US 20090145218A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2009/0145218 A1**

Wells et al. (43) **Pub. Date: Jun. 11, 2009**

(54) **FLUID LEVEL SENSING ASSEMBLY AND METHOD FOR CONFIGURING SAME**

(75) Inventors: **Richard D. Wells**, Birmingham, MI (US); **Jerome F. Rock**, Grosse Pointe Park, MI (US)

Correspondence Address:
REISING, ETHINGTON, BARNES, KISSELLE, P.C.
P O BOX 4390
TROY, MI 48099-4390 (US)

(73) Assignee: **Bulldog Boiler Rentals, Ltd.**, Hamtramck, MI (US)

(21) Appl. No.: **11/952,638**

(22) Filed: **Dec. 7, 2007**

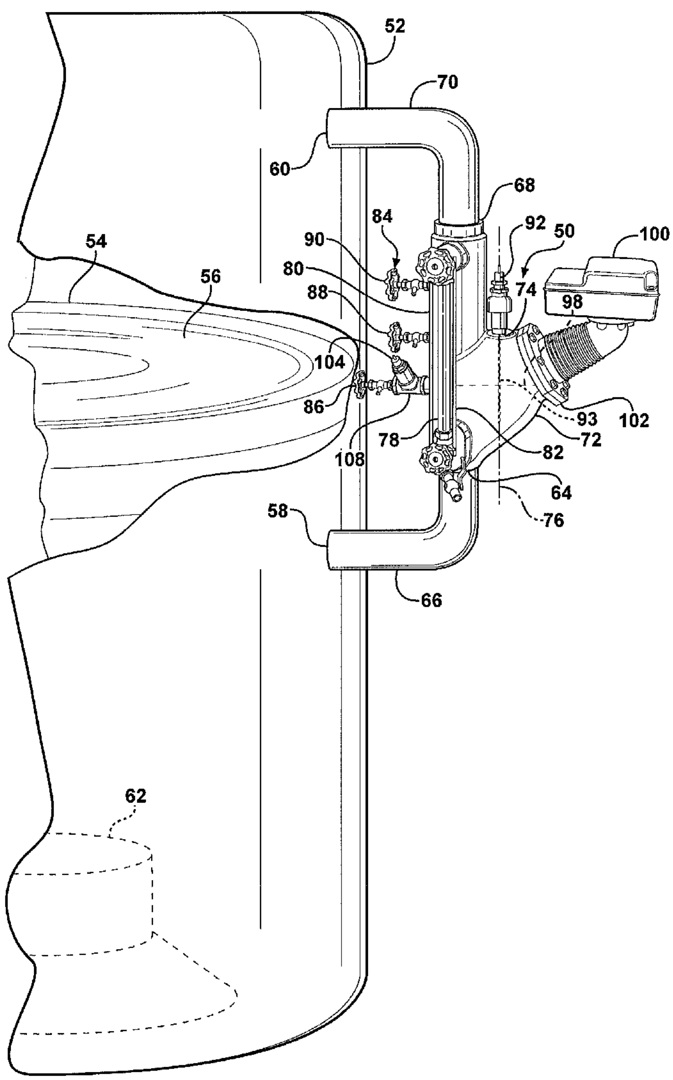
Publication Classification

(51) **Int. Cl.**
G01F 23/00 (2006.01)

(52) **U.S. Cl.** .... **73/290 R**

(57) **ABSTRACT**

A level sensing assembly senses the level of a fluid in a tank. The tank includes a fluid port that is disposed below the level of the fluid and an air port disposed above the level of fluid. The level sensing assembly includes a lower port in fluid communication with the fluid port of the tank. An upper port is in fluid communication with the lower port of the tank. A measuring vessel is disposed between the lower and upper ports and is in fluid communication therebetween. The measuring vessel includes an auxiliary port disposed adjacent the upper port. The level sensing assembly also includes a level sensor extending down through the auxiliary port into the measuring vessel to measure the level of the fluid in the measuring vessel and the level of the fluid in the tank.



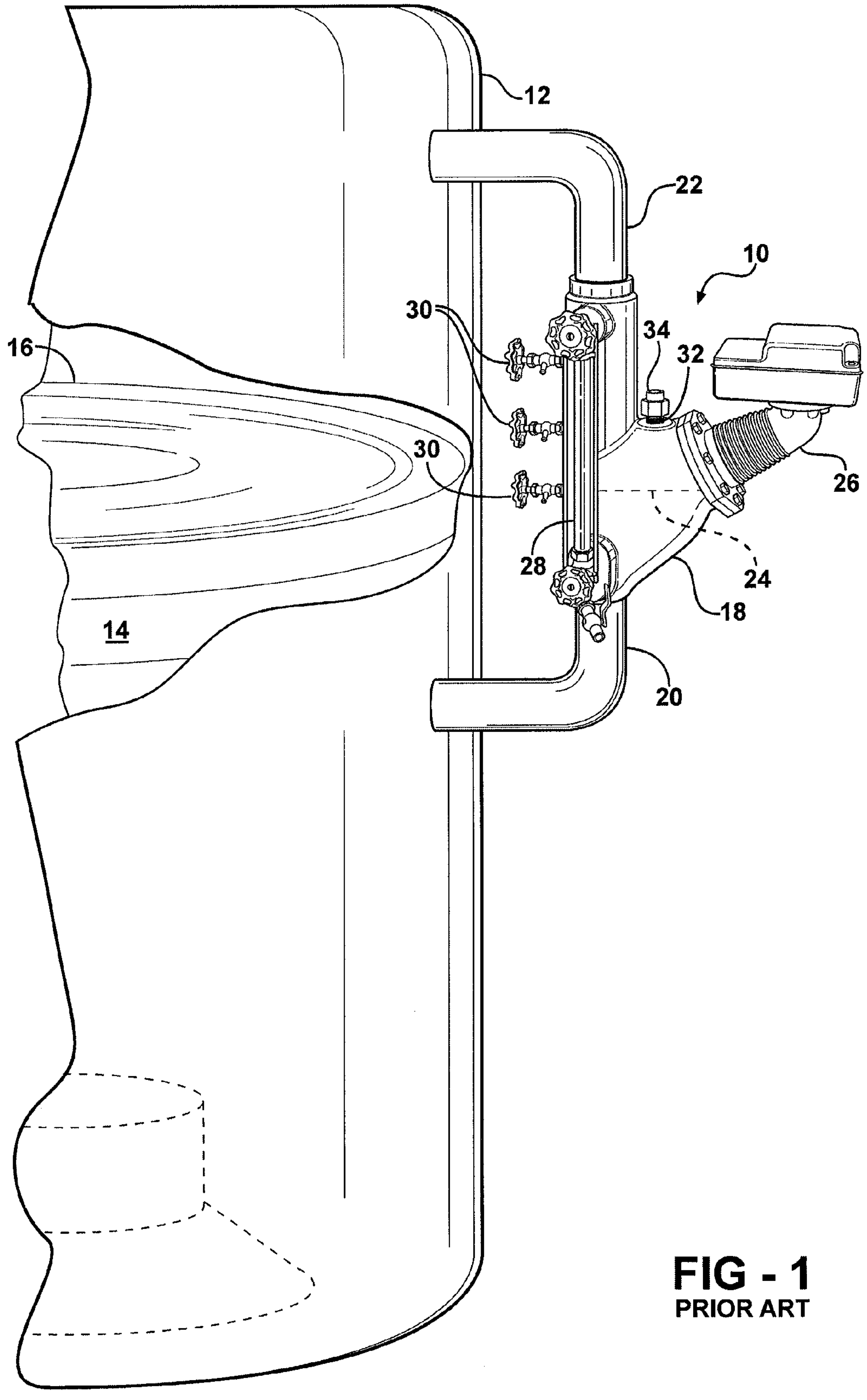


FIG - 1
PRIOR ART

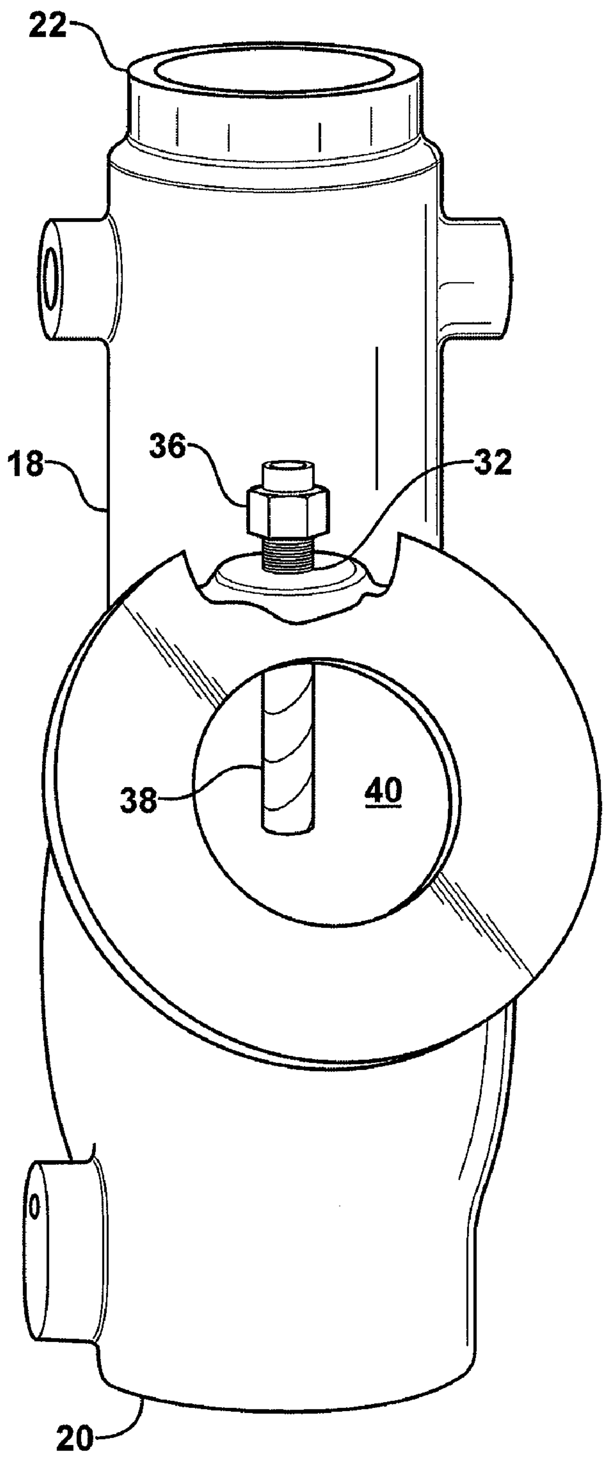


FIG - 2
PRIOR ART

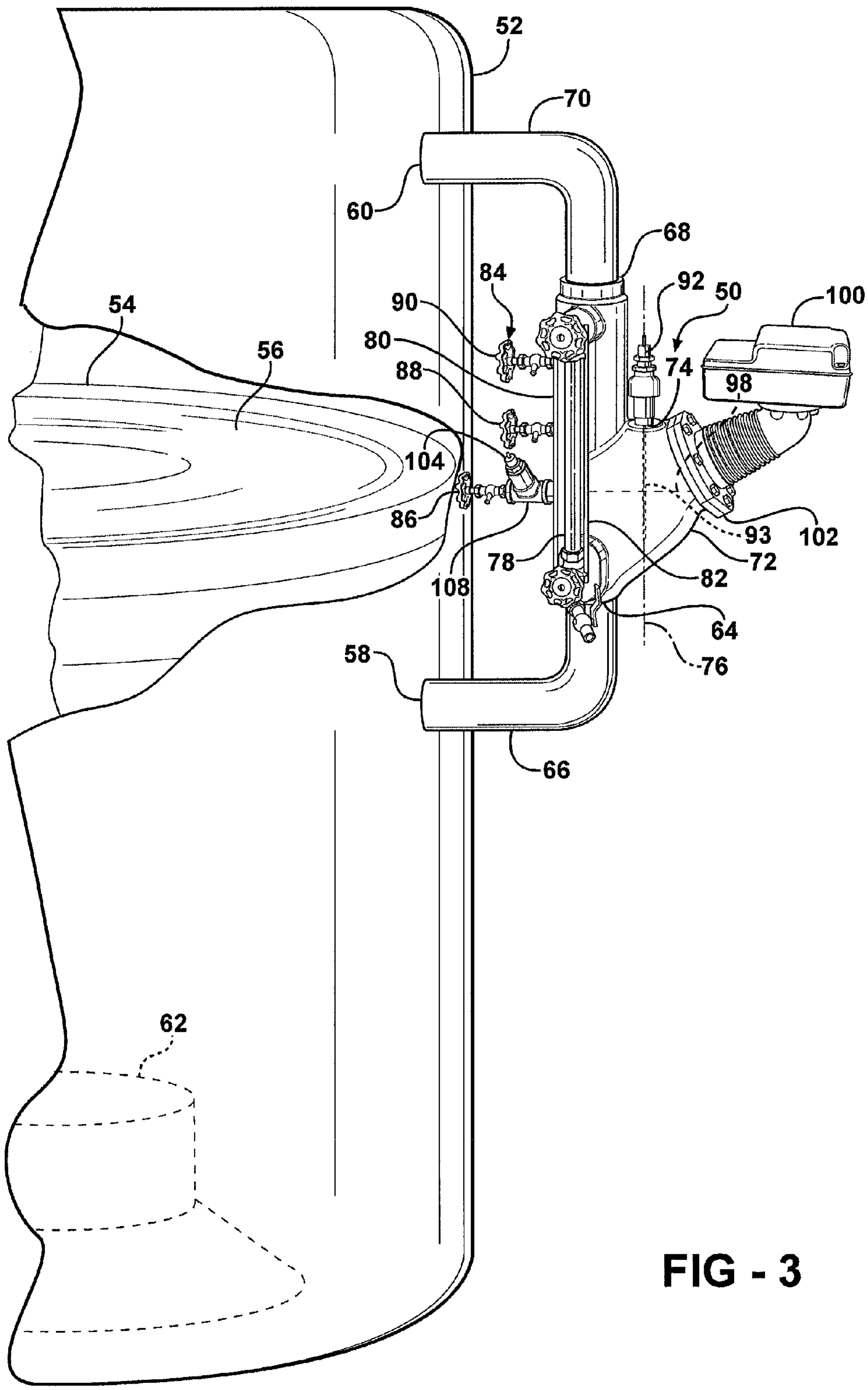

52
70
60
68
84
92
50
100
90
80
54
74
56
88
98
104
86
93
102
72
78
82
108
64
76
58
66
62

FIG - 3

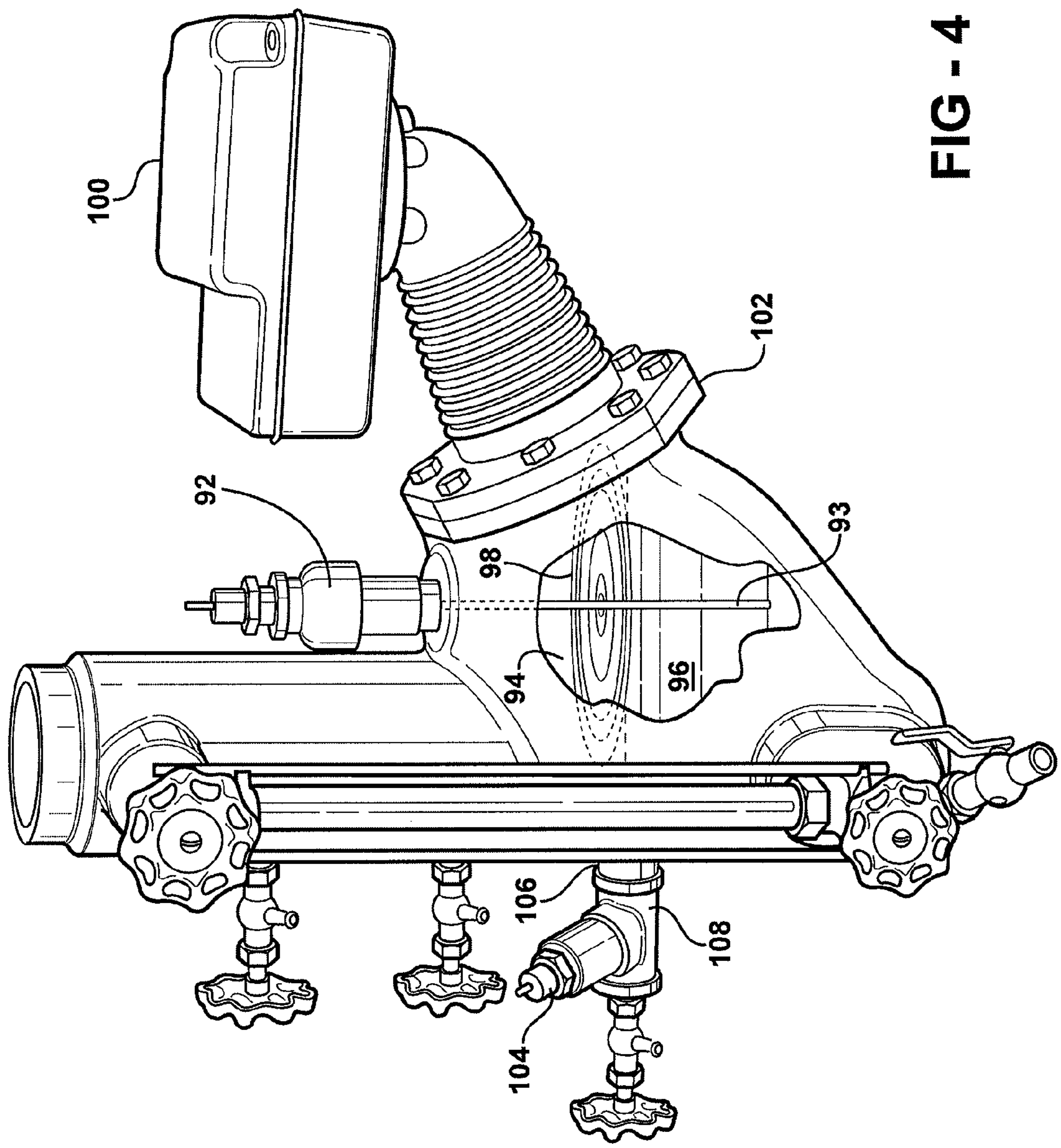


FIG - 4

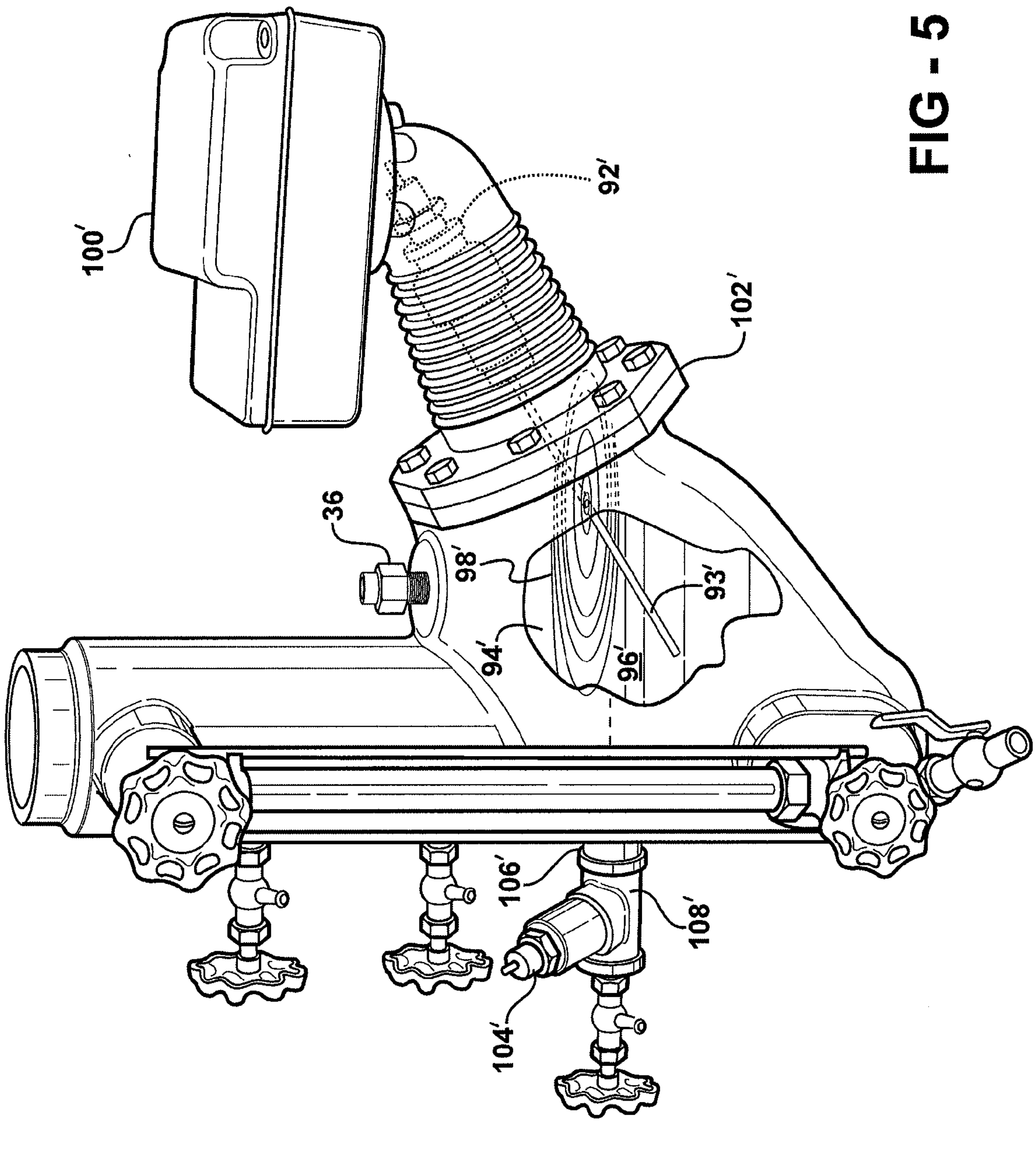


FIG - 5

FLUID LEVEL SENSING ASSEMBLY AND METHOD FOR CONFIGURING SAME

BACKGROUND ART

[0001] 1. Field of the Invention

[0002] The invention relates to level sensing assemblies for measuring the level of a fluid in a vessel. More particularly, the invention relates to a non-float level sensing assembly to measure the level of water in a vessel.

[0003] 2. Background of the Art

[0004] There are many situations that require an accurate reading of a fluid in a tank or vessel. While may of these tanks are pressurized, fluid level measurements are also important in non-pressurized tanks. Accurate fluid level measurements are important in order to maintain a system operating as it is designed. Fluid level measurements are important because they can be used to warn an operator of a system that the fluid in a particular tank is about to empty. In many situations, the system that requires the fluid in the tank may be damaged if the level of the fluid in the tank drops below a certain level.

[0005] One example of a system that requires a monitoring of a fluid level within a tank is a boiler system. Steam boilers have feed water controls that are responsible for the level of fluid, e.g., water, in the boiler. As the boiler boils the water to create steam, a source of water must supply water to the boiler. If the boiler runs out of water, the boiler will be damaged or destroyed because the steel that creates the boiler cannot transfer the thermal energy it receives to the water at a rate sufficient to avoid damage thereto without having a sufficient supply of water therewithin.

[0006] Referring to FIG. **1**, an embodiment of a prior art fluid level sensor is generally indicated at **10**. The fluid level sensor **10** is in fluid communication with a tank **12** that has a fluid **14** therein. The fluid **14** defines a fluid level **16**.

[0007] The fluid level sensor **10** includes a measuring vessel **18** with a water port **20** and a steam port **22** disposed on either end thereof. A fluid level **24**, shown in phantom, represents the fluid level **16** in the tank **12**.

[0008] The fluid level sensor **10** includes three separate and independent systems for measuring the fluid level **24** in the measuring vessel **18**. The fluid level sensor **10** has a mechanical float mechanism, generally shown at **26** that includes a float (not shown) which extends into the measuring vessel **18** to float on the fluid level **24**. The fluid level sensor **10** also includes a glass gauge **28** that allows an operator the ability to visually identify the location of the fluid level **24** within the measuring vessel **18** without having to open the measuring vessel **18**. The third mechanism for identifying the fluid level **24** in the measuring vessel **18** includes a set of tricocks **30** that may be opened to identify what flows out of each of the set of tricocks **30**. The measuring vessel **18** includes an auxiliary port **32**, which receives a plug **34** therein.

[0009] Referring to FIG. **2**, the measuring vessel **18** of the prior art is shown prior to installation. The measuring vessel **18** is shipped to a sight for installation with the mechanical float mechanism **26** secured thereto (although not shown in FIG. **2** for simplicity). Inserted into the auxiliary port **32** is a temporary plug **36** and a positioning cylinder **38** disposed therewithin. The positioning cylinder **38** is coaxial with the temporary plug **36** and extends down into the interior **40** of the measuring vessel **18**. The positioning cylinder **18** is typically fabricated of cardboard. The positioning cylinder **38** is used exclusively for maintaining the mechanical float in a particular position during shipment of the measuring vessel **18** to the site of installation. The positioning cylinder **38** and temporary plug **36** are removed upon reaching the site of installation and the auxiliary port **32** is immediately plugged with the plug **34** for continued operation of the measuring vessel **18** through its life.

[0010] The problem with the three mechanisms for identifying the fluid level **24** within the measuring vessel **18** is that they are very insensitive and, when translating the mechanical measurement to an electrical signal, inaccurate methods for measuring a fluid level such as the fluid level **24**. If an operator is not present to view the glass gauge **28**, or the glass gauge **28** is dirty or corroded such that the fluid level is not visible therein, the method of using the set of tricocks **30** or the mechanical float mechanism **26** reduces the fluid level sensing assembly **10** to one that is very cyclical with the fluid level either being too high or too low and rarely being at an optimal level for operation. This increases the costs of energy as more energy is consumed when the level of fluid in the vessel **12** cycles through such a large range of fluid levels.

SUMMARY OF THE INVENTION

[0011] A level sensing assembly senses the level of a fluid in a tank. The tank includes a fluid port that is disposed below the level of the fluid and an air port disposed above the level of fluid. The level sensing assembly includes a lower port in fluid communication with the fluid port of the tank. An upper port is in fluid communication with the lower port of the tank. A measuring vessel is disposed between the lower and upper ports and is in fluid communication therebetween. The measuring vessel includes an auxiliary port disposed adjacent the upper port. The level sensing assembly also includes a level sensor extending down through the auxiliary port into the measuring vessel to measure the level of the fluid in the measuring vessel and the level of the fluid in the tank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

[0013] FIG. **1** is a perspective view, partially cut away, of a fluid level sensing assembly of the prior art;

[0014] FIG. **2** is a perspective view of a measuring vessel of the prior art prior to installation;

[0015] FIG. **3** is a perspective view partially cut away of one embodiment of the invention;

[0016] FIG. **4** is a perspective view, partially cut away, of the measuring vessel shown in FIG. **3**; and

[0017] FIG. **5** is a perspective view, partially cut away, of an alternative embodiment of the measuring vessel configuration shown in FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] Referring to FIG. **3**, one embodiment of the inventive level sensing assembly is generally indicated at **50**. The level sensing assembly **50** is operatively secured to a tank or vessel **52** and senses a level **54** of a fluid **56** in the tank **52**. The tank **52** is equipped with a fluid port **58** and an air port **60**. The fluid port **58** creates an opening in the tank **52** below the level **54** of the fluid **56**. The air port **60** creates an opening in the tank **52** above which the level **54** that the fluid should be. The fluid **58** and air **60** ports are shown in the upper half of the tank

52. It should be appreciated by those skilled in the art that the respective ports **58**, **60** may be positioned anywhere along the tank **52** so long as the fluid port **58** has a portion of the fluid **56** flowing therethrough and the air port **60** is disposed above the position in which the level **54** is located.

[0019] The tank **52** includes a heating element **62**, graphically represented as an indentation in the bottom portion of the tank **52**. The heating element **62** may house a heating element or receive thermal energy from a source to heat up the fluid **56** inside the tank **52** to produce steam for any desired purpose. It should be appreciated by those skilled in the art that while the inventive level sensing assembly **50** is shown attached to a boiler tank **52**, the level sensing assembly **50** may be used with any type of tank **52**, boiler or otherwise, mobile or immobile, pressurized or non-pressurized. In addition, the tank **52** may be used on a vehicle or in a craft so long as the fluid **58** and air **60** ports maintain their position relative to the level **54** of the fluid **56** stored within the tank **52**.

[0020] As discussed with the prior art, the level sensing assembly **50** includes a lower port **64** that is in fluid communication with the fluid port **58** of the tank **52**. A pipe **66** extends between the fluid port **58** and the lower port **64**. Likewise, the level sensing assembly **50** includes an upper port **68** which is in fluid communication with the air port **60** of the tank **52**. A second pipe **70** extends between the upper port **68** and the air port **60**.

[0021] The level sensing assembly **50** also includes a measuring vessel **72** that is disposed between the lower **64** and upper **68**. The measuring vessel **72** provides fluid communication between the upper **68** and lower **64** ports. The measuring vessel **72** also includes an auxiliary port **74** disposed adjacent to the upper port **68**. The auxiliary port **74** is threaded and extends through the measuring vessel **72** in an orientation that creates an auxiliary axis **76** which is perpendicular to a plane defined by the level **54** of the fluid **56**. In the embodiment shown, the auxiliary axis **76** created by the auxiliary port **74** is parallel to axes which may define the upper port **68** and lower port **64**.

[0022] The measuring vessel **72** includes a glass gauge **78**, which is protected by two metal rods **80**, **82**. The glass gauge **78** allows an operator of the level sensing assembly **50** to view the level **54** of the fluid **56**. The glass gauge **78** is discussed in greater detail above with reference to the prior art.

[0023] In addition, the level sensing assembly **50** also includes a set of tricocks, generally shown at **84**, that also allow an operator to physically determine the level **54** of the fluid **56**.

[0024] The level sensing assembly **50** includes a set of tricocks generally shown at **84**, that also allow an operator to physically determine the level **54** of the fluid **56** in the measuring vessel **72** which corresponds directly to the level **54** of the fluid **56** in the tank **52**. The set of tricocks define a lower **68**, middle **80**, and upper **90** tricocks and may be used if the operator were to not be able to use the glass gauge **78**. The operator may open the upper tricock **90** to determine whether the fluid level was that high. If it were not, the operator may open the middle tricock **80** or the lower tricock **86** to identify what flows therefrom.

[0025] The level sensing assembly **50** also includes a level sensor **92** that extends down through the auxiliary port **74** along the auxiliary axis **76** into the measuring vessel **72** to measure the level **54** of the fluid **56** in the measuring vessel **72** and the level of the fluid **56** in the tank **52**. The level sensor **92** defines a sensor body **93** that is linear. More specifically, the sensor body **93** extends through a straight line. Because the measuring vessel **72** is in fluid communication with the tank **52**, a portion of the fluid **56** exists in an interior chamber **94** (best seen in FIG. **4**) whereby the portion of fluid **96** disposed therein has a level **98** which is the same level as the level **54** of the fluid **56** and the tank **52**. By measuring the level **98** of the fluid **96** inside the measuring vessel **72**, the level sensor **92** can accurately and precisely determine the level **98** and, hence, the level **54** in the tank **52**. The level sensor **92** measures the level **98** along its entire length. It can, therefore, identify an infinite number of levels **98** at which the fluid in the measuring vessel **72** is at. The ability to provide an infinite number of outputs allows the control circuit to control the valve feeding fluid into the tank **52** to open variably to match the rate at which the fluid is leaving the tank **52**. This leads to a more even control of the tank **52** and less energy consumption when the tank **52** is a boiler. As opposed to an on/off sensor, that only changes its output when the fluid with the measuring vessel **72** is no longer in contact with the sensor, the level sensor **92** produces a signal regardless of the level **54** of the fluid **56** in the tank **52**. And the signal changes with the level **56** of the fluid **54** in the tank **52**.

[0026] In one embodiment, the level sensor **92** is a capacitive sensor that is electronically connected to a control circuit (not shown) that provides immediate feedback as to the level **54** in the tank **52**. This allows the level sensing assembly **50** to minimize the swings (peaks and valleys) between level minimums and level maximums to optimize the energy consumption of the system by maintaining a level **54** as close to an optimal level as possible. The capacitive sensor **92** used as the level sensor **92** is capable of an output that allows greater control than a standard on/off switch. Flow rates can be adjusted based on the level **54** of the fluid **56** in the tank **52**. This allows the flow of water into the tank **52** to match more precisely the flow of water out of the tank **52** in the form of steam, avoiding energy absorbing swings in the amounts of water being fed into the tank **52**. This is because the level sensor **92** measures the level **54** in the tank **52** and not merely when the level **54** reaches a particular low level, at which point the valve to fill the tank **52** is opened fully allowing a huge amount of cold water into the tank **52**, which in turn, requires a greater amount of energy to bring the cold water up to boiling temperature. In the preferred embodiment, the valve (not shown) is opened an amount proportional to the amount of water needed to fill the tank **52** to the optimal level of operation. If the system is slowly having the liquid in the tank **52** exit the system, then the level sensor **92** will indicate such and the valve will not be opened fully. If, on the other hand, the tank **52** is emptying rapidly, the signals produced by the level sensor **92** will indicate such and the valve will be opened more fully. Therefore, the level sensor **92** assists in maintaining the level **54** in the tank **52** as close to steady state as possible.

[0027] The level sensor **92** may be any type of sensor that is capable of extending down into the interior chamber **94** and into the fluid **96** that is stored therein. Other types of level sensors **92** include, but are not limited to, resistive and magneto-resistive sensors.

[0028] As with the prior art, a cover **100** for a mechanical float mechanism of the prior art is shown in FIGS. **3** and **4**. By adding the level sensor **92** to the auxiliary port **74**, much of the mechanical float mechanism that was housed within the cover **100** is removed because it is no longer necessary. The cover **100** is, however, typically replaced because it is rated as a cover **100** that may close the measuring vessel **72** at the float port **102**. If it were desired, the cover **100** could be replaced with a flat plate, so long as the flat plate were proven to be of a quality of metal or material that is acceptable for the rules and regulations that govern the safety parameters of these types of vessels. These exist primarily for boilers and pressurized tanks.

[0029] As an additional safety feature for the measuring vessel **72**, a shut off sensor **104** is included to ensure that the measuring vessel **72** not fail. The shut off sensor **104** is in fluid communication with the fluid **96** inside the measuring vessel **72** and will produce a signal which will shut down any boiler or heating element or pressure generating device that is used in the system to which the tank **52** is attached. The shut off sensor **104** is connected to the measuring vessel **72** at a location disposed adjacent the lower tricock **86**. More specifically, the lower tricock **86** is removed from the measuring vessel and the shut off sensor **104** is secured to the port associated with the lower tricock **86** using a T-shaped pipe **108**. Once the shut off sensor **104** is secured to the measuring vessel **72**, the lower tricock **86** is secured to an end of the shut off sensor **104**. Therefore, if the fluid **96** within the measuring valve **72** drops to a level below that which is associated with the lower tricock **86**, the shut off sensor **104** will provide a signal to shut down the system associated with the tank **52** to prevent any damage to the tank **52** or the system with which the tank **52** is connected.

[0030] The configuration of the level sensing assembly **50** may occur at the point in which the measuring vessel **72** is fabricated or, in the alternative, may be configured at a later time after the measuring vessel **72** has been in operation. In other words, the level sensing assembly **50** may be configured as an original manufacturing piece of equipment. Alternatively, the level sensing assembly **50** may be a retrofit to an existing sensing assembly that may include a mechanical float mechanism **26**.

[0031] In the situation when the level sensing assembly **50** is original equipment, the level sensor **92** is secured within the auxiliary port **74** along the auxiliary axis **76** at the time of manufacture. In addition, the shut off sensor **104** is secured to the port to which a lower tricock **86** would be secured prior to the securing of the lower tricock **86**.

[0032] In the case of a "retrofit," the plug **34** that is used to seal the auxiliary port **32** for the fluid level sensing assembly **10** of the prior art is removed. This sometimes requires much effort as the auxiliary port **32** could have been sealed for decades. Once that is removed, the auxiliary port **74** may be used to receive the level sensor **92** therein. The float mechanism, not shown, that is housed within the cover **100** and which also extends down into the interior chamber **94** of the measuring vessel **72** is then removed. The cover **100** could be replaced. Alternatively, an approved plate of material could replace the cover **100** as the cover is no longer necessary.

[0033] In addition, the lower tricock **86** is removed from the measuring vessel **74**. A pipe **108** having a "T" configuration is secured thereto. The shut off sensor **104** is then secured to the pipe **108**. The lower tricock **86** is then secured to a second opening in the pipe **108** that holds the shut off sensor **104** in place. In the preferred embodiment, the pipe **108**, tricock port **106** and lower tricock **86** are all pipe threaded to allow each of these parts to threadingly engage their respective or adjacent parts. After the shut off sensor **104** and the level sensor **92** are in place, the level sensing assembly **50** is sealed by sealing the auxiliary port **74** and the tricock port **106**.

[0034] In either method of assembly, either the original equipment or retrofit scenario, the preferred embodiment of the invention has the level sensor **92** oriented vertically such that it extends into the fluid **96** within the measuring vessel **72** perpendicularly to a plane created by the level **98** thereof. This avoids any orientation problems associated with possibly having a sensor extend into the measuring vessel **72** at an angle.

[0035] Referring to FIG. **5**, wherein like primed numerals represent similar elements to those of the preferred embodiment, the level sensor **92'** is mounted within the cover **100'** used to house the float mechanism. As with the preferred embodiment, the float mechanism is removed. The level sensor **92'** will operate in a manner identical to the preferred embodiment with the only difference being the signal generation and how it is treated by the control circuitry to match the level **54'** in the tank **52'** based on the location of the level **94'** of the fluid that is covering the level sensor **52'**.

[0036] The invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

[0037] Many modifications and variations of the invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the invention may be practiced other than as specifically described.

We claim:

1. A level sensing assembly for sensing a level of a fluid in a tank having a fluid port disposed below the level of the fluid and an air port disposed above the level of fluid, said level sensing assembly comprising:

a lower port in fluid communication with the fluid port of the tank;

an upper port in fluid communication with the air port of the tank;

a measuring vessel disposed between said lower and upper ports and in fluid communication therebetween, said measuring vessel an auxiliary port disposed adjacent said upper port; and

a level sensor defining a sensor body extending down into said measuring vessel to measure the level of the fluid in the measuring vessel and the level of the fluid in the tank by measuring at where along said sensor body the level of the fluid is.

2. A level sensing assembly as set forth in claim **1** wherein said level sensor extends down through said auxiliary port.

3. A level sensing assembly as set forth in claim **1** wherein measuring vessel includes a sensor access port.

4. A level sensing assembly as set forth in claim **3** wherein said level sensor extends into said measuring vessel through said sensor access port.

5. A level sensing assembly as set forth in claim **2** wherein said sensor body is linear.

6. A level sensing assembly as set forth in claim **5** wherein said sensor body is perpendicular to the level of the fluid in the tank.

7. A level sensing assembly as set forth in claim **6** wherein said auxiliary port is threaded.

8. A level sensing assembly as set forth in claim **7** wherein said level sensor is a capacitive sensor.

9. A level sensing assembly as set forth in claim **8** wherein said measuring vessel includes a set of tricocks having upper, median and lower drain cocks.

10. A level sensing assembly as set forth in claim **9** including a shut-off sensor in fluid communication with said measuring vessel.

11. A level sensing assembly as set forth in claim **10** wherein said shut-off valve is fixedly secured to said lower drain cock.

12. A method for installing a level sensor into a measuring vessel having a lower port, an upper port, an auxiliary port and a set of tricock ports, the method comprising:

inserting the level sensor into the auxiliary port;

orienting the level sensor to extend vertically within the measuring vessel; and

securing the level sensor to the measuring vessel.

13. A method as set forth in claim **12** including the step of installing a shut-off sensor in one of the set of tricock ports.

14. A method as set forth in claim **13** wherein the step of securing the level sensor includes the step of threadingly engaging the level sensor with the auxiliary port of the measuring vessel.

15. A method as set forth in claim **14** including the step of securing level sensing assembly as set forth in claim **10** wherein said approach light includes a light source for emitting visible light therefrom.

16. A method for modifying a level sensing assembly having a measuring vessel with a lower port, an upper port, an auxiliary port, a set of tricock ports and a mechanical float port having a mechanical float extending therethrough into the measuring vessel, the method comprising:

unsealing the mechanical float port;

removing the mechanical float therefrom;

opening the auxiliary port;

inserting a level sensor into the auxiliary port; and

sealing the level sensor within the auxiliary port.

17. A method as set forth in claim **16** including the step of orienting the level sensor vertically within the measuring vessel.

18. A method as set forth in claim **17** including the step of orienting the level sensor vertically within the measuring vessel along the entire length thereof.

19. A method as set forth in claim **18** including the step of removing a tricock from one of the set of tricock ports.

20. A method as set forth in claim **19** including the step of securing a shut-off sensor to the one of the set of tricock ports.

21. A method as set forth in claim **20** including the step of securing the tricock to the shut-off valve.

22. A method as set forth in claim **21** wherein the step of removing a tricock includes removing the tricock from a lower most one of the set of tricock ports.

23. A method as set forth in claim **22** including the step of sealing the mechanical float port after the step of removing the mechanical float therefrom.

* * * * *