquid required to open the valve.

27. A method for separating solids received from an external body of liquid that includes solids and liquids comprising:

the method of claim 26; and

positioning a height of the valve such that at least some of the solids sink to a position below the height of the valve, wherein when the valve is opened, liquids exit into the outlet.

28. A method of separating liquids having a first density and a second density that are disposed together in a liquid received from an external body of liquid comprising:

the method of claim 26; and

positioning the height of the valve such that liquids having a first density sink to a level within the container that is below the valve and liquids having a second density rise to a level that allows them to exit into the outlet through the valve when the valve is opened.

29. The method of claim 27, wherein the liquid received from an external body of liquid further comprises a liquid having a third density, and further comprising positioning the height of the valve such that the liquid having a third density rises to a level above the valve such that when the valve is opened, the liquid having a second density exits the container while the liquids having a first and third density remain in the container.

30. A device for the selective control of a liquid flow from an external body of liquid or liquid and solid separation comprising:

a container having an inlet for the intake of a liquid into the container from an external body of liquid, an outlet for the discharge of the liquid from the container, and a closed bottom surface;

a valve positioned inside the container in association with the outlet and configured to be opened and closed, wherein the valve is oriented at an angle that ranges from an angle greater than zero to about a 60° angle relative to horizontal.

31. The device of claim 30, further comprising a winch coupled to the valve for opening and closing the valve.

32. A device for the selective control of a liquid flow from an external body of liquid or liquid and solid separation comprising:

a container having an inlet with a first dimension for the intake of a liquid into the container from an external body of liquid, an outlet with a second dimension for the discharge of a liquid from the container, and a closed bottom surface, with the inlet dimension being smaller than the outlet dimension; and

a flapper valve positioned in the container in association with the outlet and configured to be opened and closed.

33. The device of claim 32, wherein the flapper valve comprises a rigid plate adjoined to a flexible seal.

34. The device of claim 33, further comprising a float buoyantly positioned within the container and configured to rise and fall in response to a level of liquid in the container, said flapper valve being coupled to the float.

35. A valve assembly for positioning inside a container having an inlet and an outlet for controlling a flow of a liquid from the inlet to the outlet comprising:

a valve seat defining an opening through which a liquid may exit a container, said valve seat being positioned at an angle relative to a horizontal reference that ranges from greater than zero to about 60 degrees; and

a flapper valve coupled to the valve seat.

36. The valve assembly of claim 35, wherein the flapper valve comprises a rigid plate that is rotationally coupled to the valve seat, and a flexible seal coupled to the rigid plate, said flexible seal configured to mate with the valve seat to close the opening.

37. The device of claim 1, wherein the container if formed as a single piece utilizing rotational molding.

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