United States Patent [19]

Bennett

[11] **3,916,945**

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[54] **FLOAT OPERATED VALVE**

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[52] **U.S. Cl.** **137/445;** 137/448

[51] **Int. Cl.²** **F16K 31/18**

[58] **Field of Search** 137/445, 448; 251/232

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[57] **ABSTRACT**

A pivotally mounted valve for closing or exposing a conduit end through which a liquid moves either from or into said conduit when the valve is in an open position. The float which is responsive to a liquid level within a receptacle with which said conduit end communicates is connected through a parallelogram and bellcrank linkage arrangement to the valve for opening or closing the valve as the liquid level rises or falls.

6 Claims, 9 Drawing Figures

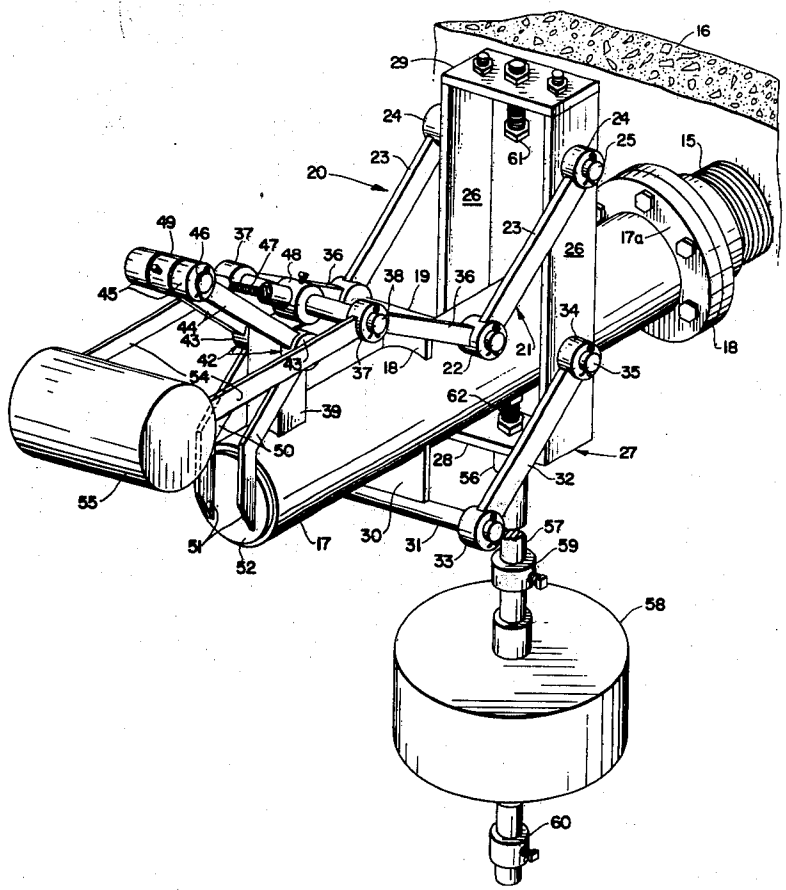


FIG. 1

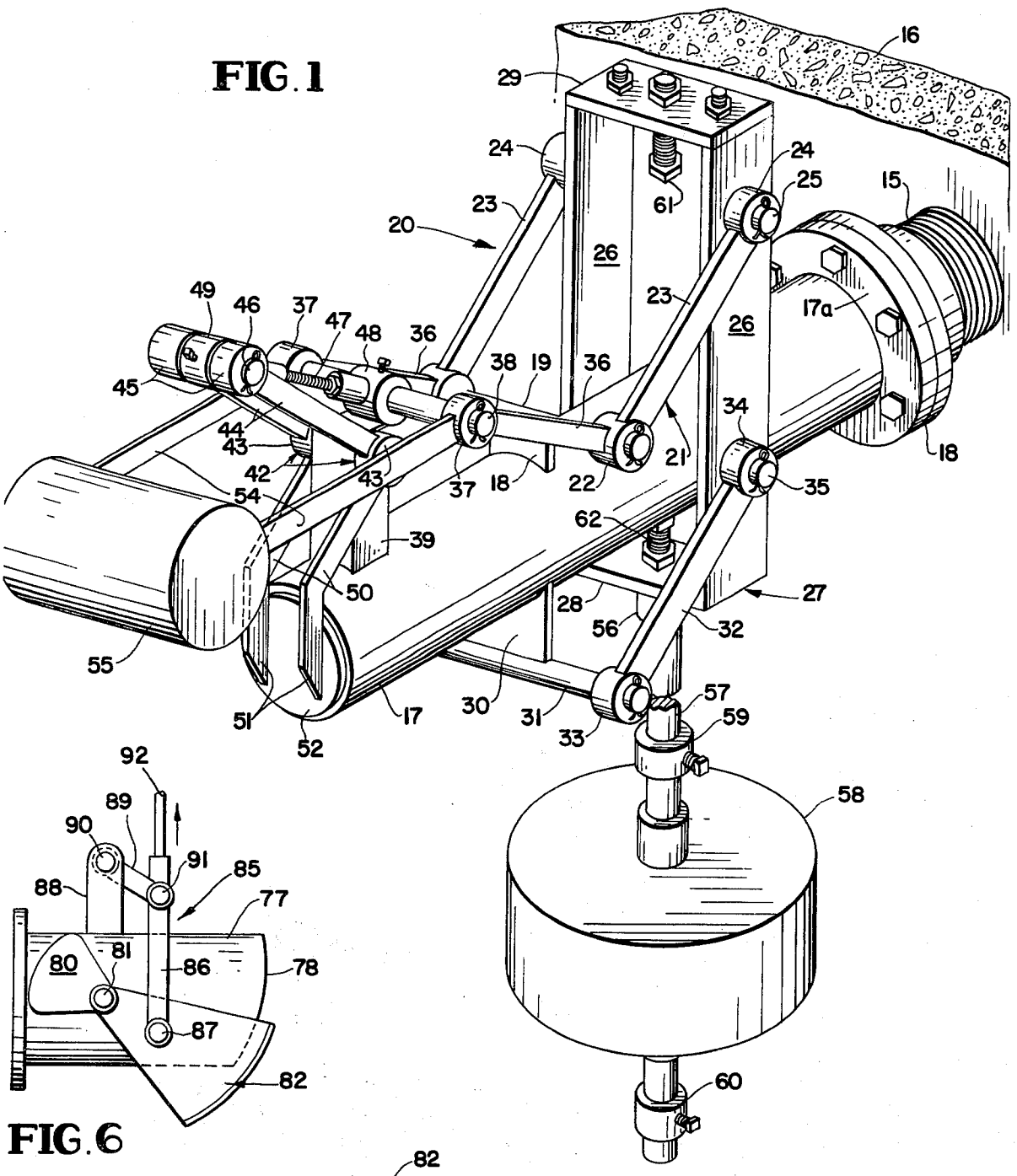


FIG. 6

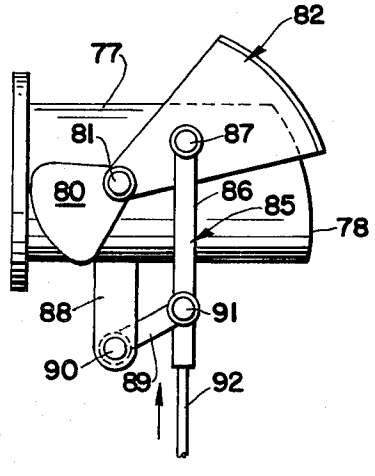


FIG. 7

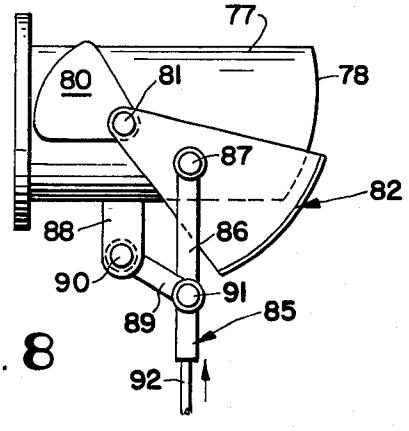


FIG. 8

FIG. 2

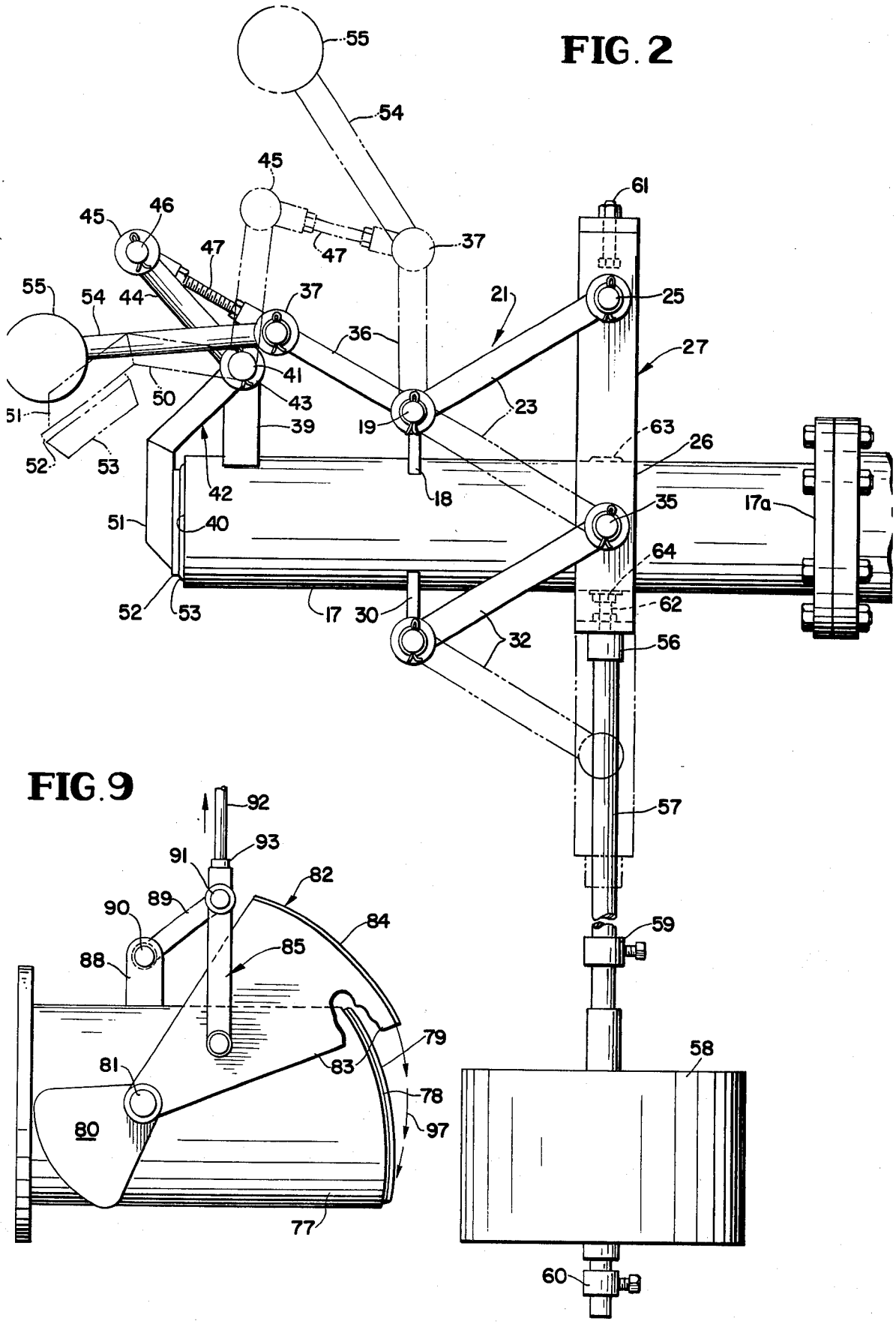
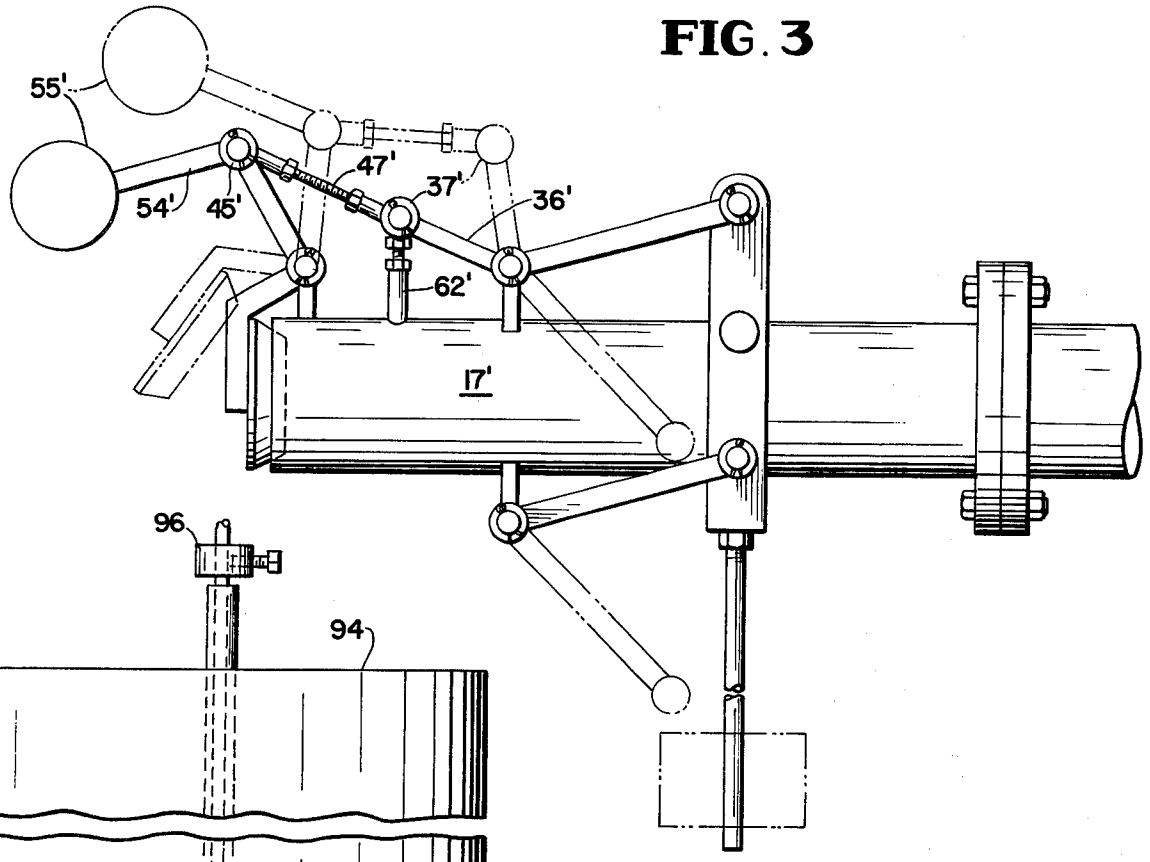

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FIG. 9

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FIG. 3



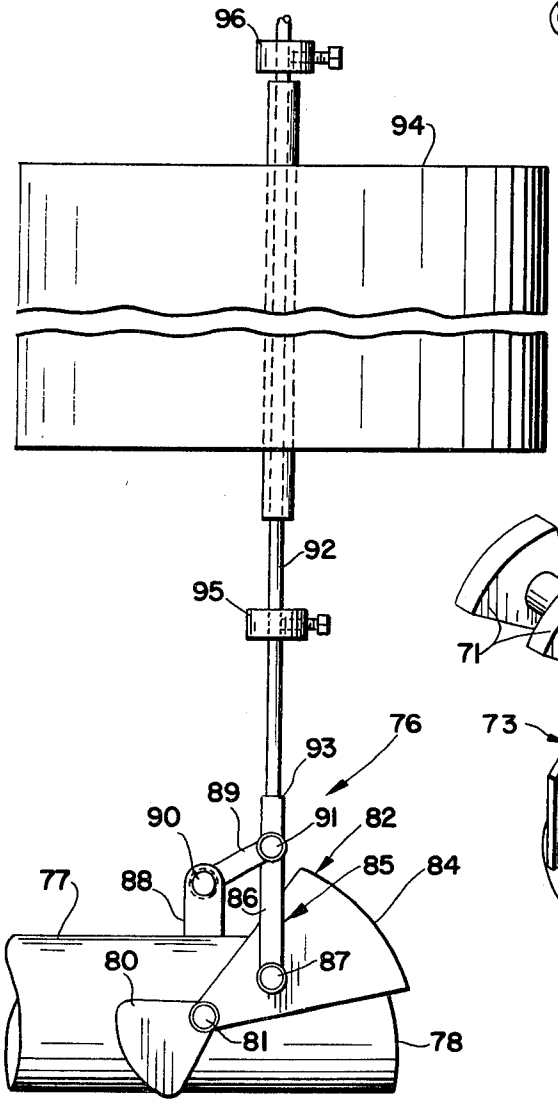


FIG. 5

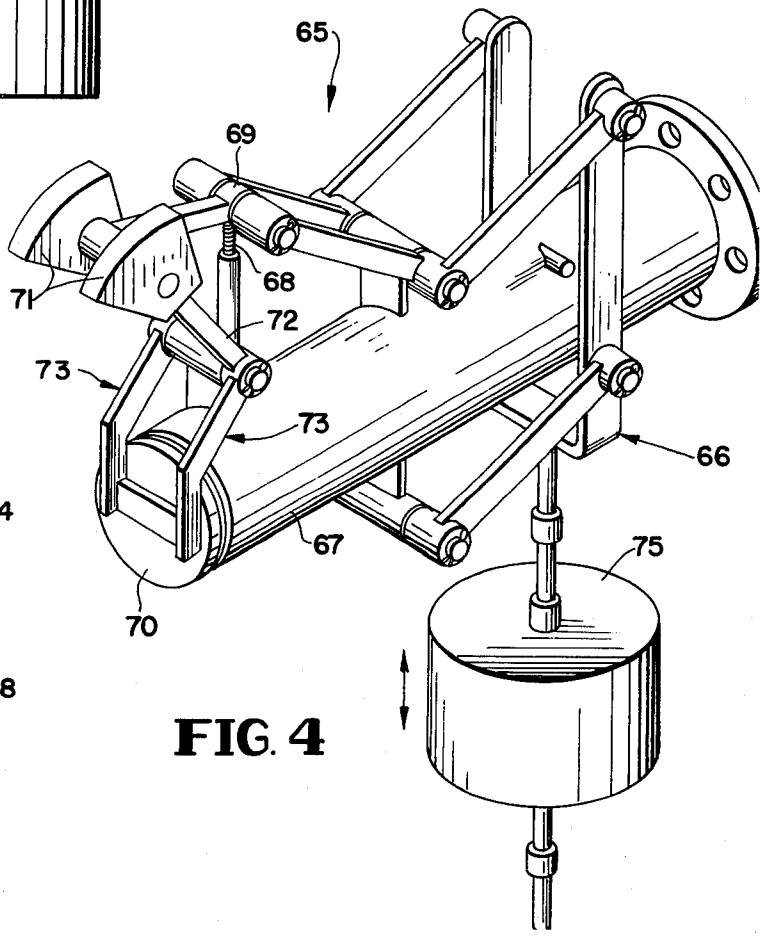


FIG. 4

FLOAT OPERATED VALVE

BACKGROUND OF THE INVENTION

In a sewage treatment plant, it is customary to provide a holding or surge tank to receive raw sewage which is released periodically to flow by gravity into a wet well from which the sewage is pumped into the treatment plant. The holding or surge tank is provided to compensate for peak loads which would otherwise overflow the wet well and so that nearly a constant liquid level can be maintained in the wet well.

SUMMARY

Accordingly, one primary object of the present invention is to provide a valve structure which is uniquely adapted to function in controlling the flow of liquid from the holding tank to the wet well and which may be so arranged that the valve will open automatically when the liquid level of the wet well falls to a predetermined extent and will thereafter close automatically when the liquid level rises to a desired maximum extent.

A further object of the present invention is to provide a valve arrangement which will insure movement of the valve to an effective closed position.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating presently preferred embodiments thereof, and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating a preferred embodiment of the float operated valve;

FIG. **2** is a side elevational view of the same;

FIG. **3** is a side elevational view of a portion of a slightly modified embodiment of the valve of FIGS. **1** and **2**;

FIG. **4** is a perspective view of another modification of the float operated valve;

FIG. **5** is a side elevational view of still another embodiment of the float operated valve;

FIGS. **6**, **7** and **8** are fragmentary side elevational views illustrating different arrangements of the valve of FIG. **5**, and

FIG. **9** is an enlarged fragmentary side elevational view partly broken away of the float operated valve of FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more specifically to the drawings and first with reference to FIGS. **1** and **2**, the conduit **15** extends through a portion of a wall **16** which separates a holding or surge tank from a wet well. A short length of conduit or pipe **17** is coupled in a conventional manner as seen at **17***a* to the outlet end of the conduit **15** and is disposed within the wet well.

A post **18** rises from the conduit **17** and provides a support for a fixed axle **19**. A pair of corresponding bellcranks **20** and **21** have hubs **22** at their apexes which fit turnably on the ends of the axle **19**. Said bellcranks have arms **23** extending from the hubs **22** and terminating at their distal ends in eyes **24** which turnably engage aligned trunnions **25** which project from parallel sides **26** of a rectangular frame or yoke **27**. Said sides **26** straddle the conduit **17** and are spaced therefrom. The yoke **27** additionally includes a bottom cross member **28** which is disposed beneath the conduit **17** and a detachable top cross member **29** which is disposed thereabove. The length of the yoke **27** is substantially greater than the diameter of the conduit **17**, as seen in FIGS. **1** and **2**. A hanger **30** depends from the conduit **17**, in alignment with the post **18**, and supports an axle **31** which is immovably secured thereto. A pair of levers **32**, corresponding to the arms **23**, have eyes **33** at corresponding ends thereof which turnably engage the ends of the axle **31**, and eyes **34** at their opposite ends which are turnably connected to a second pair of aligned trunnions **35** which are disposed beneath and spaced from the trunnions **25**, a distance corresponding to the spacing between the axles **19** and **31** to provide a parallelogram linkage between the conduit **17** and yoke **26**.

The other arms **36** of the bellcranks **20** and **21** project from the hubs **22** at an obtuse angle to the arms **23** and have eyes **37** at their distal ends which turnably engage end portions of a shaft **38**.

A post **39** is fixed to and rises from the conduit **17**, adjacent its discharge end **40**, to support an axle **41** which is disposed parallel to the axles **19** and **31**. A pair of corresponding bellcranks **42** have hubs **43** at the apex thereof which turnably engage on ends of the axle **41**. Bellcranks **42** have corresponding lever arms **44** extending upwardly from the hubs **43** and which terminate at their distal ends in eyes **45** which turnably receive end portions of a shaft **46**. A connecting rod **47** has a collar **48** at one end thereof which is secured to the intermediate portion of the shaft **38**, and a collar **49** at its opposite end which is secured on the intermediate portion of the shaft **46**. The rod **47** is of a conventional type the length of which may be varied. Bellcranks **42** have arms **50** which extend forwardly from the hubs **43** and which have angularly turned terminal portions **51**, which are secured immovably to the outer side of a plug valve **52** having a tapered or frusto-conical inner portion **53** which conformably fits the internally tapered outlet end or valve seat **40** of the conduit **17**, in a closed position of the valve **52**, as seen in FIG. **1** and in full lines of FIG. **2**. A pair of arms **54** connect immovably to the hubs **37** and extend forwardly therefrom on opposite sides of the bellcranks **42** and are disposed at obtuse angles to the arms **36**. A counterweight **55** is connected to and supported by the free ends of the arms **54**.

A socket **56** mounted on the underside of the cross member **28** receives and supports a float rod **57** on which is slidably mounted a float **58**, confined between stops **59** and **60** which are adjustably secured to the rod **57**. An adjustable stop **61** is secured to and depends from the upper cross brace **29**, and an adjustable stop **62** is connected to and rises from the lower cross brace **28**.

In FIG. **1** and in full lines of FIG. **2**, the valve **52** is shown in a closed position and the float **58** is shown buoyantly supported between and spaced from the stops **59** and **60**. In this position of the valve, the yoke **27** is in its uppermost position with the lower stop **62** abutting the underside of the conduit **17** to limit the extent that the bellcranks **20** and **21** can be rocked counterclockwise for pressing the plug portion **53** into the valve seat **40**. The plug portion **53** is formed of a soft material to provide a good seating engagement with the valve seat. In this position of the parts, as seen in FIG. **2**, the rod **47** is disposed coplanar with the lever arms **36** to resist any tendency for the valve **52** to be forced

away from the valve seat **40** and to rock the bellcranks **42** in a clockwise direction.

As the liquid level, not shown, in which the float **58** is supported falls, said float will slide down the rod **57** and come to rest on the lower stop **60.** As the weight of the float **58** is substantial, when a sufficient preponderance of such weight is supported by the stop **60** and rod **57,** said rod and the yoke **27** will be pulled downwardly for swinging the bellcranks **20** and **21** and the levers **32** from their full line to their dotted line positions of FIG. **2,** along with the yoke **27.** This downward movement of the aforementioned parts will continue until the upper stop **61** engages the seat **63** on the upper side of the conduit **17** to prevent further downward movement of the parts. It will be apparent that the yoke **27** and rod **57** will maintain the same, substantially vertical plane during movement of said parts between their full and dotted line positions.

As the bellcranks **20** and **21** swing clockwise from their full to their dotted line positions of FIG. **2,** the lever arms **36** thereof will move to substantially upright positions and, in so doing, will exert a pull on the connecting rod **47** for swinging the bellcranks **42** clockwise as a unit from their full to their dotted line positions to move the valve **52** to its open, dotted line position, to allow the liquid or raw sewage to flow through the outlet end **40** of the conduit **17** into the wet well receptacle in which said conduit **17** is disposed. Additionally, as the bellcranks **20** and **21** swing from their full line to their dotted line positions, the arms **54** and counterweight **55** will swing upwardly from their full line to their dotted line positions of FIG. **2.** During this movement the counterweight **55** passes across the vertical plane passing through the pivot axis **42,** so that in its dotted line position, counterweight **55** cooperates with the float **58** for maintaining the valve **52** in an open position. However, the weight of the float **58** is adequate to overcome the weight **55** for moving the parts from their full line to their dotted line positions.

When the liquid level rises sufficiently, the float **58** will become buoyantly supported and will move upwardly on the rod **57** against the upper stop **59.** When said float is sufficiently buoyant, it will force the rod **57** and yoke **27** upwardly for moving the parts back from their dotted line to their full line positions of FIG. **2.** During this initial movement, counterweight **55** will pass back across the vertical plane of the axis **41,** after which said counterweight will assist in returning the parts to their full line positions and this assistance will increase as its leverage force is enhanced by movement of the weight **55** away from the vertical plane of the pivot axis **41.** Thus, the counterweight **55** will assist the float **58** in moving the valve **52** to a fully closed position for sealing the outlet **40.** As the valve **52** reaches a full closed position, the collar **48** will come to rest against the post **39,** as seen in FIG. **1,** to prevent the levers **36** from moving past a position coplanar with the rod **47.** Also, as the parts reach their full line positions, the lower top **62** will move into abutting engagement with an abutment **64** on the underside of the conduit **17.**

FIG. **3** illustrates a slight modification of the float operated valve of FIGS. **1** and **2,** and wherein crank arms **36'** are shortened, rod **47'** is lengthened, and arms **54'** supporting weight **55',** extend from the hubs **45'** rather than hubs **37'.** The adjustable stop **62** of the embodiment of FIGS. **1** and **2** is replaced by an adjustable stop **62'** which rises from the conduit **17'** and is engaged by the hubs **37'** when the valve **52'** is in a closed position.

The structure and operation of the valve of FIG. **3** otherwise corresponds with the valve of FIGS. **1** and **2.**

FIG. **4** illustrates a third embodiment of the float operated valve which differs only slightly from the embodiment as previously described. In the float operated valve of FIG. **4,** designated generally **65,** the yoke **27** is replaced by a U-shaped yoke **66** which has no top cross brace and which does not include adjustable stops **61** and **62.** The conduit **67** which corresponds to conduit **17,** supports an adjustable stop **68** which rises therefrom and which is engaged by a collar **69,** corresponding to the collar **48,** in the closed position of the valve **70.**

Counterweights **71** are supported on the distal ends of the lever arms **72** of the bellcranks **73,** which replace the bellcranks **42.** The counterweights **71,** like the counterweight **55** but unlike the counterweight **55',** are capable of swinging across a vertical plane passing through the pivot axis **74** to assist the float **75** in moving the valve **70** to a fully open or fully closed position. Operation of the valve **65** otherwise corresponds with the operation of the valve of FIGS. **1** and **2.**

FIGS. **5** to **9** illustrate a fourth embodiment of the float operated valve. The float operated valve of these views, designated generally **76,** includes a conduit **77** replacing the conduit **17** and having an open end **78** which is convexly rounded, as best seen in FIG. **9,** and which is outlined by an O-ring **79** forming a yieldable valve seat.

A valve member **82,** composed of spaced apart substantially parallel side members **83** and an intermediate valve face portion **84,** is swingably supported by distal portions of the sides **83** turnably engaging trunnions **81** which project from opposite sides of the conduit **77.** Counterweights **80** are secured to the sides **83** and turn on trunnions **81.** The valve face **84** is shaped so that the inner face thereof is capable of moving into flush sealing engagement with the seat **78** as the valve **82** swings downwardly from its open portion of FIGS. **5** and **9.**

An inverted U-shaped yoke **85** includes spaced apart legs **86** which straddle the valve member sides **83** and are pivotally connected at their lower ends to trunnions **87** which project outwardly from said sides **83.** Posts **88** rise from the conduit **77.** Rigid links **89** are pivoted at **90** to aligned pivots of the posts **88** and at **91** to aligned pivots on upper portions of the legs **86.** The pivots **81** and **90** are disposed in the same vertical planes as are the pivots **87** and **91,** and the spacing between the pivots **81** and **87** correspond with the spacing between the pivots **90** and **91,** so that the portions of the sides **83** disposed between the pivots **81** and **87** constitute an additional pair of rigid links to form with links **89** a parallelogram, like the parallelogram linkage of FIGS. **1** to **4.**

A rod **92** is secured to and extends upwardly from the top portion **93** of the yoke **85** and slidably supports a float **94** between stops **95** and **96,** which are adjustably secured to said rod.

The conduit **77** is disposed in a submerged position and the float **94** is shown buoyantly supported in FIG. **5.** When the level of the liquid supporting the float **94** drops to a predetermined extent, said float will strike the lower stop **95** to force the rod **92** downwardly together with the yoke **85** for swinging the links **89** and the valve member **82** downwardly in a clockwise direction for moving the valve face **84** into sealing engagement with the valve seat **79.** The valve face **84** in moving to a closed position follows the path indicated by

the broken lines **97** so that said valve face moves downwardly and inwardly with respect to the valve seat **79** which is inclined upwardly and inwardly relative to the axis of the conduit **77**. Conversely, when the liquid level rises sufficiently to move the float **94** upwardly against the upper stop **96**, the valve member **82** will swing upwardly to its open position of FIGS. **5** and **9**. During this movement, the valve face **84** moves not only upwardly but outwardly and away from the valve seat **79**.

In FIGS. **6**, **7** and **8**, the float **94**, and stops **95** and **96** have been omitted. The remaining parts correspond to the similarity numbered parts of FIGS. **5** and **9**. However, in FIG. **6**, conduit member **77** has been rotated 180°, so that its opening **78** is inclined downwardly and inwardly, and the valve member **82** swing upwardly to a closed position. Thus, when the liquid level rises, the valve is pulled by the float to a closed position and is caused to open by the weight of the float as the liquid level falls.

In FIG. **7**, the conduit **77** and valve member **82** are disposed in the same position as in FIGS. **5** and **9**. However, the supports **88** are located below the conduit **77** and the yoke **85** extends downwardly from the pivots **87**. With this arrangement of the parts, the conduit **77** is disposed above the water level. The weight of the float pulling downwardly on the rod **92** swings the valve member **82** downwardly to a closed position and the rise of the water level lifts the float and rod **92** for opening the valve.

In FIG. **8**, conduit **77** and valve member **82** are disposed as in FIG. **6**; however, the posts **88** and yoke **85** are disposed as in FIG. **7**, so that a rising liquid level causes the float to exert an upper thrust on the rod **92** for swinging the valve member **82** upwardly to a closed position and a falling liquid level causes the weight of the float to pull the rod **92** and yoke **85** downwardly for opening the valve. In the arrangement of FIG. **8**, conduit **77** is disposed above the liquid level, as in FIG. **7**.

Various other modifications and changes are contemplated and may be resorted to, without departing from the function or scope of the invention.

I claim as my invention:

1. A float operated valve comprising a conduit having an open end defining a valve seat, a valve, means swingably supporting said valve for movement into and out of engagement with said valve seat, a liquid level responsive float, means including a parallelogram linkage system connecting said float to the valve whereby an up or down movement of the float will produce a swinging movement of the valve into or out of engagement with said valve seat, said parallelogram linkage system including a pair of rigid links, means pivotally supporting corresponding ends of said links on said conduit, means connected to said float and to which the opposite ends of said links are pivotally connected in spaced apart relation to one another such that said links are disposed parallel to one another, one of said links comprising an arm of a bellcrank, said means swingably supporting the valve including a second bellcrank having one arm connected to and supporting the valve, and a rod connecting the other arm of the first mentioned bellcrank to the other arm of said second bellcrank for causing said bellcranks to swing in unison about parallel axes in response to up and down movement of the float.

2. A float operated valve as in claim **1**, an arm fixed to and extending from the distal end of the last mentioned arm of said first mentioned bellcrank, and a counterweight supported by said arm and disposed beyond said second bellcrank in the closed position of the valve.

3. A flat operated valve as in claim **2**, said counterweight being supported to swing across a vertical plane intersecting the axis of the second bellcrank during movement of the valve between a closed and open position to assist in moving and maintaining the valve in either a fully closed or fully open position.

4. A float operated valve as in claim **1**, a rigid arm fixed to and extending from the distal end of the last mentioned arm of the second bellcrank and in a direction away from said first mentioned bellcrank, and a weight secured to the outer end of said last mentioned arm.

5. A float operated valve as in claim **1**, and a counterweight supported on the distal end of the last mentioned arm of the second bellcrank for swinging movement across a vertical plane intersecting the pivot axis of the second bellcrank, during swinging movement of the valve between an open and closed position for cooperating with the float in maintaining the valve in either a fully open or fully closed position.

6. A float operated valve as in claim **2**, said valve comprising a plug valve and being receivable in said open end of the conduit in a closed position of the valve.

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