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(54) Title: AUTOMATED METERING GATE

(57) Abstract: An automated metering gate having a semicircular shaped flow control leaf gate which is automatically controlled to permit undershot and overshot water flow. The glow control leaf gate is includes in a flow control structure which may be preassembled and installed as a unit at the use location.

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AUTOMATED METERING GATE

CROSS-REFERENCE TO RELATED APPLICATIONS

The following U.S. Patent applications are hereby incorporated by reference in their entirety for their teachings:

U.S. Application No. 60/406,145 for Adler Automated Metering Gate for Irrigation, Salinity and Sediment Control, Fish Passage and Water Conveyance, by Richard Steven Adler, Tom Zhao, and Erick Breton, filed August 26, 2002.

U.S. Application No. 60/408,167 for Adler Automated Metering Gate One Piece Construction of Strut Arms, Gate Leaf, Rotating Shaft and Counterweight, by Richard Steven Adler, Del Jones, and Edward Burroughs, filed September 3, 2002.

U.S. Application No. 60/413,395 for Adler Automated Metering Gate for Irrigation, Dams and Marsh Management, by Richard Steven Adler, Tom Zhao, Edward Burroughs, and Erick Breton, filed September 24, 2002.

U.S. Application No. 60/428,865 for Adler Automated Metering Gate with Software Controls for Irrigation, Fish Friendly Applications and Bayou Applications, by Richard Steven Adler, Tom Zhao, and Edward Burroughs, filed November 26, 2002.

FIELD OF THE INVENTION

The present invention relates to an automated metering gate for controlling and measuring the flow of water in a gravity fed man-made or natural open trough or channel. The automated metering gate is also intended for other uses such as in controlling the flow of water between adjoining but separate bodies of water and in being friendly to fish moving from higher water on one side of the gate to the other side.

BACKGROUND OF THE INVENTION

Water control structures are placed in gravity fed, man-made or natural, open troughs or channels to control water flow. Some of these control structures are also used to measure water flow. Historically, existing structures have allowed water to pass either over or under the control device, but not both. Most structures include flat panels the ends of which are held in a track. The flat panels are made to raise or lower vertically to control water flow. Other structures have flat panels which are hinged to tilt downward. Structures of this type offer water flow over the top as overshot flow or water flow under the bottom as undershot flow.

More complicated two-panel system gates have been built to be operated to allow for either overshot or undershot flow. Still another popular water control structure is the radial gate. A radial gate uses a portion of a cylinder as the gate's leaf. The leaf is connected to strut arms, which are in turn connected to trunnion pins mounted onto concrete sidewalls. The leaf, the lower edge of which sits on the channel floor, is raised by a force applied to the top of the leaf, thereby allowing for undershot flow. However, none of the previously described water control structures are designed to accurately control and measure flow in both overshot or undershot modes. A more versatile structure is needed to accommodate those requirements.

Gravity fed active open water conveyance channels, such as irrigation canals, have a multitude of requirements to maintain a controlled environment for delivery of water to either the next water control structure downstream or to meet a customer's demand for timely and accurate water deliveries from structures which feed off of the main canals. Many times the measurement of the water flow is critical in making decisions to either pass a certain amount of water downstream or to hold or dam the water at the structure to control the upstream water level. The concepts of operation of the majority of water gates used in the world today date back hundreds of years to the time honored tradition of using a small crew of individuals to manually operate the gates to control and deliver water in a non-analytical manner. The technique of moving the water is usually "passed down" in a non-written form from experienced personnel to younger apprentices.

In the current climate of competition for water among agricultural, urban and environmental users, improved water management is seen as a means of stretching, or more efficiently using water resources. Efforts to improve water management often depend on reliable water flow control and measurement so as to provide knowledge of inflows and outflows to and from a particular body of water. This knowledge can be used to evaluate the nature and extent of water usage for crop production, urban needs, and environmental protection.

Further, in order to preserve bayous, particularly those adjoining bodies of salt water, it is most desirable to control the inflow and outflow of water from bayous. More particularly, it is desirable to automatically maintain the water level in a bayou within a predetermined range. To maintain the water level within the predetermined range, it may be desirable to permit water from another body such as a river to enter the bayou. However, if the water in the river is at a stage wherein it has a high salt content, it is not desirable to permit the salty water to enter the bayou. When the bayou is subjected to heavy rains, it is desirable to permit water to flow out of the bayou to prevent the water level from becoming too high. The best location for gates to control the flow of water to and from a bayou is frequently quite inaccessible. Therefore, it is desirable to provide automated local control of the gate, as well as control from a remote location.

SUMMARY OF THE INVENTION

Accordingly, it would be advantageous to provide a flow control structure, including a metering gate which is adaptable to many uses, and which may be automatically controlled. This invention is directed to providing such a flow control structure. In providing the desired flow control structure, this invention is intended to fulfill the following objectives:

1. To be able to control flow in either an overshot or undershot mode.

2. To be able to measure flow in either an overshot or undershot mode.

3. To be able to use a radial gate leaf to both control and measure flow in either the overshot or the undershot mode.

4. To provide a balanced gate using a counterweight to reduce the energy input required to actuate the movement of the gate.

5. To be able to actuate the device at a center-rotating shaft to offer positive drive in both directions.

6. To use an actuating device positioned at the center of the rotating shaft as a lock to keep the gate in place when it is stopped.

7. To be able to pass floating trash over the gate and bedload trash under the gate by rotating the gate.

8. To be able to power a large gate by a small solar cell battery set up, as a result of a counterweight balancing of the system.

9. To be able to fabricate the flow control structure from inexpensive steel angle and tube parts.

10. To be able to accurately measure the flows past the gate in either the overshot or undershot modes.

11. To provide a hinged cammable sharp crested weir blade which remains vertical during all overshot flow modes, thereby permitting the use of standard weir formulas to determine flow volume.

12. To supply a detachable, removable cammable sharp crested weir blade which can be replaced upon wear.

13. To provide camming steel linkage arms and a cam follower between the cammable weir blade and the center-rotating shaft.

14. To connect the cam follower of the sharp crested weir blade underneath the hinged blade in order to avoid encumbrances across the top of the gate to allow for full open flow over the weir blade.

15. To supply side seals and bottom seals between the gate leaf and the containment box or channel which are intended to close off 100% of the flow in the closed position.

16. To have the side seals made integral with the containment box, such that they do not project into the flow channel.

17. To supply a fluorocarbon cladded cover to the side seals, so as to provide a very low friction but high impact resistance watertight contact with the gate leaf.

18. To have compressible areas inside the containment box for the sideseals to compress into to further keep the seal out of the channel.

19. To provide side seals which are removable, with the gate leaf raised, without the need to remove cover plates or to enter the canal to remove the seals.

20. To permit personnel to change out the side seals while water is flowing in the channel.

21. To supply a bottom seal which can be compressed at least 1/4" to take up any of the inconsistencies in the forming of the radial gate and to provide sealing force.

22. To supply the bottom seal with fluorocarbon cladding to provide a very low friction and high abrasion contact fit with the gate leaf.

23. To be able to remove and replace the bottom seal without having to enter the channel.

24. To be able to remove and replace the bottom seal as water is flowing in the canal by moving the gate leaf to its full open position..

25. To position the strut arms adjacent the sidewalls of the channel to avoid any debris build up on the structure.

26. To have an elastic seal mounted on the top of the gate leaf strut arms to rub against the side wall of the canal to further inhibit build up of debris in the system.

27. To fit the entire flow control structure in a containment box, so as to be able to install the system as a simple “drop in”unit in a canal.

28. To be able install the entire flow control structure inside a containment box in a channel with flowing water.

29. To measure the upstream and downstream water levels, and gate position so as to mathematically determine the flow rate of water past the gate.

30. To utilize electronic sensing equipment to measure upstream, downstream water levels, and the angular displacement of the gate, in order to measure the flow rate of water past the gate.

31. To utilize the product of the flow calculation of the gate to determine to whether to move the gate or hold the gate’s position to either maintain or change the flow rate passed by the gate.

32. To electronically move or hold the gate’s position to maintain or change the flow rate passed by the gate.

33. To provide a device which will accurately measure the flow to a level of +/- 2% in weir overshot position and +/- 4% in orifice flows.

34. To supply a worm gear or other such device providing sufficient friction to be able to hold the gate in position even as changing water levels flow either over or under the gate.

35. To provide a manual system for complete operation of the gate.

36. To be able to offer the same gate structure with either a fully manual operation, an automated motor actuated operation, or with motor actuated supervisory control operation.

37. To mechanically design the flow control system such that it is fully scalable.

38. To supply a digital readout on site or remote, of the flow through the gate.

39. To supply a push button system to move the gate either up or down or to position the gate to automatically meet a set point or to search for a new set point.

40 To be able to rotate the gate into a position to sluice the canal clean.

41. To include an absolute rotary pulse encoder sensor to provide a fixed electronic positioning mark when power is interrupted.

42. To supply vertical and horizontal set screws to reposition the structure at the site to accommodate seal variations and friction issues.

43. To supply split babbitt bearing blocks for the rotating shaft, such that the gate may be lifted out the channel without having to remove the strut arms.

44. To be able to omit the counterweight and utilize a winch or hydraulic jack system to rotate the gate with positive drive in both directions.

45. To be placed inside a spillway area of a dam to permit both overshot and undershot flow modes.

46. To create a fish friendly gate structure by closing off the back of the gate leaf, so as not impinge upon the swimming fish.

47. To safely spill fish over the spillway gate using less water than a standard radial gate which only opens from the bottom.

48. To save millions of gallons of water by safely spilling fish over the spillway, thereby allowing the saved water to be passed through the hydropower turbines to create additional electricity.

49. To safely spill trash and ice in the overshot mode.

50. To allow for greater control of small flows over the top of a large spillway gate as opposed to the passing of water under the large gate.

51. To be able to retrofit the gate into the existing trunnion pin area of a dam.

52. To be able to create a new trunnion pin area in the dam so as to minimize the size of the device and also minimize the load on the gate.

53. To alter the geometry of the back of the gate when used with a dam, so as to guide the tailrace waters to a position desirable to the dam operator.

54. To be able to have adjacent units of the flow control structure control upstream water level and pass trash at the same time.

55. To use electronic salinity measuring devices to control the flow of saline waters into a wetland area.

56. To be able to provide the entire flow control structure, with tested water seals, as a unit to drop into any interior or exterior environment.

57. To be able to remotely control the flow of water in marsh management situations.

The “automated” metering gate of this invention controls and meters the flow of water in an open channel flow canal for UV treatment, from reservoirs, in large dams, and in general water conveyance or in an irrigation channel. The automated metering gate of this invention serves as a controller and a highly accurate measuring device as well. The automated metering gate is designed to provide for a single fully automated controlled structure to both control and measure flow using either standard weir or submerged orifice formulas for flow measurement as both an overshot and an undershot water control gate. The gate is also designed to sluice itself clean of any silt or debris build up.

The fully scalable automated metering gate of this invention is a drop in unit, which after being calibrated in both field tests and in a hydraulics lab requires a minimum of installation adjustments. The flow control structure utilizes known technologies that require low to no maintenance over long periods of time.

The shape of the gate leaf is that of a section of a cylinder. A shaft is located at the center of the cylinder. Support arms connect the inside surface of the gate leaf and the shaft. A counter balance weight is provided at the opposite side of the shaft from the gate leaf, so as to minimize the moment created by the weight of the gate leaf. The fluid pressure on both sides of the gate leaf surface acts perpendicular to the gate leaf surface and, in fact, goes through the shaft. Therefore, there is no turning load on the gate leaf due to the fluid pressure. Turning power applied to the shaft is only required to overcome friction.

The radius of the gate leaf is chosen so that the gate leaf surface is tangentially sealed at the bottom of the channel. Therefore, the gate leaf serves as a weir when the bottom of the gate is sealed and as an orifice when the gate leaf is raised.

Flow rate can be measured by weir flow formulas and orifice flow formulas depending on the flow conditions. When the energy in the channel is high, a sharp crested weir flow can be formed. When the energy in the channel is low, an orifice flow can be formed. The desired flow in the channel can be controlled by the orientation of the gate leaf.

The channel can be fully opened when the gate leaf is oriented above the water surface. Therefore, the channel is self-cleaning.

A rotary position pulse encoder connected to the shaft can accurately measure the position of the gate leaf at a resolution of +/- 1 mm over a 10' radius range. With inputs from upstream and downstream water level sensors, software senses when the gate needs to measure in either weir or submerged orifice positions and can alter the program to accommodate either mode or automatedally rotate the gate leaf to a correct elevation while again, automatedally measuring the flow.

The flow control structure of this invention can be used as a stand alone device, or in a group. When connected in a group, the units may be connected in series to control the flow in one channel, or in parallel to control the flow from one channel to several other channels. Whether used alone or in groups, the flow control structures may be remotely controlled. Typical applications for the flow control structure of this invention are in irrigation, bayou salinity control, rivers for permitting fish passage, as large gate for spillways, and for controlling flow to UV machines in waste water plants.

As compared to prior flow control devices, the automated metering system of this invention can output precise flow measurements after an extensive calibration effort for a fully scalable range of almost any size gate structure. It can automatically continuously adjust to all flow conditions using its sensors in an uninterrupted manner, without the need of personnel. A stiff drive arrangement, such as a worm gear actively stabilizes the automated metering system of this invention against a variety of flows.

By accurately metering flow, the automated metering system of this invention can maintain automated upstream or downstream water levels to better manage water, allowing others to have more water to use for other purposes. Multiple automated metering systems connected together can be programmed to avoid unnecessary water spills from being contaminated with farm pesticides which, at the end of the channel would need to be processed through a waste water plant before being returned to use.

The automated metering system provides for flow under the gate as it is raised, and overflow as a weir as the gate is moved downward through the ordinary closed position. This allows the reliable upstream level control associated with weir flows, and the steady discharge rates downstream associated with flows under a control gate. The overflow weir mode passes floating trash well, and the underflow mode passes bed load sediments well. The gate has potential uses beyond irrigation, such as salinity control for marsh management applications, and use on large dams where fish passage is often regulated with weir overflow that is above the usual fish population swim depth.

The purpose of the fish friendly automated metering gate is to control flow through a spillway of a dam in either undershot or overshot modes using a single water control structure. The counterweighted, fully scalable device can be made to either rotate upwards, as a standard radial gate allowing for submerged flow under the gate or downwards allowing for weir flow over the top. The benefit to dam owners is that by using the overshot mode this configuration allows fish swimming at the top of the reservoir or canal to easily pass over the top of the water control structure with a minimum amount of water loss. By decreasing voluntary spill from a typical undershot mode much more water can be made to pass through the turbines thereby increasing the generation of hydropower.

The design of the fish friendly automated metering gate is a modification of a standard radial gate. One of the main design features of the device is that it may be retrofitted into the existing trunnion pin area of the spillway opening without the need to modify any of the existing structure of the dam.

However if the maximum pool elevation is deemed too high then the trunnion pin for the fish friendly automated metering gate may be moved both upwards and closer upstream in efforts to reduce the size of the arc of the gate. In these circumstances additional fortification around that area would be needed. One technique suggested for this is the addition of a steel element placed inside a cored opening through the pier at the new trunnion pin area. Then fitting steel plates connected to the new element against the sides of the spillway sidewall will spread out the increased loads. In both cases the use of the counterweight allows for a lower power requirement to actuate the gate and in some cases solar panels may be used to operate the system.

The fish friendly automated metering gate uses the same gate leaf, strut arms, trunnion pin and cable/drum or hydraulic jack to activate the gate.

In this configuration the back mounted counterweight is attached to a continuation of the strut arms opposite the end of the gate leaf. This balanced configuration allows the unit, actuated from the turning shaft to rotate equally in both directions. In other configurations standard radial gate actuators, cables and drums or hydraulic jack means connected to the gate leaf may rotate the gate in both modes by raising the gate for the undershot mode and allowing the weight of the gate to tangentially swing in an arc passed its bottom seal mounted on the spillway.

The counter balance weight minimizes the moment created by the weight of the gate. The fluid pressure on both sides of the gate's surface acts perpendicular to the gate surface and, in fact, goes through the turning shaft. Therefore, there is no load on the gate due to the fluid pressure. Power is required only to overcome the frictions.

The bottom seal being mounted to the floor of the spillway instead of to the gate itself tangentially contacts the seal in the closed and all overshot mode positions. The stainless steel mounting assembly calls out for a centered flexible natural rubber extrusion with a fluorocarbon cladding. This configuration has both a low friction and high wear resistance. Standard radial gate side seals mounted to the sidewalls are utilized for the ends of the gate.

To make the gate fish friendly the backside of the gate leaf is closed off with a flat-sheeted steel top plate. In addition thin teardrop shaped strut arm covers provide fully radiused surfaces for the fish to safely move over the gate structure. The flat plate has been designed to mimic the flow of a removable spillway weir.

In addition to controlling flow the fish friendly automated metering gate serves as a highly accurate flow-measuring device. The unit has been designed to allow for a single fully automated SCADA structure to both control and measure flow using either standard weir or submerged orifice formulas for flow measurement as an overshot or undershot water control gate. The gate is also designed to sluice itself clean of any silt or debris build up. Of course during flooding conditions the gate can be make to swing fully open for maximum discharge.

One method of powering the gate is to use a single large helical gear mounted on the outside of one end of the turning shaft connected to a bottom mounted motor actuated worm gear which provides fail in place operation. This construct may work in conjunction with the standard cable/drum or hydraulic jack actuator.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of a first embodiment of an automated metering gate in accordance with this invention;

FIGURE 2 is a perspective view of the automated metering gate of Fig. 1, with a sidewall removed and with the gate leaf in a raised position;

FIGURE 3 is a perspective view of the automated metering gate of Fig. 1, with a sidewall removed and with the gate leaf in the closed position;

FIGURE 4 is an exploded perspective view of the automated metering gate of Fig. 1, with the gate leaf raised above the channel:

FIGURE 5 is a perspective view of the automated metering gate of Fig. 1, with a sidewall removed and with the gate leaf in positioned for flow over the top lip of the gate leaf;

FIGURE 6 is a perspective view of the automated metering gate of Fig. 1, with a first sidewall removed, the gate leaf in the closed position, and one of the semicircular sealing segments removed from the second sidewall;

FIGURE 7 is a perspective view of a second embodiment of an automated metering gate in accordance with this invention, with the channel removed;

FIGURE 8 is a detailed cross-sectional view of the sealing arrangement between a sidewall and the weir blade;

FIGURE 9 is a detailed cross-sectional view of the leaf gate and the weir blade;

FIGURE 10 is a detailed cross-sectional view of the raised member and sealing arrangement provided on the bottom of the channel for engagement with the gate leaf;

FIGURE 11 is a cross-sectional view of the automated metering gate of this invention as used with a dam for passing fish over the dam in a fish friendly manner, showing the flow control leaf gate in a closed position;

FIGURE 12 is a cross-sectional view of the automated metering gate of this invention as used with a dam for passing fish over the dam in a fish friendly manner, showing the flow control leaf gate in a fish passage overshot mode;

FIGURE 13 is a cross-sectional view of the automated metering gate of this invention as used with a dam for passing fish over the dam in a fish friendly manner, showing the flow control leaf gate in an under shot flood discharge position;

FIGURE 14 is a perspective view of the flow control gate and flow control gate leaf support as modified for use in a fish friendly manner;

FIGURE 15 is a perspective view of the flow control gate and flow control gate leaf support as modified for use in a fish friendly manner;

FIGURE 16 is a perspective view of two of the automated metering gates of this invention as used to control the flow of water in and out of a bayou;

FIGURE 17 is an operator interface terminal menu tree for the operation of the automated metering gate of this invention; and

FIGURE 18 is a continuation of the operator interface terminal menu tree of FIGURE 17.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, a first embodiment of the automated metering gate of this invention will be described. The flow control structure 10 or automated metering gate of this invention includes a channel 12, formed with an elongated bottom 14 and parallel sidewalls 16 and 18. The elongate bottom 14 and the sidewalls 16 and 18 are formed of sheet metal 20 which is secured to a grids 22 of tubular metal stock. By using the tubular metal stock to reinforce the sheet metal 20, the channel 12 is of lighter weight than would be the case if the bottom 14 and sidewalls 16 and 18 were formed of sheet metal thick enough to be self supporting.

A semicircular or semi-cylindrical flow control leaf gate 24 is supported from a support shaft 26 by leaf gate support members 28, which extend from the concave or back side of the leaf gate 24. The support shaft 26 is support on sidewalls 16 and 18 by a pair of support bearings 30 and 32. Also supported by the support shaft 26 is a counter weight 34. The counter weight 34 is support from the support shaft 26 by a pair of support arms 36 and 38. The counter weight 34 is attached to the support arms 36 and 38 such that it may be readily removed for shipment apart from the balance of the flow control structure. Grooves 40 are formed in the sidewalls 16 and 18 for receiving sealing members which engage the edges 44 of the leaf gate 24.

Referring to Fig. 2, the bottom lip 46 of the leaf gate 24 is provided with a rounded smooth curved surface 48, which mates with a sealing member 50 provided on the elongated bottom 14. The top lip of the leaf gate 24 is provided with a weir blade 52. The weir blade 52 is pivotally mounted on the top lip of the leaf gate 24. The weir blade, which is provided with sharp crest, is maintained in a vertical position as the leaf gate is rotated by a positioning mechanism 54 including linkage arms 56 and 58.

Referring to Fig. 1 - 6, the leaf gate is shown in the closed position in Figs. 1, 3 and 6, in the undershot mode in Fig. 2, wherein water may flow under the gate, and in the overshoot mode in Fig. 5, wherein water may flow over the gate. In Fig. 4, the flow control structure is shown with the leaf gate, support shaft, counter weight and bearings spaced above the sidewalls 16 and 18. In Figs. 4 and 6, sealing members 60 and 62 are shown spaced from the grooves 40 and 42 in which they are received.

Fig. 7 shows another embodiment of the flow control structure 10, except for the channel 10. Like components of the flow control structure are identified with the same numerals as in Figs. 1 - 6. As shown in Fig. 7, the leaf gate is supported by a pair of pie shaped members 64 and 66. In addition to the elements shown in Figs. 1 - 6, an air dispensing system 68 is shown. The air dispensing system 68 includes tubes or pipes 70 and 72 mounted on the pie shaped members 64 and 66 for carrying compressed air supplied at ends 74 and 76 of pipes 70 and 72 to air dispenser 78 and 80 positioned on the back side of the leaf gate 24, under the weir blade 52. The air is provided to promote smooth flow of water over the weir blade 52, such that a weir flow formula my be used to determine to volume of water flow over the leaf gate 24. Also shown in Fig. 7 is a rotary pulse encoder sensor which provides an electrical signal to a control mechanism to indicate the position of the gate. The rotary pulse encoder is able to measure the position of the gate leaf with a resolution of +/- 1 mm over a 10 foot radius.

Referring to Fig. 8, the sealing arrangement between a sidewall 16 and the weir blade 52 is shown in detail. The base of an extruded resilient seal 82 is secured to the sidewall 16, with a bulb like free end 84 engaging the weir blade 52. A side seal 86 is secured to the weir blade, with a free end 88 engaging the sidewall 16.

Referring to Fig. 9, the weir blade 52 is shown connected to the leaf gate 24 by a hinge 90. The resilient sealing member 92 spans the hinge 90 to prevent water from passing between the weir blade 52 and the leaf gate 24. Also shown in Fig. 9 is the air dispenser 78 and a bracket 94 to which is connected the linkage arm 56, which causes the weir blade 52 to be pivoted with respect to the leaf gate 24 when the leaf gate is rotated. It should also be noted that the weir blade is provided with a sharp edge 96.

Referring to Fig. 10, a raised member and sealing arrangement formed under the gate leaf 24 on the bottom 24 of the channel 12 is shown in cross-section. The raised member includes a retainer plate and lead ramp 98 which secures an elongated strip 100 of resilient material having a flourocarbon cladding over a somewhat flexible hose 102, which is held in position by a pair of half rounds 104.

Referring to Figs. 11-13, the use of the automated metering gate of this invention for the passage of fish over a dam in a friendly manner is shown.

Referring to Figs. 14 and 15, the modification of the automated metering gate of this invention for use in a fish friendly application is shown. As shown in Fig. 14, the gate leaf support members 28 are located close to the edges of the leaf gate 24, and are streamlined to aid the passing of fish by them. As shown in Fig. 15, the concave back side of the leaf gate 24 is covered by a flat member 106, which provides a better surface for the flow of water carrying fish over the leaf gate.

Referring to Fig. 16, the use of two of the automated metering gates of this invention are shown as used to control the flow of water into and out of a bayou. Due to the nature of the soil in bayous, a supporting deck resting on piles is used to support the flow control structure of the automated metering gates of this invention.

Figs. 17 and 18 set forth the operator interface terminal menu tree for the control of the automated metering gates of this invention. Following is the operation control Sequence which is related to the operator interface terminal menu tree.

Operation Control Sequence for flow control structure.

Receive and store the following data

Mode of operation—full open, full closed, overshot, undershot, or sluicing

Operation criteria—maintain upstream level, maintain downstream level, maintain flow rate, none

Set Points (as required)

- Upstream Level
- Downstream Level
- Flow Rate
- Totalized Flow
- Dead Band—for weir operation—flow control
- Dead Band—for weir operation—upstream level control
- Dead Band—for weir operation—downstream level control
- Dead Band—for orifice operation—flow control
- Dead Band—for orifice operation—upstream level control
- Dead Band—for orifice operation—downstream level control

Automated Operation

Automated Sluicing—enabled, disabled
Automated Obstruction Clearing (5 attempts)—enabled, disabled
Automated Switching--

- Weir to Orifice—enabled, disabled
- Orifice to Weir—enabled, disabled
- Free Flowing Orifice to Submerged Orifice—enabled, disabled
- Submerged Orifice to Free Flowing Orifice—enabled, disabled
- Automated Totalized Flow Operation—enabled, disabled

Alarms

High Upstream Level—enabled, disabled
Low Upstream Level—enabled, disabled
High Downstream Level—enabled, disabled
Low Downstream Level—enabled, disabled
High Flow Rate—enabled, disabled
Low Flow Rate—enabled, disabled

Store and output the following data (unless disabled)

Analog

Gate Angle
Upstream Water Level
Downstream Water Level
Flow Rate
Totalized Flow
Outside Temperature
Inside Temperature
Power Line Voltage
Battery Voltage
Battery Charge

Status Indicators

Undershot Mode—Submerged Orifice
Undershot Mode—Free Flow
Overshot Mode
Sluicing Mode

Gate Rising

Gate Lowering

Gate Full Open

Gate Full Closed

Battery Power

Line Power

Solar Power Operation Selected

Alarms

Overshot—Insufficient Free Fall

Undershot—Free Flow--Insufficient Upstream Level

Obstruction—Alert

Obstruction Trouble—not cleared after 5 attempts

High Upstream Level

Low Upstream Level

High Downstream Level

Low Downstream Level

High Flow Rate

Low Flow Rate

High Cabinet Temperature

Cabinet Door Open

PLC Trouble

Drive Controller Trouble

No Line Power

Calibration

Zero Point

The zero point for the pulse encoder is established by moving the gate until a level horizontal line from the pivot centerline to the calibration target affixed 2-inches below the top of the main gate structure. This places the calibration target six inches below the top of the movable weir blade. This corresponds to 3.900-degrees of rotation from the top edge of the weir blade and 74.00-degrees (verify) of rotation to the pipe seal.

Full Open

The gate is moved to the full open position

Store the absolute pulse encoder value

Full Closed

The gate is moved to the full closed position

Store the absolute pulse encoder value

Sluicing

The gate is moved to the sluicing position

Store the absolute pulse encoder value

Operation

Obtain angular displacement of gate from rotary pulse encoder.

This should be a negative value if the gate is depressed below the horizontal

Scale this value in decimal degrees.

Store this value.

Read input signal from upstream level sensor.

Scale this value in inches

Store the result

Read input signal from downstream level sensor

Scale this value in inches

Store the result

Assuming Overshot Operation—

Read the stored value for the angular displacement of the gate. (in degrees)

To this value add +3.900 degrees

Take the absolute value

Store it

Find the tangent of this angle

Multiply the tangent by 74.5 (gate radius—verify)

Subtract this value from the pivot elevation

This provides the actual elevation of the top of the weir.

Store it

Subtract the top of the weir elevation from the upstream water level

This is the value of "h" for the weir formula—store this value

Using the weir formula calculate the flow over the weir

Note: It may be necessary to use a coefficient to obtain weir flow—also it may be necessary to program a number of coefficients and choose between them

If it has not already been done—convert weir flow to cfs (cubic feet per second)

Store this value

Test for insufficient free fall—subtract downstream level from the top of the weir elevation

If this value is less than YY.YY-inches—trigger "Insufficient Free Fall" alarm

If Automated Switching is enabled—switch to Undershot Operation

Assume Undershot Operation

Read the stored value for the angular displacement of the gate. (in degrees)

Subtract 74.00-degrees (very likely two negative numbers are being added)

Take the absolute value

Store it

Find the tangent value of this angle

Multiply the tangent by 74.5 (gate radius—verify)

Subtract this value from the pivot elevation

This provides the height of square orifice

Obtain the downstream level

If this value is below XX.XX—calculate the flow using the "free flow" formula.

If this value is equal to or greater than XX.XX—calculate the flow using the "submerged" orifice formula

Assuming Free Flow operation

It may be necessary to use a coefficient to obtain correct flow—also it may be necessary to program a number of coefficients and choose between them

If it has not already been done—convert the flow to cfs (cubic feet per second)

Store this value

Test for insufficient upstream level—the upstream level must be higher than the height of the orifice opening

If it is not, trigger "Low Upstream Level" alarm

Test for a submerged discharge—the downstream level must be below the top of the orifice opening

If it is not, trigger "High Upstream Level" alarm—and

If Automated Switching is enabled—switch to Submerged Orifice operation

Assuming Submerged Orifice Operation

It may be necessary to use a coefficient to obtain correct flow—also it may be necessary to program a number of coefficients and choose between them

If it has not already been done—convert the flow to cfs (cubic feet per second)

Store this value

Test for submergence—insure downstream level is above the orifice opening

If it is not—trigger "Low Downstream Level" alarm—and

If Automated Switching is enabled—switch to Free Flow Orifice measurement

Test for sufficient head and available free fall—subtract downstream level from the upstream level

If this value is less than +2-inches (verify)—trigger "Low Downstream Level" alarm

If this value is greater than +12-inches (verify)--and

If Automated Switching is enabled—switch to Overshot Operation

Transition from Overshot Operation to Undershot Operation

Receive Command to make transition

Record flow rate

Refer to the section: "Assuming Undershot Operation"

Modify this procedure so that using the recorded flow above—calculate the new gate position

Move the Gate to the new position

Enable Undershot Operation as referred to in the section: "Assume Undershot Operation"

Transition from Undershot Operation to Overshot Operation

Receive Command to make transition

Record flow rate

Refer to the section: "Assuming Overshot Operation"

Modify this procedure so that using the recorded flow above—calculate the new gate position

Move the Gate to the new position

Enable Undershot Operation as referred to in the section: "Assume Undershot Operation"

Additional Programming Requirements

Provide PID control for the following modes of operation:
Control Upstream Level
Control Downstream Level
Control Flow Rate

Provide PWM (pulse width modulation) for ramping the gate when it is close to its destination. This feature may be provided by the drive controller, if the VFD purchased has PWM speed control.

Program the following capabilities:
Move Gate Up
Move gate Down

Move Gate to Full open
Move Gate to Full Closed
Move to Sluicing Position
Automated Sluicing Cycle
Obstruction Detection
Automated Obstruction Clearing (5 attempts maximum)
Automated Totalizer Operation

Test and Demonstration Requirements

Determine the current flow rate in CFS
Move to a new CFS
Maintain a current CFS
Go to a predetermined position (disregarding CFS)
Go to another predetermined position
Alternate between these two points
Stall Gate—demonstrate warning signal
Demonstrate that the encoder and PLC do not lose track of gate position due to a power failure
Shoot the gate to all positions
Change upstream water level—have gate readjust to provide required CFS
Change downstream water level—have gate readjust to provide required CFS
Change upstream water level—have gate readjust to provide new CFS
Change downstream water level—have gate readjust to provide new CFS
Rotate gate full open to full closed
Rotate gate from full closed to full open

Demonstrate “ramping” as gate nears selected position
Have gate start in Undershot Mode, swing down to 2-inches fro the sealing position, and then seal or move to Overshot position
Demonstrate gate attempting to close on an obstruction (provide obstruction alarm) and then opening to clear itself (5 attempts) and then provide obstruction trouble alarm
Manually operate the gate and display CFS
Show how the desired CFS set point is shown on the top line of the display
Show how the actual CFS flow rate is displayed on the second line of the display
Have the technician manually adjust the flow rate with the hand wheel
Show the desired elevation in relation to the circular dial to get the proper CFS
Demonstrate automated sluicing of the gate
Demonstrate handling waves and hunting of the gate by deadband adjustment
Demonstrate a transfer from line power to solar power and back
Demonstrate the actuator motor stalling due to debris, and the resulting alarm
Display Power Line Voltage
Display Battery Voltage
Display Battery Charge

While several embodiments of the invention has been shown, it should be apparent to those skilled in the art that what have been described are considered at present to be preferred embodiments of the automated metering gate of this invention. In accordance with the Patent Statute, changes may be made in the automated metering gate without actually departing from the true spirit and scope of this invention. The appended claims are intended to cover all such changes and modification which fall in the true spirit and scope of this invention.

WHAT IS CLAIMED IS:

1. A flow control structure, for use in controlling the flow of a liquid, in a trough comprising:

a channel having first and second ends, formed by an elongated bottom of a predetermined width, and a pair of parallel sidewalls extending from said elongated bottom and spaced apart by said predetermined width,

a flow control gate leaf located in said channel between said first and second ends, having a semicircular shape with a convex surface facing toward the direction of flow of the liquid in said channel, and a concave surface facing toward the direction of flow of the liquid in said channel, top and bottom lips and parallel side edges,

a support shaft, the axis of said support shaft being perpendicular to said sidewalls,

a flow control gate leaf support attached to the concave surface of said flow control gate leaf for supporting said flow control gate leaf on said support shaft,

support bearings for pivotally supporting said support shaft, such that said flow control gate leaf may be rotated within said channel between positions wherein said flow control gate completely blocks the flow of the liquid in the channel, wherein the liquid may flow over the top lip of the flow control gate leaf, and wherein the liquid may flow under the lower lip of the flow control gate leaf.

2. The flow control structure of claim 1, wherein counter weight supports are attached to said support shaft for supporting a counterweight to balance about the center of said support shaft, said flow control gate leaf and flow control gate leaf supports, thereby reducing the force necessary to rotate the flow control gate leaf.

3. The flow control structure of claim 2, wherein said counterweight is removable secured to said counterweight supports, such that said counterweight may be secured to said counterweight supports after said flow control structure is placed in a trough for control of the flow of a liquid in the trough.

4. The flow control structure of claim 1, wherein said support shaft is located above said sidewalls.

5. The flow control structure of claim 1, wherein said support bearings are mounted on top of said side walls.

6. The flow control structure of claim 1, wherein said elongated bottom and said side walls form a U-shaped channel and said support bearings are mounted on top of said side walls, such that said flow control structure is preassembled for placement in a trough for control of the flow of a liquid in the trough.

7. The flow control structure of claim 6, wherein a wing wall is secured to each of said side walls, which wing walls extend to the sides of the trough in which said flow control structure is placed.

8. The flow control structure of claim 7, wherein said wing walls have a top edge which is below the tops of said side walls, thus forming spillways when the liquid level is higher than that which the flow control gate leaf is intended to control.

9. The flow control structure of claim 6, wherein said side walls and said elongated bottom are formed by a sheet material on the inner side, and reinforced by a grid of tubular members on the outer side.

10. The flow control structure of claim 7, including a pair of temporary end walls secured to said elongated bottom and said side walls at said first and second ends, to provide a more rigid assembly for testing and moving the flow control structure.

11. The flow control structure of claim 6, wherein said support bearing are adjustable mounted on said sidewalls, for positioning said flow control gate leaf in said channel.

12. The flow control structure of claim 1, wherein a raised member extends across said elongated bottom under said flow control gate leaf to form a fluid flow seal with the outer surface and bottom lip of said flow control gate leaf.

13. The flow control structure of claim 12, wherein said raised member is compressible.

14. The flow control structure of claim 12, wherein said raised member is provided with a wear resistant fluorocarbon surface for engaging the bottom lip of said flow control gate leaf.

15. The flow control structure of claim 12, wherein said raised member is provided with a friction reducing surface for engaging the bottom lip of said flow control gate leaf.

16. The flow control structure of claim 12, wherein said friction reducing surface may be readily removed and replaced.

17. The flow control structure of claim 1, wherein the bottom lip of said flow control gate leaf is formed as a smooth curved surface, so as to provide for an even discharge of liquid under said flow control gate.

18. The flow control structure of claim 1, wherein semicircular sealing segments are provided on said sidewalls to form a seal between said flow control gate leaf and said sidewalls.

19. The flow control structure of claim 18, wherein said semicircular sealing segments are compressively recessed in said sidewalls.

20. The flow control structure of claim 18, wherein said semicircular sealing segments may be readily removed and replaced when said control gate leaf is in the open position.

21. The flow control structure of claim 1, wherein said parallel side edges of said flow control gate leaf are formed with outer curved surfaces which engage said semicircular sealing segments.

22. The flow control structure of claim 21, wherein said outer curved surfaces are formed by round bars secured to said parallel side edges of said flow control gate leaf.

23. The flow control structure of claim 18, wherein said semicircular sealing segments are provided with a wear resistant flourocarbon surface for engagement with said outer curved surfaces of said flow control gate leaf.

24. The flow control structure of claim 1, wherein each of said support bearings are formed by a pair of semicircular bearing surfaces, such that said support shaft may be supported on a first one of said pair of semicircular bearing surfaces, and the second one of said pair of semicircular bearing surfaces then placed over said support shaft.

25. The flow control structure of claim 1, including a drive arrangement and an electric motor connected to said drive arrangement to rotate said support shaft and said flow control gate leaf.

26. The flow control structure of claim 25, wherein said drive arrangement includes a gear reduction drive.

27. The flow control structure of claim 26, provided with an operating member through which a manual rotational force may be applied to said gear reduction drive.

28. The flow control structure of claim 25, wherein said drive arrangement prevents rotation of said support shaft when not driven by said electric motor.

29. The flow control structure of claim 1, including a hydraulic drive system for rotating said support shaft and said flow control gage leaf.

30. The flow control structure of claim 1, including a pair of come-a-longs having first and second ends, for rotating said support shaft and said flow control gate leaf, operation of one of said come-a-longs rotating said support shaft and said flow control gate leaf in a first direction, and operation of the second one of said come-a-longs rotating said support shaft and said flow control gate in the opposite direction to said first direction.

31. The flow control structure of claim 30 wherein first ends of said come-a-longs are secured to the flow control gate leaf near the top lip and the second ends are secured on opposite sides of said flow control gate leaf so as to be fixed in position with respect to said top lip of said flow control gate leaf.

32. The flow control structure of Claim 30, wherein a radially extending lever arm is secured to said support shaft, and said first ends of said come-a-longs are secured to the radially extending lever arm.

33. The flow control structure of claim 1, wherein an elongated weir blade having a sharp crest and front and back sides, is pivotably mounted on said top lip of said flow control gate leaf.

34. The flow control structure of claim 33, including an air dispenser for introducing air along the length of said elongated weir blade under the liquid flowing over the elongated weir blade to promote laminar flow of the liquid over the elongated weir blade.

35. The flow control structure of claim 33, wherein said weir blade is readily removable from said top lip of said flow control gate leaf, thereby being readily replaceable.

36. The flow control structure of claim 35, wherein a positioning mechanism is provide to maintain said weir blade in a vertical position as said flow control gate leaf is rotated.

37. The flow control structure of claim 36, wherein said positioning mechanism includes linkage arms extending between the weir blade and the support shaft.

38. The flow control structure of claim 36, wherein said positioning mechanism is connected to the back side of the weir blade, thereby not interfering with liquid flow over the sharp crest of the weir blade.

39. The flow control structure of claim 1, wherein said flow control gate support includes a least two sets of strut arms, each of which extends from said inner surface of said flow control gate leaf to said support shaft.

40. The flow control structure of claim 39, wherein a first set of strut arms is located adjacent a first one of said sidewalls and a second set of strut arms is located adjacent a second one of said sidewalls.

41. The flow control structure of claim 40, wherein a first resilient member mounted on said first set of strut arms includes a portion which rubs against said first one of said sidewalls to remove debris therefrom, and a second resilient member mounted on said second set of strut arms includes a portion which rubs against said second one of said sidewall to remove debris therefrom.

42. The flow control structure of claim 39, wherein said strut arms are formed of elongated angle members.

43. The flow control structure of claim 39, wherein said strut arms are formed of elongated tubular members.

44. The flow control structure of claim 1, wherein a raised surface extends across said elongated bottom under said flow control gate leaf to form a fluid flow seal with the outer surface and bottom lip of said flow control gate leaf, and semicircular sealing segments are provided on said sidewalls to form a seal between said flow control gate leaf and said sidewalls, wherein when said flow control gate leaf is in a closed position essentially no liquid is permitted to flow past said flow control gate leaf.

45. The flow control structure of claim 1, including a pair of winches having first and second ends, for rotating said support shaft and said flow control gate leaf, operation of one of said winches rotating said support shaft and said flow control gate leaf in a first direction, and operation of the second one of said winches rotating said support shaft and said flow control gate in the opposite direction to said first direction

46. The flow control structure of claim 45 wherein a radially extending lever arm is secured to said support shaft, and said winches are secured to the radially extending lever arm.

47. The flow control structure of claim 1, wherein a non-concave surface extending between said top and bottom lips is provided over said convex surface, such that the flow of liquid which has passed over the top lip of the flow control gate is more desirable for the passage of fish over the top lip of the flow control gate.

48. The flow control structure of claim 47, wherein said non-concave surface is convex.

49. The flow control structure of claim 47, wherein a first set of strut arms is located adjacent a first one of said sidewalls and a second set of strut arms is located adjacent a second one of said sidewalls, whereby said strut arms are not obstacles to fish passing over said top lip of the flow control gate.

50. A flow control and measuring structure, for use in controlling and measuring the flow of a liquid, in a trough comprising:

a channel having first and second ends, formed by an elongated bottom of a predetermined width, and a pair of parallel sidewalls extending from said elongated bottom and spaced apart by said predetermined width,

a flow control gate leaf located in said channel between said first and second ends, having a semicircular shape with a convex surface facing toward the direction of flow of the liquid in said channel, and a concave surface facing toward the direction of flow of the liquid in said channel, top and bottom lips and parallel side edges, an elongated weir blade having a sharp crest and front and back sides, is pivotably mounted on said top lip of said flow control gate leaf,

a positioning mechanism is provide to maintain said weir blade in a vertical position as said flow control gate leaf is rotated,

a support shaft, the axis of said support shaft being perpendicular to said sidewalls,

a flow control gate leaf support attached to the concave surface of said flow control gate leaf for supporting said flow control gate leaf on said support shaft,

support bearings for pivotally supporting said support shaft, such that said flow control gate leaf may be rotated within said channel between positions wherein said flow control gate completely blocks the flow of the liquid in the channel, wherein the liquid may flow over the top lip of the flow control gate leaf, and wherein the liquid may flow under the lower lip of the flow control gate leaf,

a first measuring device for providing an indication of the surface level of a fluid flowing over the sharp crest of the weir blade,

a second measuring device for providing an indication of the height of the sharp crest of the weir blade with respect to the surface level of the fluid flowing over the sharp crest of the weir blade, thereby providing the depth of the flow of the liquid over the sharp crest of the weir blade, whereby the volume of liquid flow over the sharp crest of the weir blade is determinable.

51. The flow control and measuring structure of claim 50, including a flow control gate leaf positioning system responsive to the volume of liquid flow, to adjust the

position of the flow control gate leaf, whereby desired volume of liquid flow may be maintained.

52. The flow control and measuring structure of claim 51, including an air dispenser for introducing air along the length of said elongated weir blade under the liquid flowing over the elongated weir blade to promote laminar flow of the liquid over the elongated weir

53. The flow control and measuring structure of claim 51, including a drive arrangement and an electric motor connected to said drive arrangement to rotate said support shaft, and said flow control gate leaf, wherein said flow control gate leaf positioning system controls the energization of said electric motor to rotate said support shaft and said flow control gate to provide the desired volume of liquid flow over said weir blade.

54. The flow control and measuring structure of claim 53, including an air dispenser for introducing air along the length of said elongated weir blade under the liquid flowing over the elongated weir blade to promote laminar flow of the liquid over the elongated weir blade.

55. The flow control and measuring structure of claim 53, including a electric storage battery for providing electrical energy to said flow control gate leaf positioning system and said electric motor.

56. The flow control and measuring structure of claim 55, including at least one solar panel for providing electrical energy to said battery and to said flow control gate leaf positioning system and said electric motor.

57. A flow control and measuring structure, for use in controlling and measuring the flow of a liquid, in a trough comprising:

a channel having first and second ends, formed by an elongated bottom of a predetermined width, and a pair of parallel sidewalls extending from said elongated bottom and spaced apart by said predetermined width,

a flow control gate leaf located in said channel between said first and second ends, having a semicircular shape with a convex surface facing toward the direction of flow of the liquid in said channel, and a concave surface facing toward the direction of flow of the liquid in said channel, top and bottom lips and parallel side edges,

an elongated weir blade having a sharp crest and front and back sides, is pivotably mounted on said top lip of said flow control gate leaf,

a positioning mechanism to maintain said weir blade in a vertical position as said flow control gate leaf is rotated,

a support shaft, the axis of said support shaft being perpendicular to said sidewalls,

a flow control gate leaf support attached to the concave surface of said flow control gate leaf for supporting said flow control gate leaf on said support shaft,

support bearings for pivotally supporting said support shaft, such that said flow control gate leaf may be rotated within said channel between positions wherein said flow control gate completely blocks the flow of the liquid in the channel, wherein the liquid may flow over the top lip of the flow control gate leaf, and wherein the liquid may flow under the lower lip of the flow control gate leaf,

a first measuring device for providing an indication of the surface level of the liquid on said convex surface of said flow control gate, a second measuring device for indicating the spacing between the bottom lip of said flow control gate leaf and the elongated bottom,

an indicating device responsive to said first and second measuring devices for indicating the volume of liquid flow between the bottom lip of said flow control gate leaf and the elongated bottom is determinable.

58. A method for controlling the movement of fish between a first containment pond and a second containment pond utilizing a flow control structure comprising:

a channel having first and second ends, formed by an elongated bottom of a predetermined width, and a pair of parallel sidewalls extending from said elongated bottom and spaced apart by said predetermined width,

a flow control gate leaf located in said channel between said first and second ends, having a semicircular shape with a convex surface facing toward the direction of flow of the water in said channel, and a concave surface facing toward the direction of flow of the water in said channel, top and bottom lips and parallel side edges,

a support shaft, the axis of said support shaft being perpendicular to said sidewalls,

a flow control gate leaf support attached to the concave surface of said flow control gate leaf for supporting said flow control gate leaf on said support shaft,

support bearings for pivotally supporting said support shaft, such that said flow control gate leaf may be rotated within said channel between positions wherein said flow control gate completely blocks the flow of the water in the channel, wherein the water may flow over the top lip of the flow control gate leaf, and wherein the water may flow under the lower lip of the flow control gate leaf, a non-concave surface extending between said top and bottom lips is provided over said convex surface, such that the flow of liquid which has passed over the top lip of the flow control gate is more desirable for the passage of fish over the top lip of the flow control gate,

the method comprising:

lowering said flow control gate leaf so that water flows over the top lip of the flow control gate leaf, carrying with it top feeding fish in said first containment pond to said second containment pond,

raising said flow control gate leaf so that water flows under the bottom lip of the flow control gate leaf, carry with it bottom feeding fish in said first containment pond to said second containment pond.

59. A flow control structure, for use in controlling the flow of a liquid, in a trough comprising:

a channel having first and second ends, formed by an elongated bottom of a predetermined width, and a pair of parallel sidewalls extending from said elongated bottom and spaced apart by said predetermined width,

a flow control gate leaf located in said channel between said first and second ends, having a semicircular shape with a convex surface facing toward the direction of flow of the liquid in said channel, and a concave surface facing toward the direction of flow of the liquid in said channel, top and bottom lips and parallel side edges,

a support shaft, the axis of said support shaft being perpendicular to said sidewalls, a flow control gate leaf support attached to the concave surface of said flow control gate leaf for supporting said flow control gate leaf on said support shaft,

support bearings for pivotally supporting said support shaft, such that said flow control gate leaf may be rotated within said channel between positions wherein said flow control gate completely blocks the flow of the liquid in the channel, wherein the liquid may flow over the top lip of the flow control gate leaf, and wherein the liquid may flow under the lower lip of the flow control gate leaf.

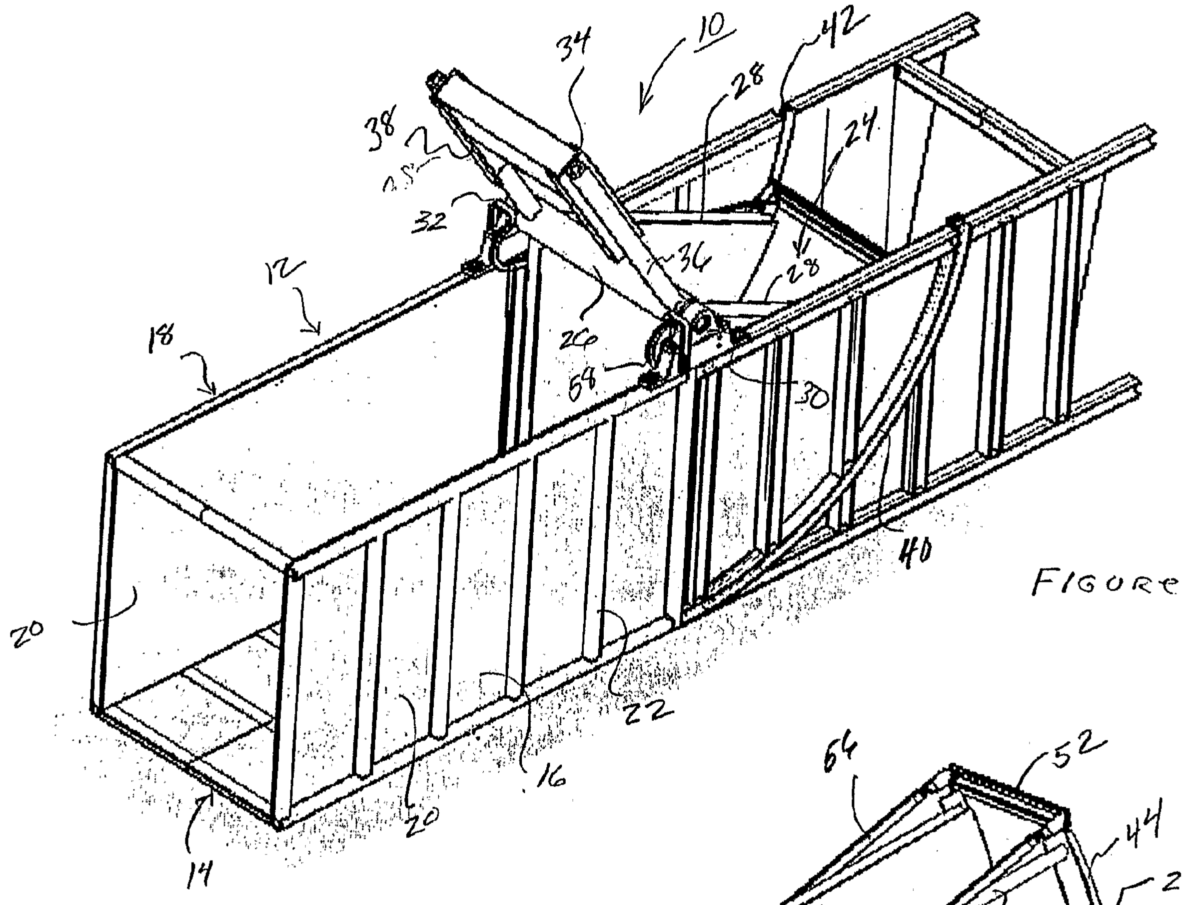


Figure 1

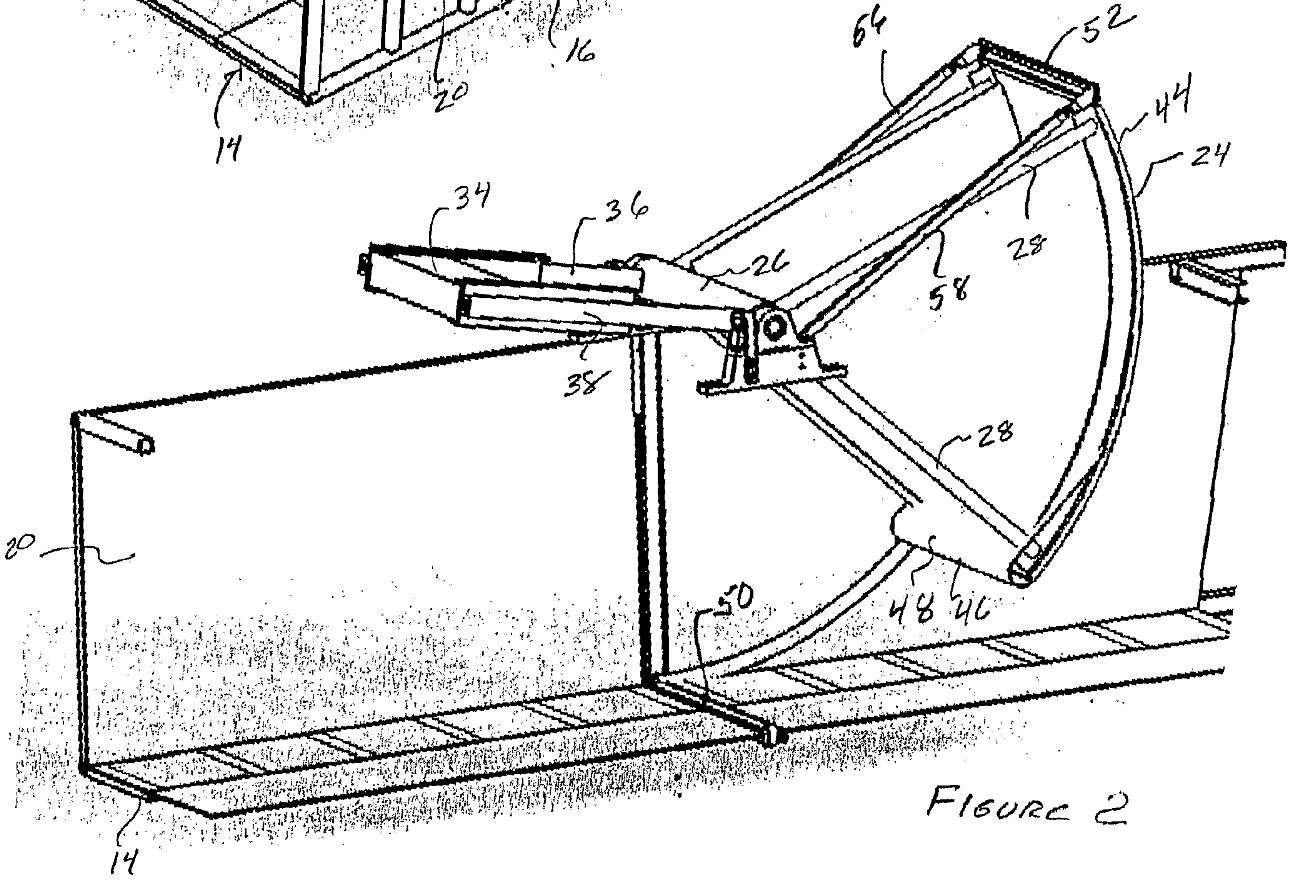


Figure 2

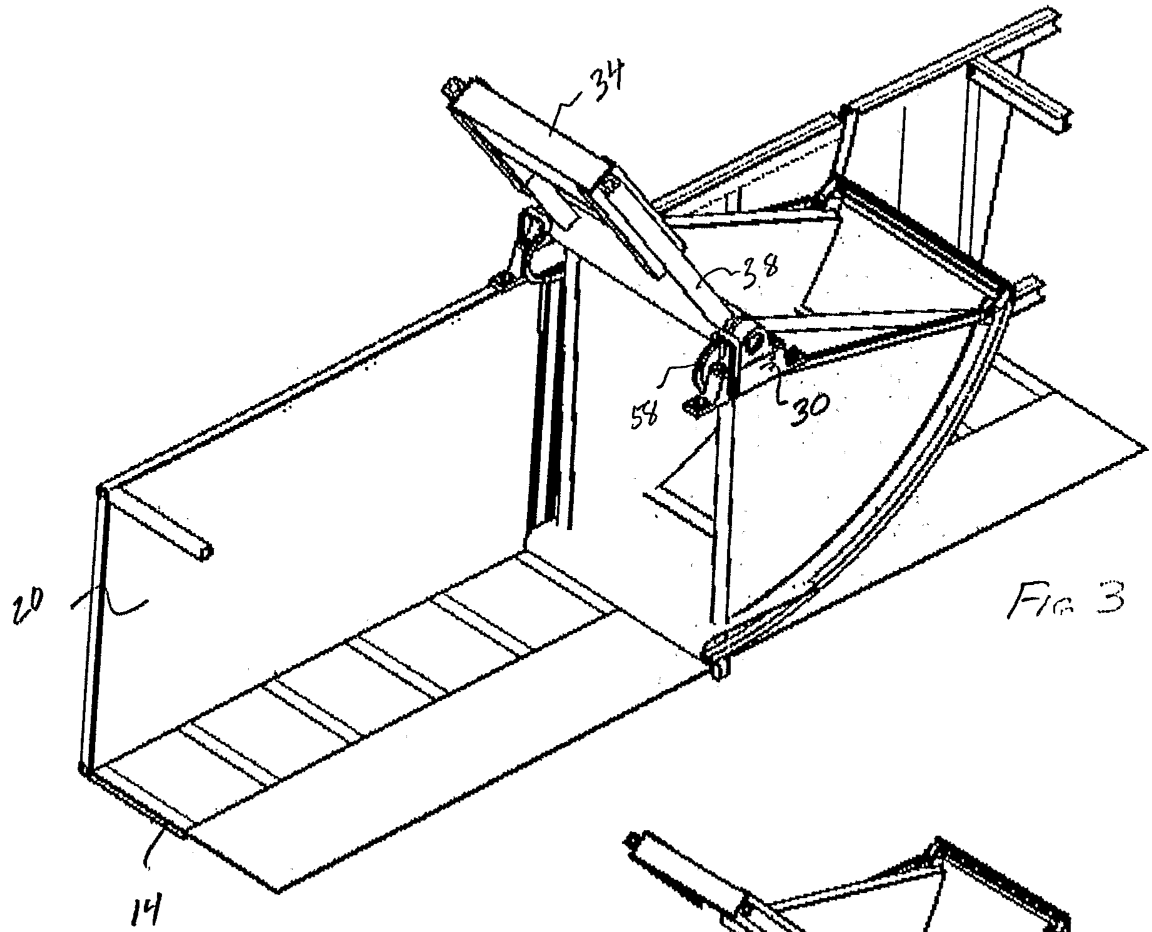


Fig. 3

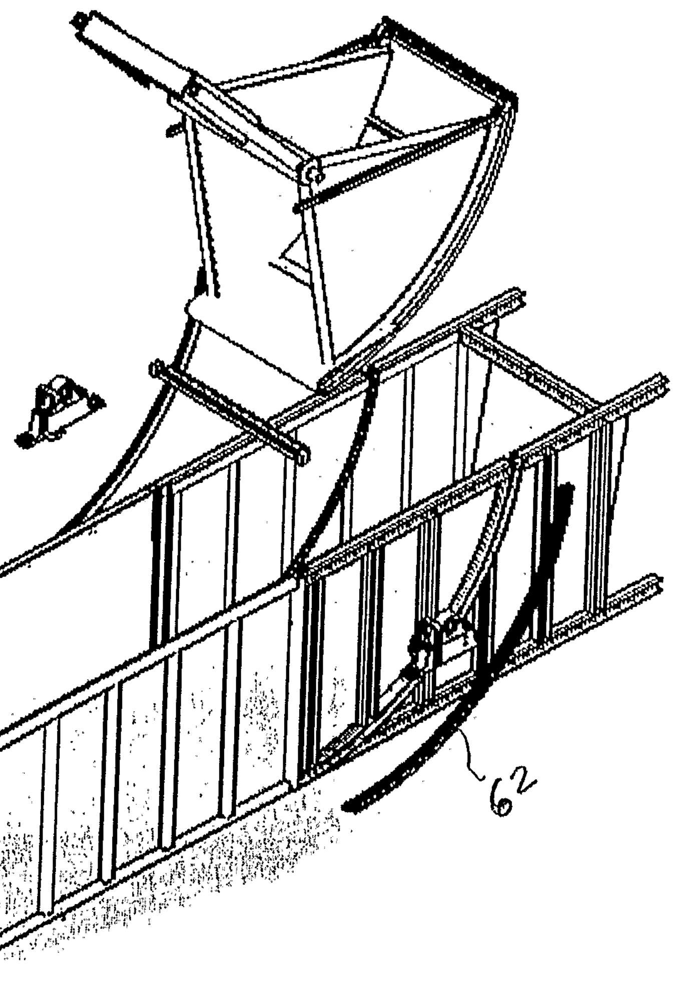


Fig. 4

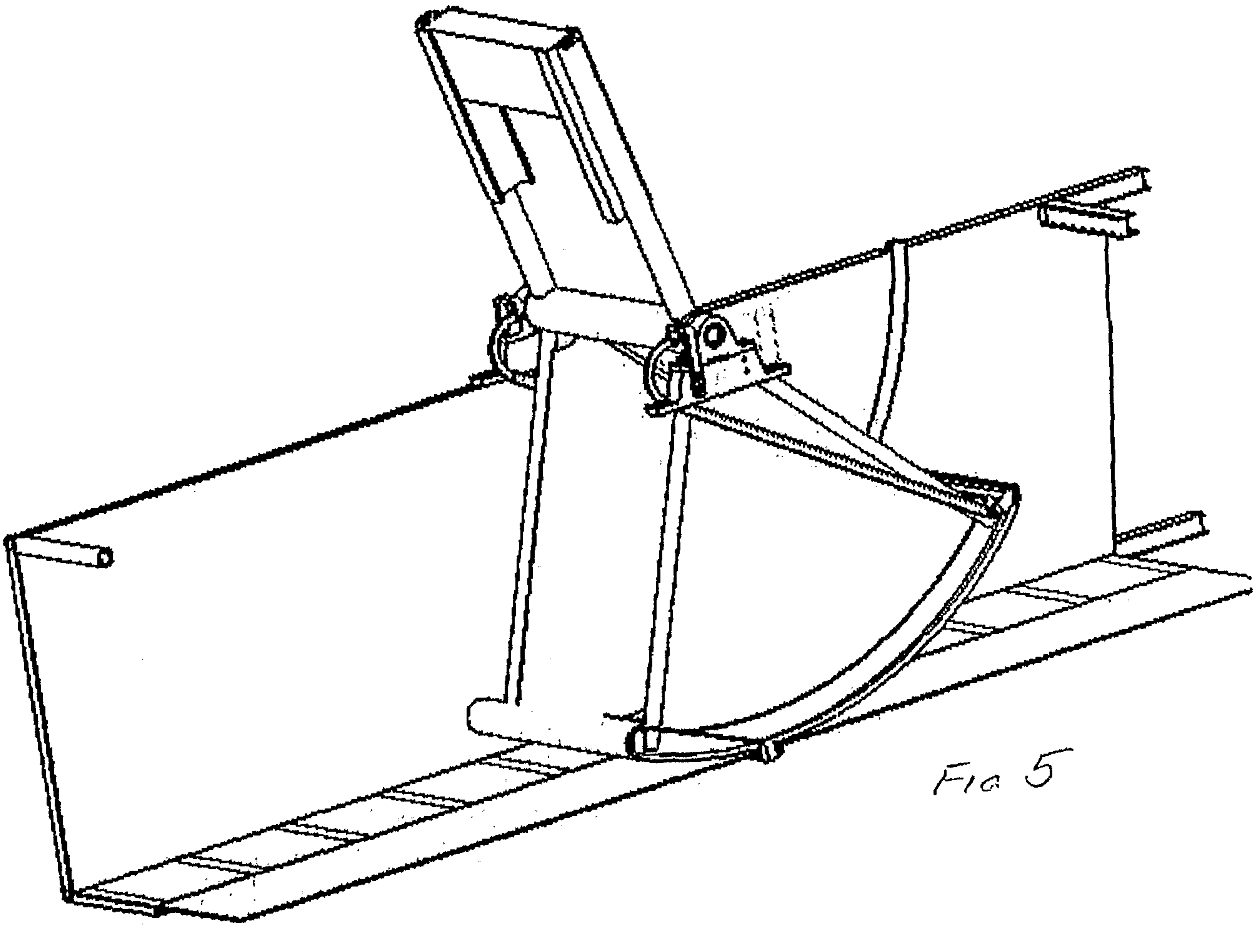


Fig 5

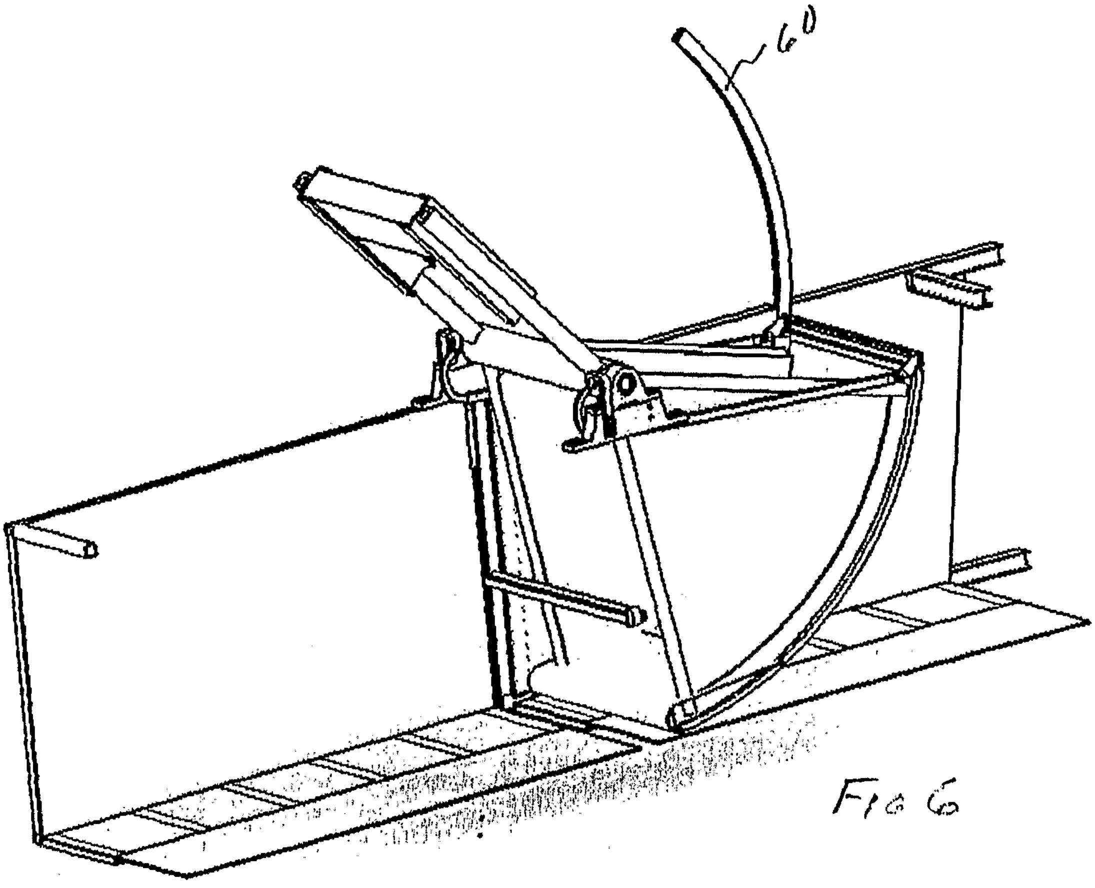


Fig 6

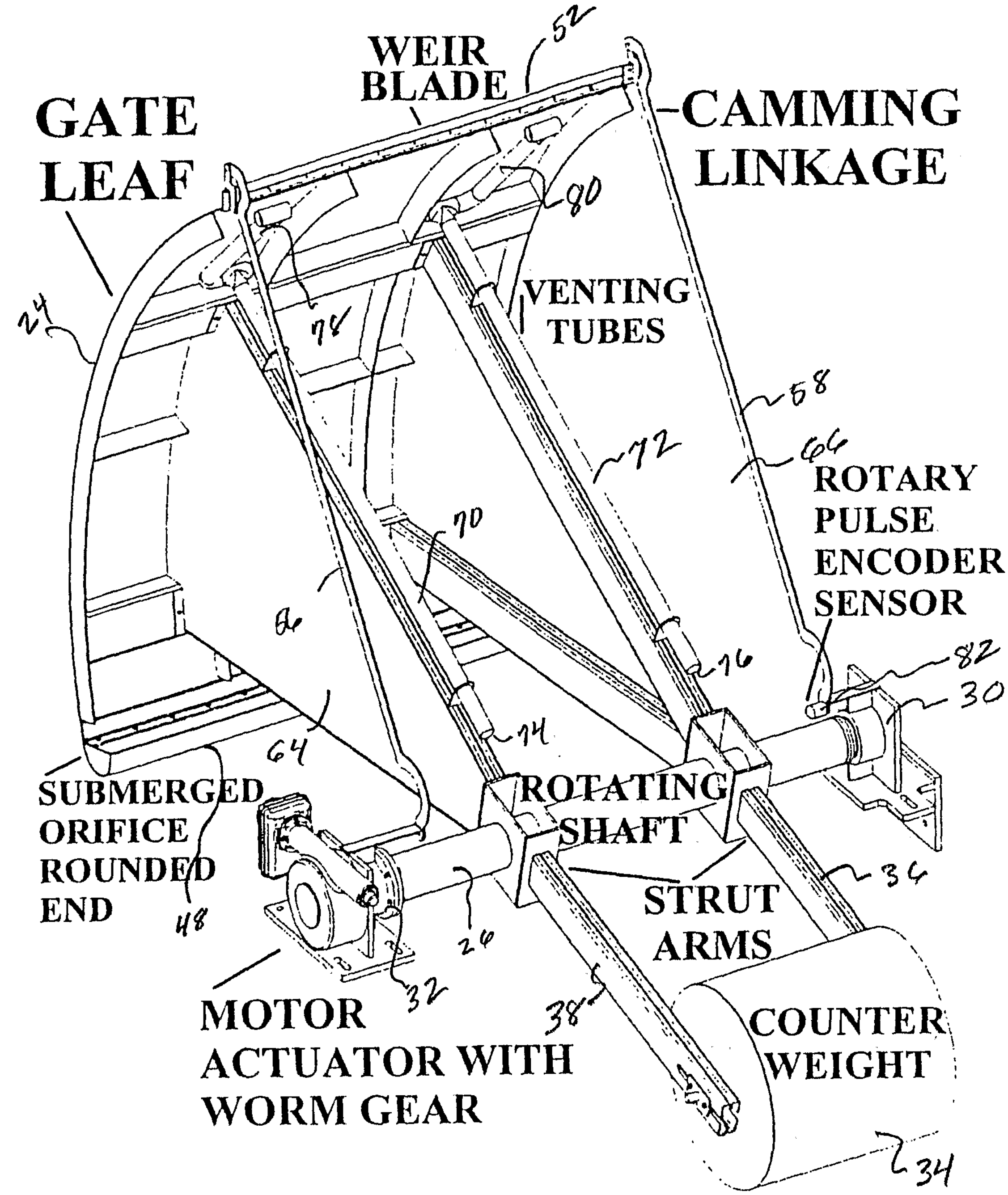
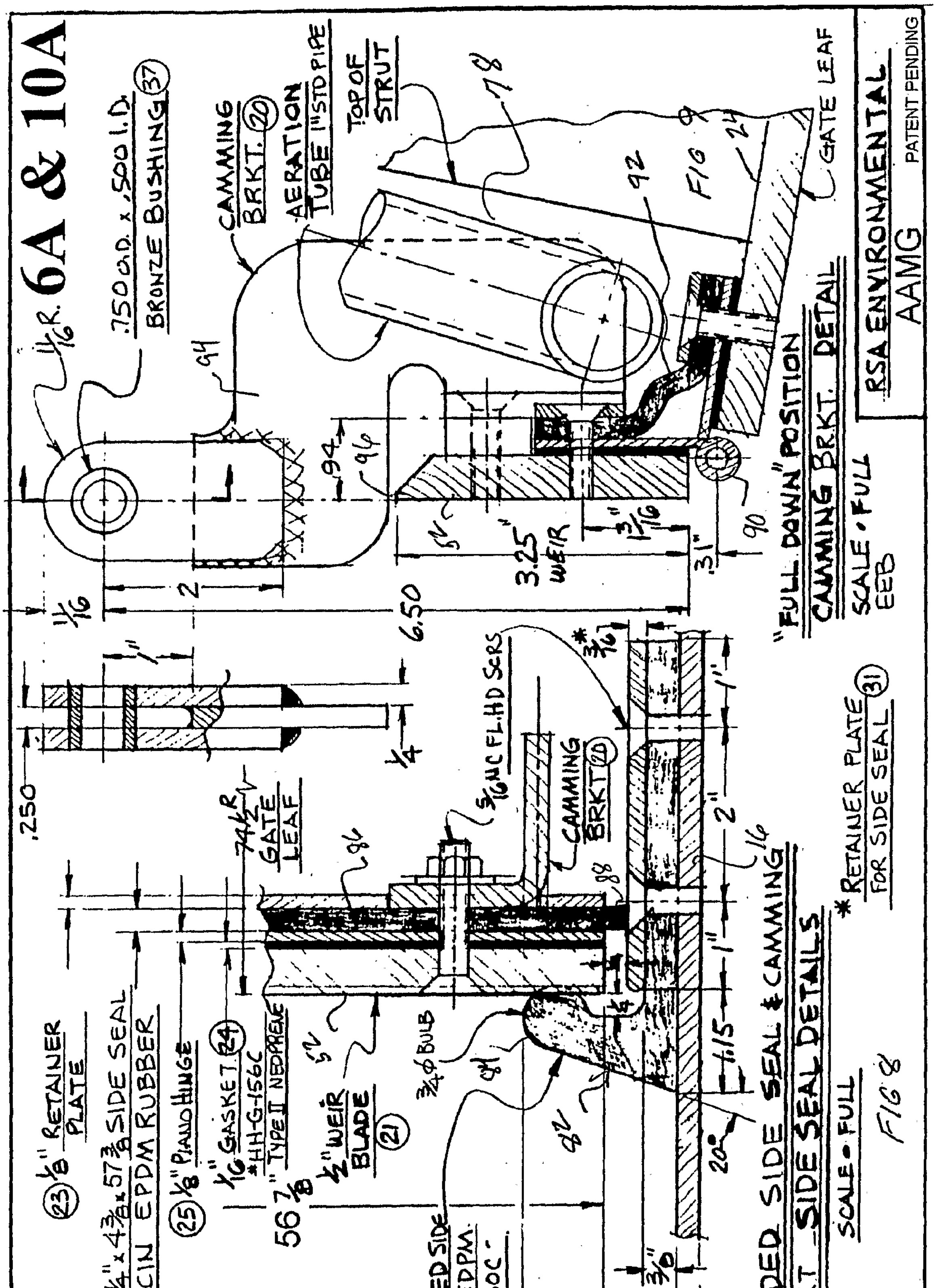

WEIR
BLADE
52
GATE
LEAF
CAMMING
LINKAGE
80
24
78
VENTING
TUBES
58
72
66
ROTARY
PULSE
ENCODER
SENSOR
70
76
82
30
74
64
SUBMERGED
ORIFICE
ROUNDED
END
48
ROTATING
SHAFT
36
STRUT
ARMS
26
32
MOTOR
ACTUATOR WITH
WORM GEAR
38
COUNTER
WEIGHT
34

FIG. 7


6A & 10A
1/16 R.
.750 O.D. x .500 I.D. BRONZE BUSHING 37
CAMMING BRKT. 20
AERATION TUBE 1" STD PIPE
TOP OF STRUT
78
94
92
96
90
24
FIG 9
GATE LEAF
"FULL DOWN" POSITION
CAMMING BRKT. DETAIL
SCALE • FULL
EEB
3.25" WEIR
6.50
2
1/16
.94
3/16
.31"
RSA ENVIRONMENTAL
AAMG
PATENT PENDING
23 1/8" RETAINER PLATE
22 1/4" x 4 3/8 x 57 3/8 SIDE SEAL CIN EPDM RUBBER
25 1/8" PIANO HINGE
1/16" GASKET 24 *HH-G-156C TYPE II NEOPRENE
56 7/8
1/2" WEIR BLADE 21
GATE LEAF
5/16 NC FL.HD SCRS
CAMMING BRKT 20
3/4 Φ BULB
30 EXTRUDED SIDE SEAL-EPDM *SU66260C-
*RETAINER PLATE FOR SIDE SEAL 31
.250
1/4
1.15
20°
1"
2"
60" BOX
1/4 A36 BOX
EXTRUDED SIDE SEAL & CAMMING
BRKT SIDE SEAL DETAILS
SCALE • FULL
FIG 8

10

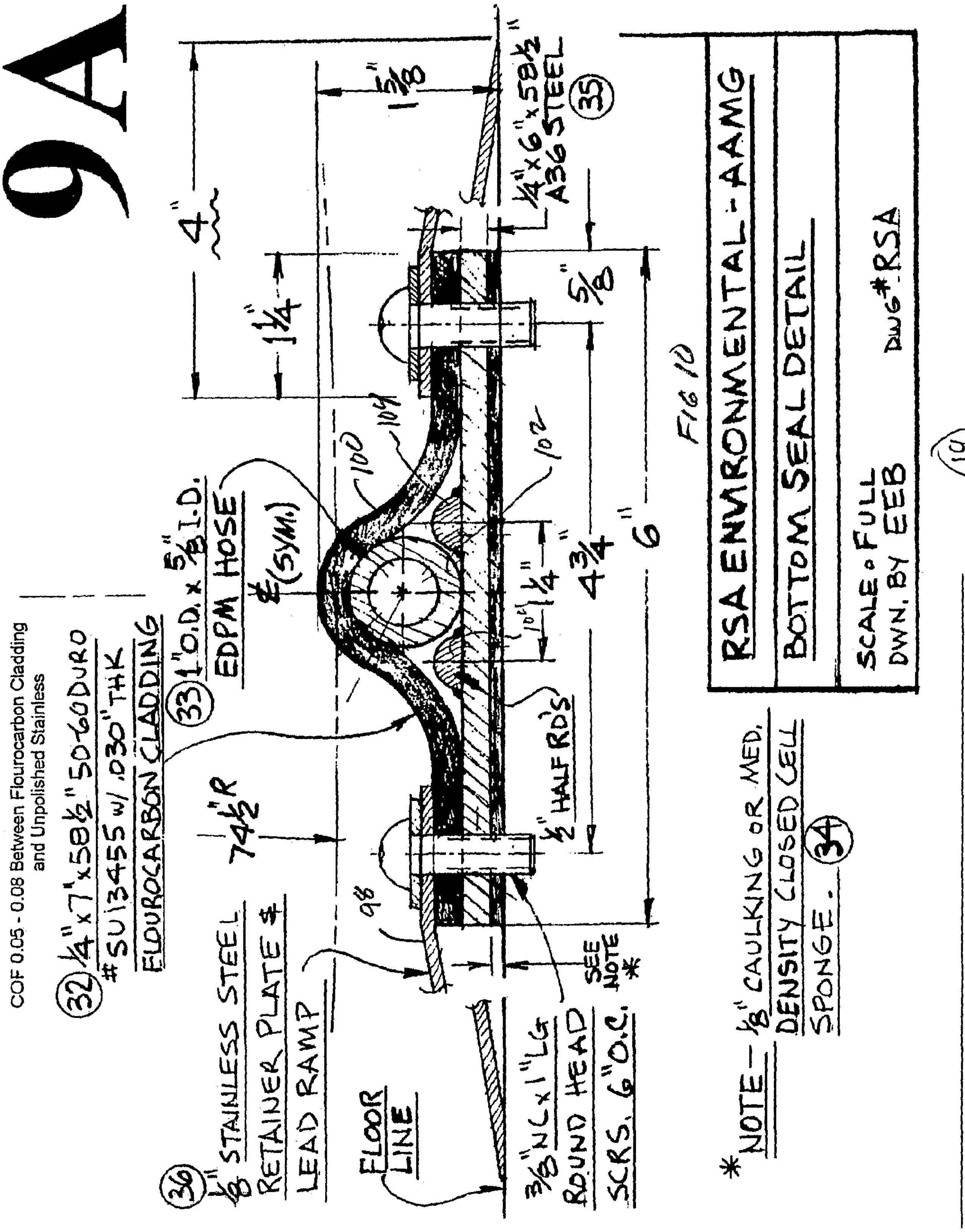

9A
COF 0.05 - 0.08 Between Flourocarbon Cladding and Unpolished Stainless
32 1/4" x 7' x 58 1/2" 50-60 DURO
#SU13455 w/ .030" THK
FLOUROCARBON CLADDING
33 1" O.D. x 5/8" I.D.
EDPM HOSE
℄ (SYM.)
36 1/8" STAINLESS STEEL
RETAINER PLATE &
LEAD RAMP
FLOOR LINE
3/8" NC x 1" LG
ROUND HEAD
SCRS. 6" O.C.
SEE NOTE *
1/2" HALF RD'S
74 1/2" R
4"
1 5/8
1 1/4"
5/8"
1 1/4"
4 3/4"
6"
1/4" x 6" x 58 1/2"
A36 STEEL
35
98
100
102
104
106
*NOTE - 1/8" CAULKING OR MED.
DENSITY CLOSED CELL
SPONGE. 34
RSA ENVIRONMENTAL - AAMG
BOTTOM SEAL DETAIL
SCALE: FULL
DWN. BY EEB
DWG# RSA
19

FIG 10

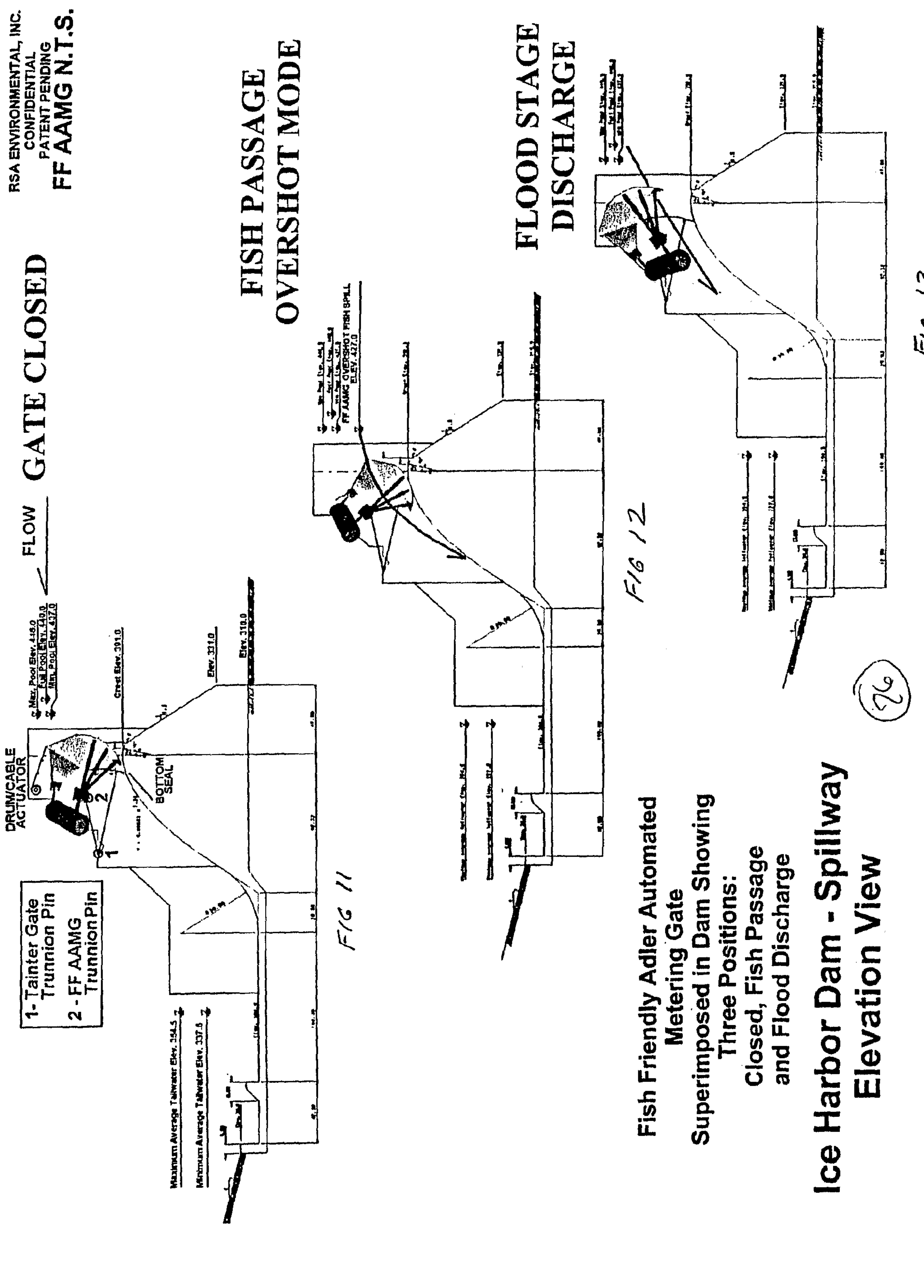


FIG 11

FIG 12

FIG 13

FLOW

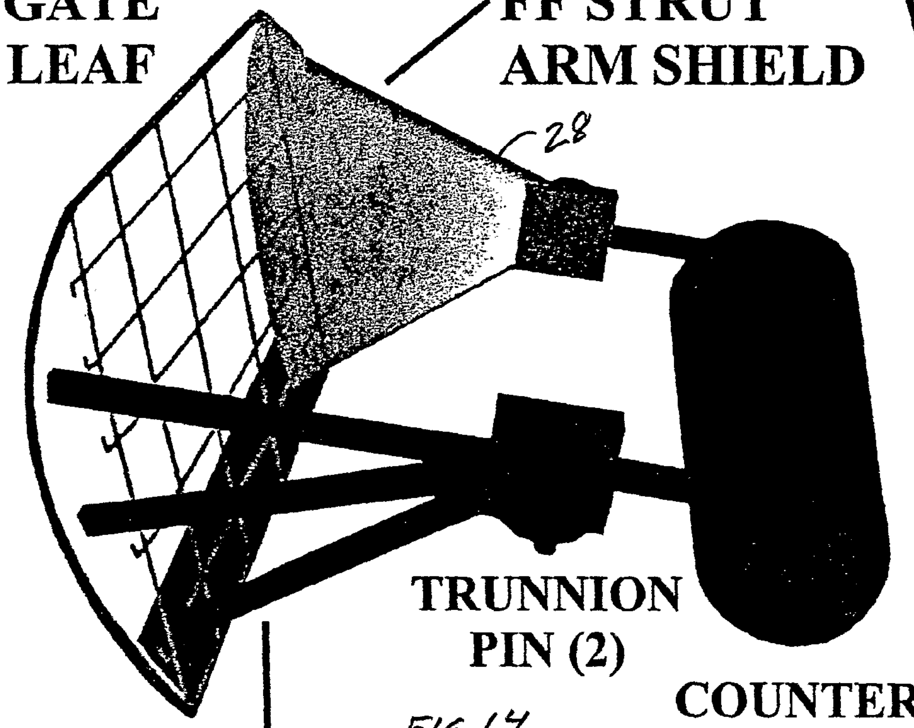


FIG 14

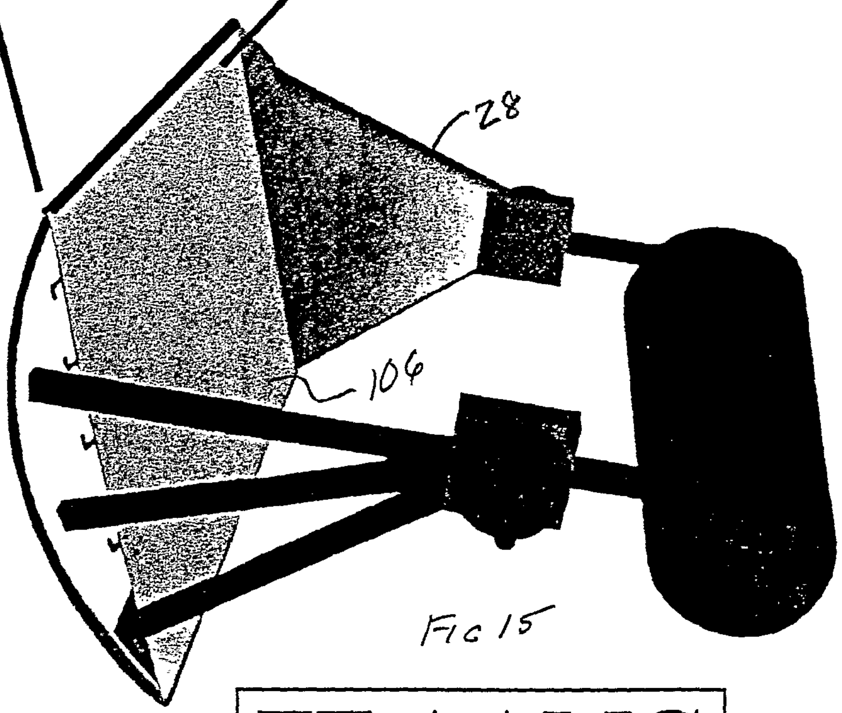


FIG 15

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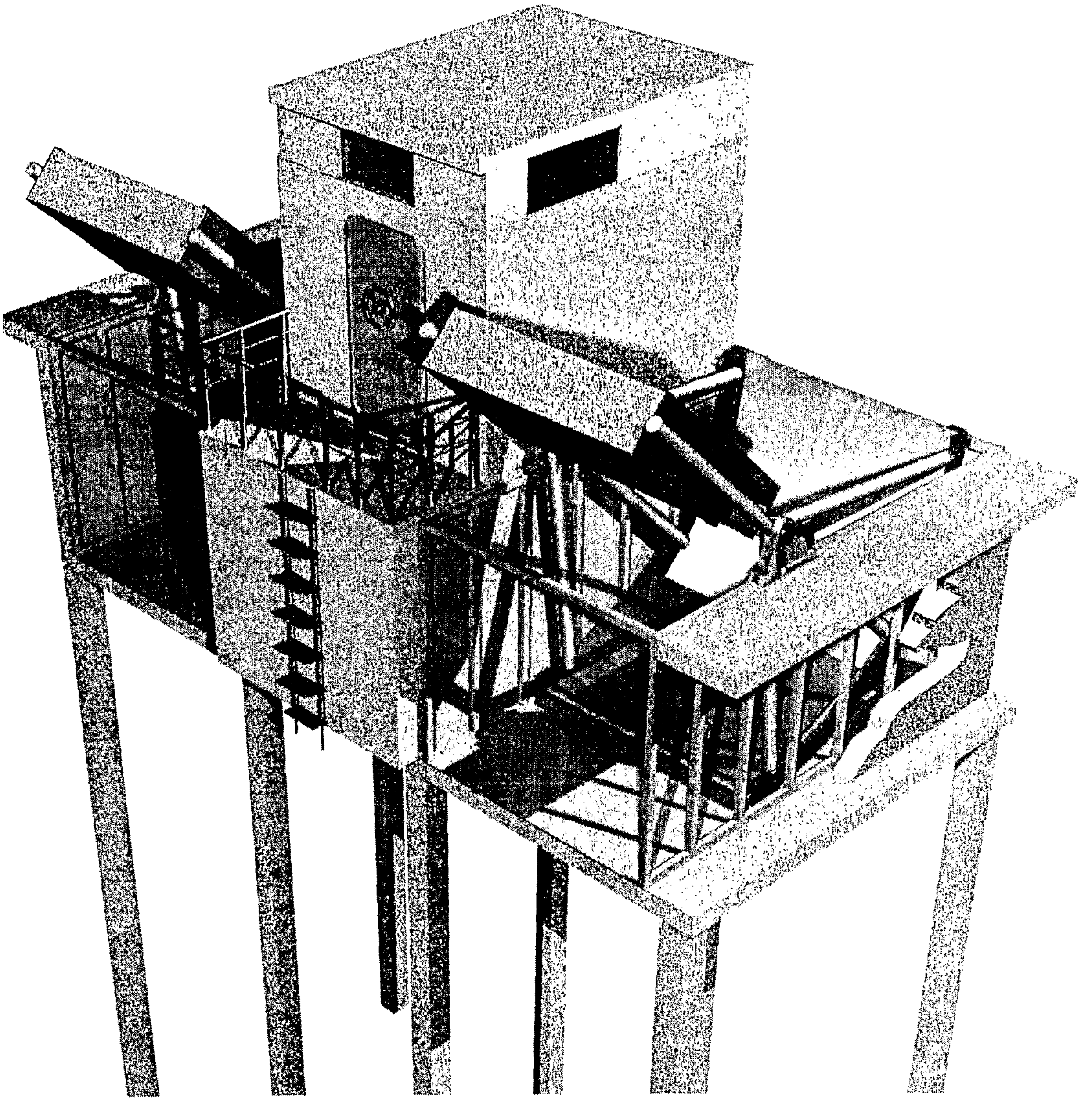

FIG. 16

ADLER GATE CONTROLLER

OPERATOR INTERFACE TERMINAL

MENU TREE

"xxxx", "yyyy", "zzzz" - 4 digit numeric password (operator, supervisor, factoy)

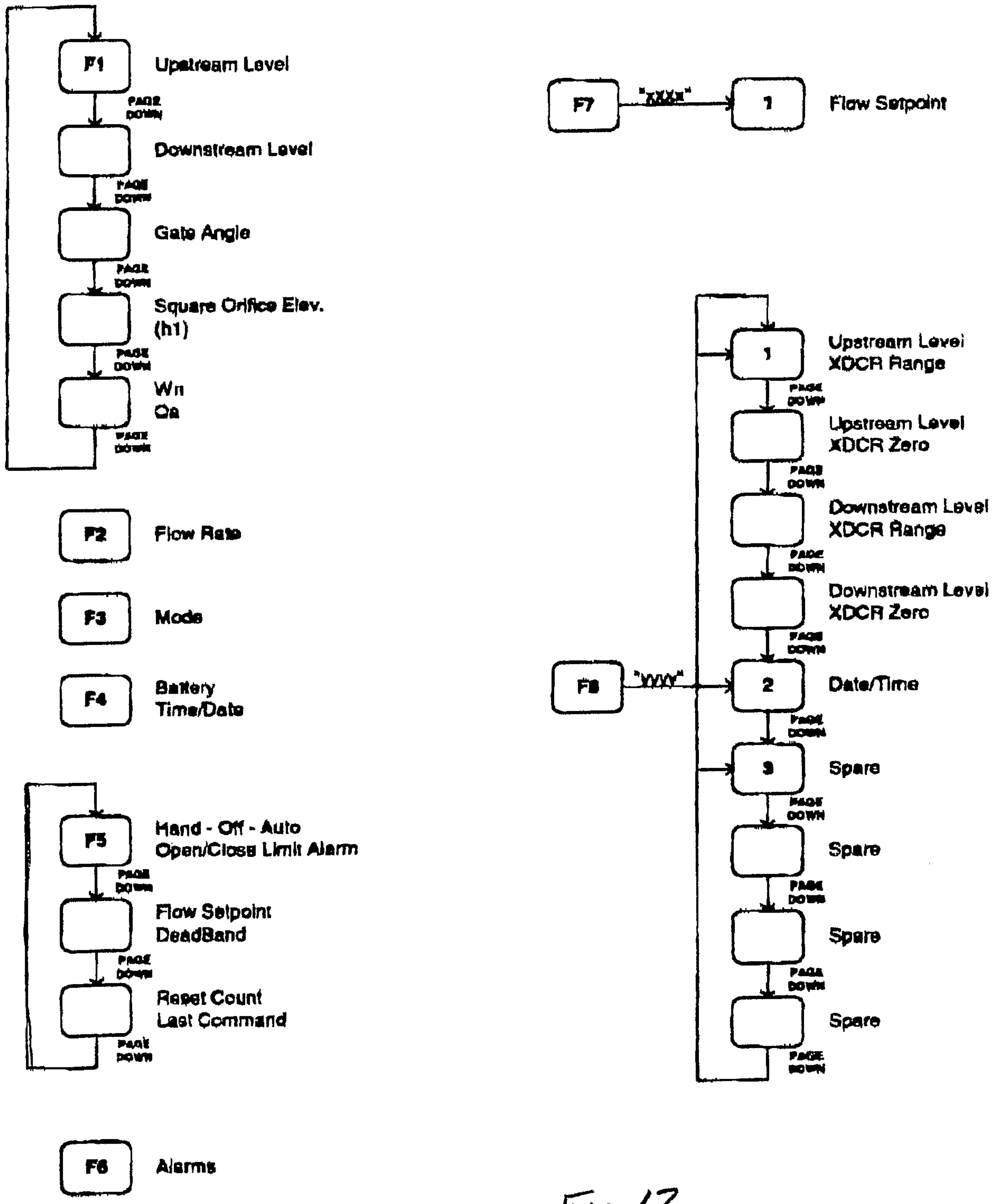

FIG 17

OPERATOR INTERFACE TERMINAL MENU TREE

"xxxx", "yyyy", "zzzz" - 4 digit numeric password
(operator, supervisor, factory)

FIG 18