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Ward et al.

[11] **3,857,358**

[45] **Dec. 31, 1974**

[54] **FLUID LEVEL ALARM AND CONTROL DEVICE**

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[22] Filed: **Nov. 27, 1973**

[21] Appl. No.: **419,361**

Related U.S. Application Data

[62] Division of Ser. No. 370,548, June 15, 1974, Pat. No. 3,807,899.

[52] **U.S. Cl.** **116/110,** 73/307, 73/319, 116/112, 137/558, 417/40

[51] **Int. Cl.** **G01f 23/00**

[58] **Field of Search** 116/109, 110, 112, 118; 73/305, 307, 308, 309, 316, 317, 318, 319, 320, 321, 322; 137/409, 410, 434, 445, 558; 417/40

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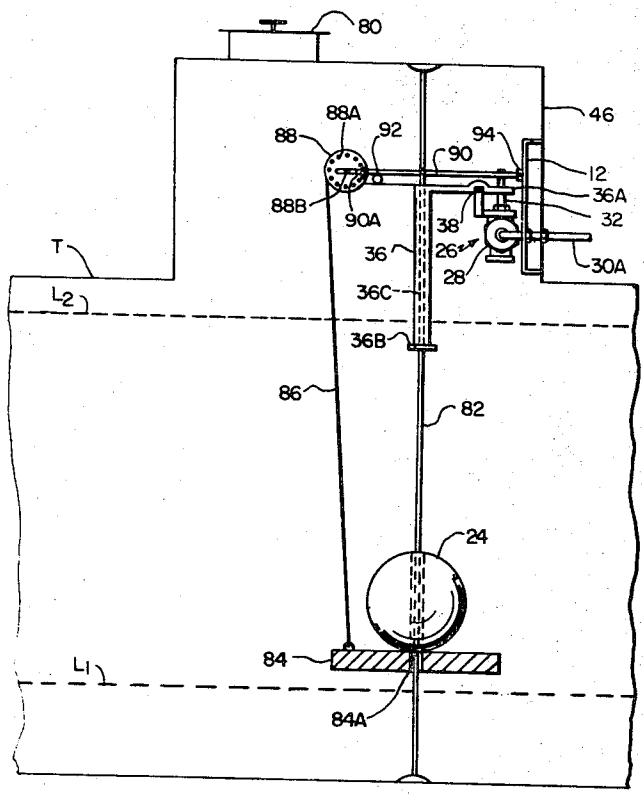
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Primary Examiner—Louis J. Capozi
Attorney, Agent, or Firm—Herbert M. Birch; Terrell C. Birch; Anthony L. Birch

[57] **ABSTRACT**

A gas operated audible alarm device is provided to signal the advent of an overflow or leakage condition in oil tanks and the like to minimize the hazards of environmental pollution from oil and chemical spills during tank filling operations. The device has a float operated pneumatic valve positioned at a predetermined upper limit of fluid level in a receiving tank, which valve controls the passage of an inert gas from a supply source to a gas operated whistle or horn in response to an overflow or leakage condition sensed by the float. In one embodiment the alarm device may be placed in the rakes of a barge or the bilge of a ship to sound an alarm in response to a sinking condition of the ship or barge. In another embodiment the source of gas is connected in circuit with a pressure sensitive switch which will actuate means to shut down the supply of oil in response to an overflow or leakage condition sensed in the oil tanks being filled.

4 Claims, 9 Drawing Figures



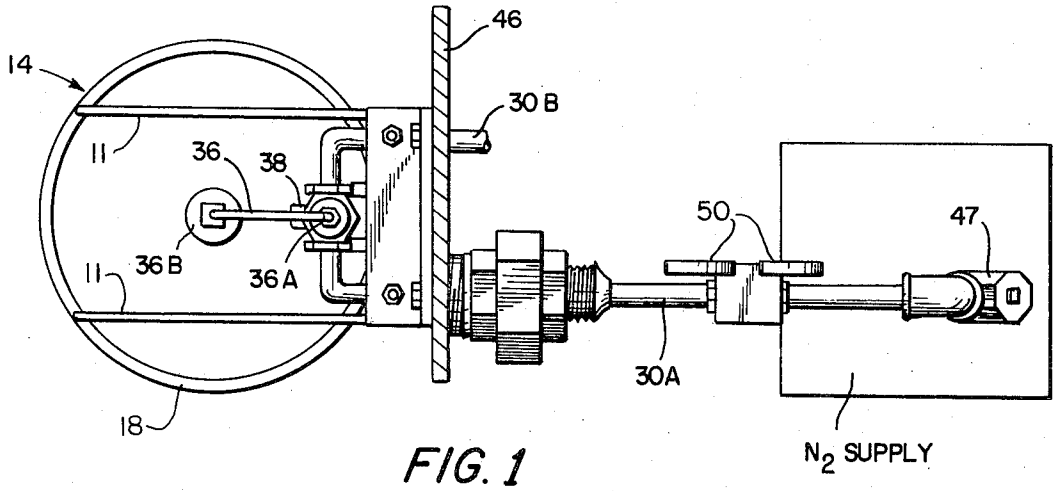

14
11
36
38
36B
36A
11
18
46
30B
50
47
30A
N_2 SUPPLY

FIG. 1

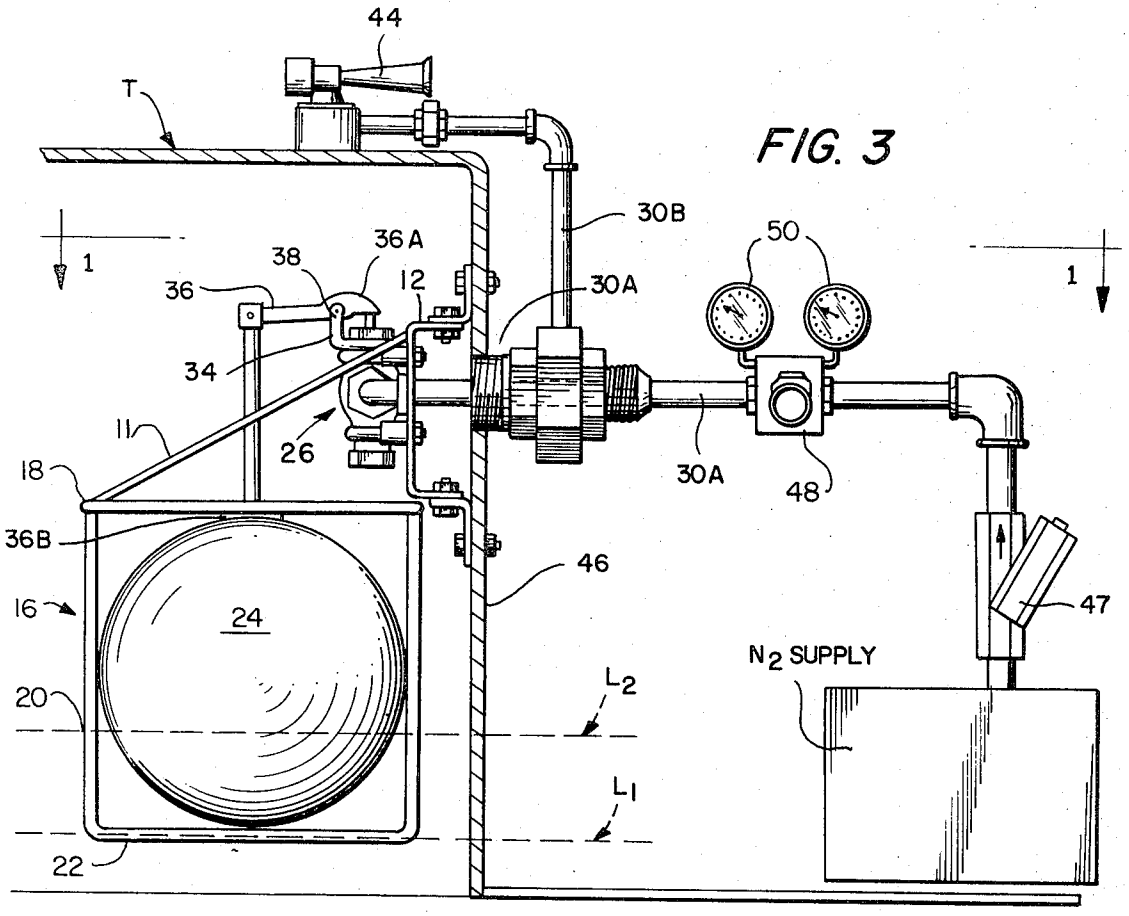

44
T
1
36
38
36A
12
30B
50
30A
34
11
26
18
36B
16
24
20
22
46
30A
48
47
N_2 SUPPLY
L_2
L_1

FIG. 3

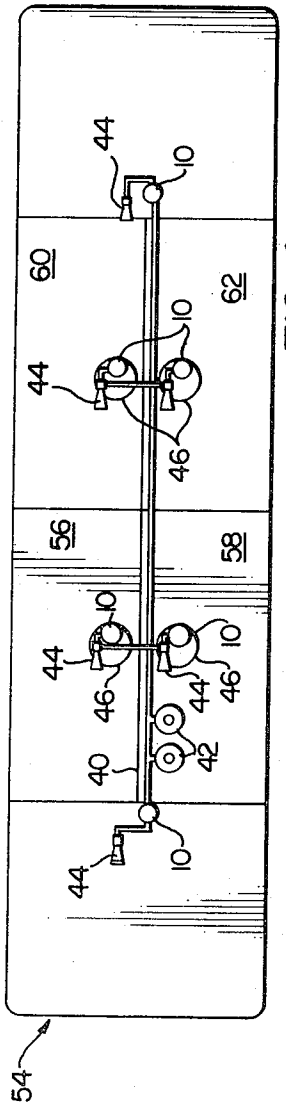


FIG. 4

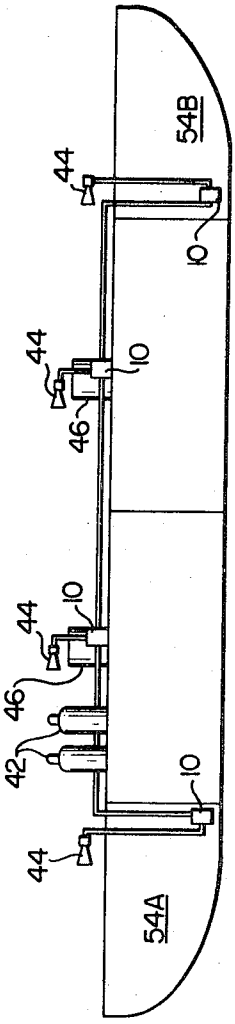


FIG. 5

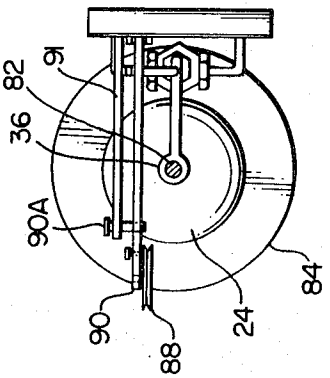


FIG. 8

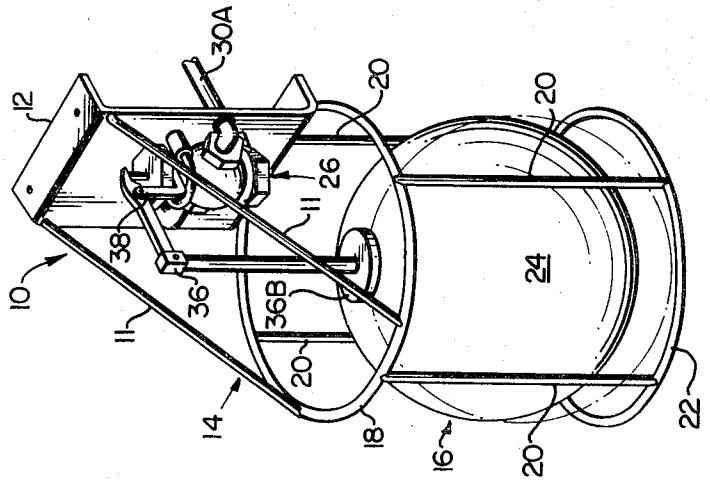


FIG. 2

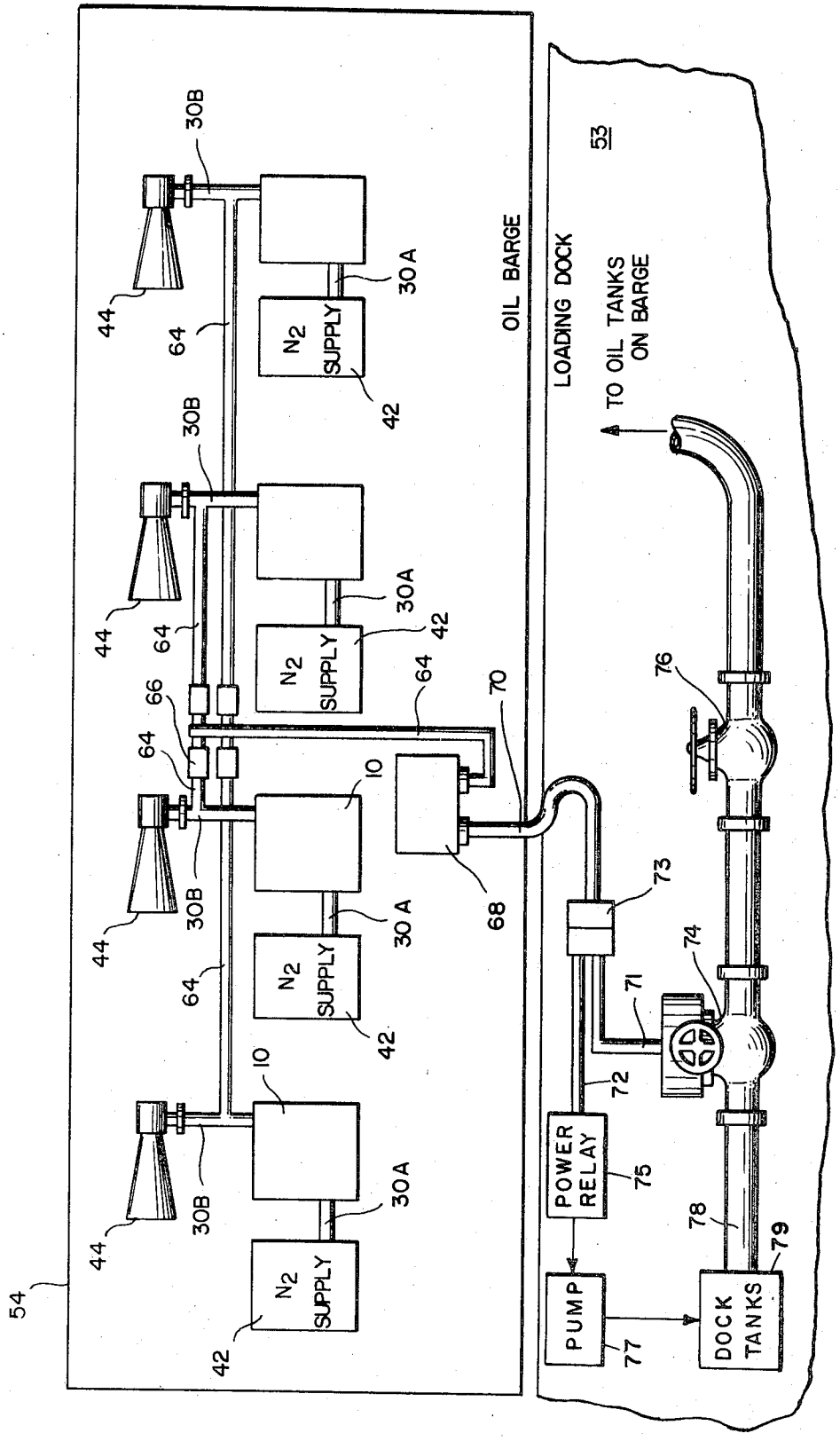

OIL BARGE
LOADING DOCK
53
TO OIL TANKS ON BARGE
54
30B
30A
44
64
42
N_2 SUPPLY
66
10
68
70
73
74
71
72
76
POWER RELAY
75
PUMP
77
78
DOCK TANKS
79

FIG. 6

FIG. 9

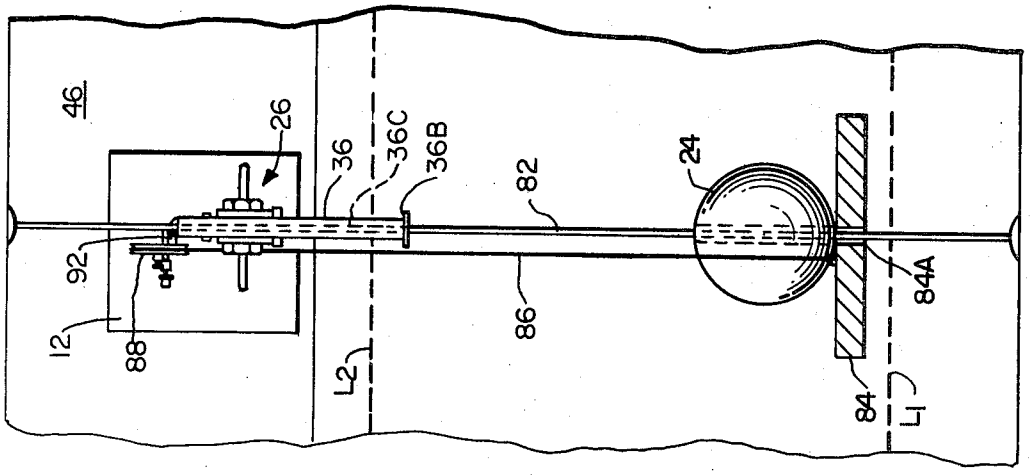
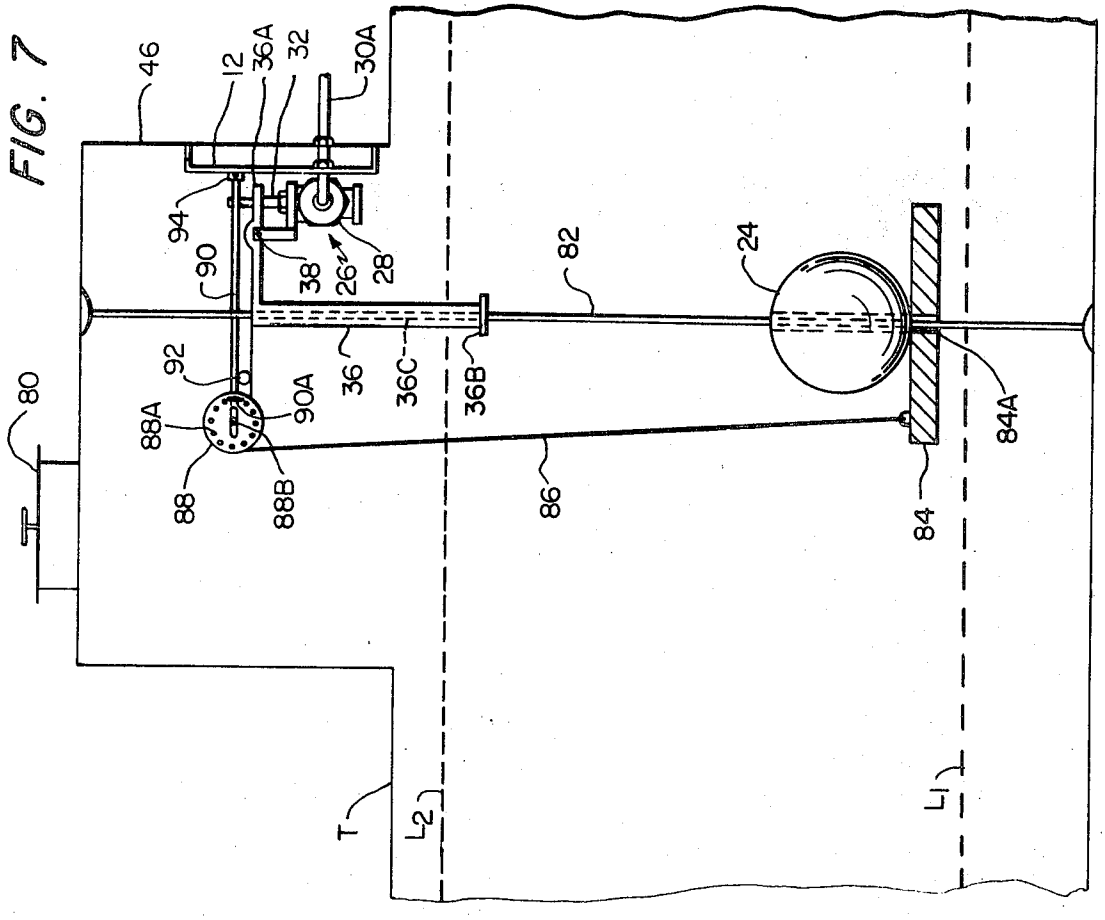

46
26
36
36C
36B
82
24
92
12
88
86
84A
84
L2
L1

FIG. 7


46
12
36A
32
30A
94
90
38
26
28
82
24
92
36
36C
36B
80
88A
90A
88
88B
86
84
84A
T
L2
L1

FLUID LEVEL ALARM AND CONTROL DEVICE

The present invention is a division of application Ser. No. 370,548 filed on June 15, 1974 now U.S. Pat. No. 3,807,899.

BACKGROUND OF INVENTION

The present invention is an improvement over U.S. Pat. No. 3,675,614 issued July 11, 1972 to the same inventors of the present invention. It is intended to incorporate by reference the disclosure of said U.S. Patent herein.

FIELD OF INVENTION

This invention relates to an audible alarm and control means for sensing the level of a liquid or fluid. More particularly the present invention relates to an audible alarm and control means for sensing the level of fluid in oil tanks or the bilge or rakes of a ship, which sound an alarm or performs a control function in response to an undesirable fluid level which is sensed.

DESCRIPTION OF PRIOR ART

Many spills of oil and other undesirable substances while pollute the environment are occasioned by human error. One of the most common forms of human error is the failure to detect that the fluid level in a tank being filled with oil or other fluid chemicals is immediately proximate to the overflow point of the tank.

Attempts have been made in the prior art to provide float actuated or pressure actuated audible alarm devices which provide an indication of the advent of an overflow condition in a storage tank. Such storage tanks may be fixed or ambulatory land-based tanks or located on cargo barges or other vessels.

Due to the highly flammable and/or reactive nature of many fluids contained in such storage tanks, electrical alarm systems are unduly expensive since they must be both corrosion resistant and spark free. Furthermore, alarm systems utilizing compressed air and compressed carbon dioxide as the activating medium for an audible whistle or similar device have numerous drawbacks based upon enviromental problems such as freezing or unsafe reactions with the fluids contained in the tanks being monitored by the alarm devices.

OBJECTS OF INVENTION

It is, therefore, an object of the present invention to provide a new and novel audible alarm device for indicating the advent of an overflow fluid level in storage or cargo tanks which is foolproof in operation and has optimum environmental capabilities regarding both the internal and external environments of the tank being monitored.

Another object of the present invention is to provide a new and novel audible alarm device having an optimally mimimum number of working parts and optimally minimum downtime due to service problems.

Still another object of the present invention is to provide a new and novel audible alarm device and system for a plurality of such devices having a source of pressurized actuating fluid feeding each of a plurality of such audible alarm devices whereby an entire network of cargo or storage tanks can be successfully monitored to indicate the advent of overflow conditions in any given tank.

It is a further object of the present invention to provide an audible alarm device which can detect either a leakage condition in a tank in response to the fluid level falling below a predetermined minimum or an overflow condition in response to the fluid level in said tank exceeding a predetermined maximum.

It is still a further object of the present invention to provide an audible alarm device which is more compact than prior art devices and more reliable in its operation.

It is another object of the present invention to provide an audible alarm device which is suitable for sensing a sinking condition of a ship or barge.

It is yet another object of the present invention to provide an automatic control means for shutting down a tank filling operation in response to the same undesirable fluid level conditions which would generate an alarm signal.

These and other objects of the invention will become more fully apparent with reference to the following specification and drawings which relate to a preferred embodiment of the invention.

In the drawings:

FIG. **1** is a top plan view of an audible alarm device of the present invention and a portion of a system embodying same;

FIG. **2** is a perspective view of the audible alarm device of FIG. **1**;

FIG. **3** is a side elevational view of the audible alarm device and portion of the system illustrated in FIG. **1** mounted in a suitable tank;

FIG. **4** is a top plan view of an audible alarm system of the present invention mounted on a ship or barge;

FIG. **5** is a side elevational view of the system of FIG. **4**;

FIG. **6** is a schematic view of the automatic control means of the present invention for automatically shutting down the filling operation of an oil barge;

FIG. **7** is another embodiment of the audible alarm device of the present invention which detects either an overflow or leakage condition in a tank;

FIG. **8** is a top plan view of the alarm device of FIG. **7**; and

FIG. **9** is a front elevational view of the alarm device of FIG. **7**.

Basically, the invention comprises a float actuated valve interconnecting a source of dry nitrogen gas under pressure through the said valve to a whistle or horn device adapted to be actuated by gas under pressure. The alarm device is adapted to be positioned in the upper extremities of the interior of a cargo or storage tank whereupon the float is responsive to the liquid level in the cargo or storage to actuate the valve and release nitrogen under pressure to the whistle when the level in the tank approaches an overflow condition. If a multiplicity of tanks is involved, each tank is provided with an individual audible alarm device connected to a supply header or manifold which in turn is connected to a source of pressurized dry nitrogen to drive the individual whistles on the audible alarm devices when the fluid level in any given tank approaches an overflow condition.

In another embodiment of the present invention an alarm device is provided including means for sounding said alarm in response to either an overflow condition or leakage condition in a cargo or storage tank. This is facilitated by including mechanical linkage means both

above and below the float, both of said linkage means being coupled to the float actuated valve, for actuating said valve in response to either an overflow condition, wherein the fluid in said tank exceeds a predetermined level, or a leakage condition, wherein the fluid in said tank falls below a predetermined minimum.

In yet another embodiment of the invention the alarm device can be placed in the rakes or bilge of a ship to sound an alarm in response to a sinking condition of said ship.

In still another embodiment of the present invention the alarm devices of the present invention may be modified to generate an automatic control signal. For example the dry nitrogen gas under pressure which is released in response to a predetermined condition may simultaneously be used to actuate a pressure responsive control switch in response to said condition. In a preferred embodiment said pressure responsive control switch is adapted to actuate an electromagnetic control valve in the supply line of an oil pumping system located on a land based loading dock and a relay in the electrical circuit of the pumping system. Therefore, when an overflow, leakage, or other undesirable condition is sensed by said alarm device, said pressure responsive switch will generate a control signal to said electromagnetic control valve and relay in said pumping system, which automatically shuts down the supply of oil being pumped from said loading dock. This embodiment constitutes a significant advance in the art since an automatic shut down of the pumping operation occurs substantially simultaneously with the sounding of the alarm.

Referring in detail to the drawings and more particularly to FIGS. **1, 2** and **3,** the audible alarm device **10** of the present invention is shown as comprising a main mounting bracket **12** attached to an open frame **14** consisting of struts **11** and support ring **18.** Extended from the open frame is a float constraining cage device **16** which is defined at an upper end by ring **18,** a plurality of dependent struts **20,** welded or otherwise fixed to the upper support ring **18,** and a circular bottom plate **22,** welded or otherwise fixed to the lower end of the vertical struts **20.** The vertical struts **20** are substantially of identical length such that the lower support plate **22** is substantially parallel to the plane of the upper support ring **18.**

A spherical float **24** is rigidly affixed to foot **36B** of bell crank **36** by welding or other suitable means within float cage **16** and normally seats on the lower support plate **22** so long as the level of the fluid in the tank being monitored is below the lower support plate **22.**

Mounted in the box frame **14,** through the bracket **12,** is a valve assembly **26.** The valve assembly **26** includes a plunger operated on-off type pneumatic valve **28** in-line mounted in a pneumatic manifold pipe **30** which extends from an input portion **30A** through the main mounting bracket **12** through the valve **28** and thence back through the mounting bracket **12** to an output section **30B.** Plunger **32** extends vertically above the valve **28** in response to a predetermined liquid level in a tank in which the alarm device **10** is mounted.

The remainder of the actuating linkage for the valve **28** comprises an upstanding bifurcated pivot bracket **34** mounted on the body of the valve **28,** in which a bell crank **36** is pivoted at a point **38** intermediate the ends thereof. Bell crank **36** is provided with an engaging foot **36A** on one side of the pivot point **38** which is adapted to engage the plunger **32** on the valve **28.** The other end of the bell crank **36** is provided with a contact foot **36B** which is rigidly affixed to the spherical float **24** contained within float cage **16.**

The input side **30A** of the pressure manifold **30** is connected to a supply header **40** which in turn is connected to a supply **42** of dry nitrogen gas under pressure through a filter **47.** Filter **47** prevents foreign particles from entering and damaging the valve seat in valve **28;** prevents damage to the diaphragms of whistles **44** by foreign particles, such as metal shavings from pipe threading, dirt or rust in the pipes; and prevents damage to the regulator valve **48** of nitrogen supply **42.** See FIG. **8.** As shown in FIG. **3** nitrogen supply **42** is provided with a pressure regulator valve **50** having pressure gauges **52** mounted thereon The output section **30B** of the pressure manifold **30** is directly connected to a gas operated whistle **44** suitably mounted on top of tank T.

The fact that float **24** is rigidly affixed by welding or other suitable means to foot **36B** of bell crank **36** offers distinct advantages over the audible alarm device disclosed in U.S. Pat. No. 3,675,614 issued July 11, 1972 to the same inventors as the present invention. In that patented device float **24** was freely constrained within float cage **16** wherein the float **24** had to rise at least 4 inches before contacting foot **36B** of bell crank **36.** In contradistinction the float **24** of the present invention is fixedly attached to foot **36B** and needs only travel about one quarter of an inch to raise bell crank **36** a sufficient distance to open valve **28.** This reduces the overall height necessary for cage **16** and, therefore, makes the audible alarm device of the present invention more compact. The structure of the present invention is also faster acting and decreases the probability of float **24** hanging up in cage **16,** because float **24** travels only one quarter of an inch instead of four inches through cage **16** and is substantially constrained against lateral movement.

As shown in FIG. **3** the audible alarm device **10,** is shown with the main mounting bracket **12** affixed to mounting brackets **12A** and **12B** affixed to the side wall **46** in the upper dome of tank T. The corners of mounting bracket **12** are angled instead of square. This feature in combination with the use of mounting brackets **12A** and **12B** facilitates the mounting of alarm device **10** on either a flat or rounded surface.

It is of the utmost importance that the supply of pressurized inert gas by dry nitrogen gas in the present invention and its application. This is occasioned by the fact that ordinary compressed air and many other readily available compressed gases would create highly flammable conditions within the tank due to their oxygen or other reactive gas content should there be a malfunction in the valve assembly **26** or the pressure manifold **39** within the tank T.

Furthermore, a commonly available inert gas, namely, carbon dioxide, has inherently bad qualities for alarm devices of this type due to environmental problems. For example, should there be an undue amount of moisture in the air or should the temperatures be relatively low in the atmosphere surrounding the tanks, the whistle **44,** when subjected to a blast of carbon dioxide therethrough in order to sound the alarm, would freeze and preclude proper actuation.

Dry nitrogen, on the other hand, is readily available and will not create freezing conditions when released from a pressurized source to pass through a whistle under extreme ranges of heat, humidity, and temperature. Neither will it react with the fluid contents of the tank T to endanger life, limb and/or property due to adverse chemical reactions or fire within the tank T.

To illustrate the effectiveness of the audible alarm device **10**, for example, if dry nitrogen under 40 pounds per square inch pressure is permitted to energize a conventional steam or air whistle **44**, noise levels of at least 99 decibels or greater can be produced. This is sufficient for industrial applications or other high noise level environments.

In a preferred embodiment for the prevention of oil spills from storage and cargo tanks the spherical float **24** can be constructed from copper and dimensioned to be 10 inches in diameter, thereby providing approximately 15 pounds of lift in response to an overly high fluid level in the tank T. The mounting bracket **12**, open frame **14** and the float cage **16** can be constructed of stainless steel and the air valve **26** can be a standard bronze air valve. The use of half-inch heavy duty galvanized pneumatic lines for the manifold **30** and the main supply header **40** is also contemplated.

In operation, referring to FIGS. **1**, **2** and **3**, the audible alarm device **10** is mounted in the tank T such that a liquid level L1 (indicated by the lowermost dotted line position in the tank T to FIG. **3**) or less will have no effect on the audible alarm device **10**. However, when the liquid level reaches the level L2 (indicated by the uppermost dotted line position in the tank T in FIG. **3**) the spherical float **24** will be constrained to assume the dotted line position shown in FIG. **2**. This causes the float **24** to direct an upward force against the foot **36B** on the bell crank **36** forcing the said bell crank **36** to pivot about the point **38** and force the contact foot **36A** down against the plunger **32** of the air valve **28**. The resulting depression of the plunger **32** opens the normally closed air valve **28** and permits pressure from the supply header **40** and supply **42** to flow into the inlet portion **30A** of the pressure manifold **30** and through the valve **28**, out through the outlet **30B** of the header **30** and into the gas whistle **44** to thereby sound an audible alarm indicating that the liquid level L2 has been achieved within the tank T.

Referring to FIGS. **4** and **5** there is shown a ship or barge generally designated **54** having four cargo tanks **56, 58, 60,** and **62**. An audible alarm device **10** is disposed in a dome portion **46** of each of said tanks and similar alarm devices **10** are located in the rakes **54A** and **54B** of barge **54**. Alarm devices **10** may either be the type disclosed in FIGS. **1** to **3** or the type shown in FIG. **7** to be described hereinafter. A common or central supply of nitrogen **42** is connected through supply header **40**, which is connected to manifold **30** of each of the alarm devices **10**. In the alternative a separate source of nitrogen may be provided for each of the alarm devices **10**. The use of separate sources of nitrogen is particularly useful on ships or barges larger than 150,000 barrels. The use of separate sources eliminates the need for long lengths of pipe, thereby reducing the chance of leaks; increases the supply of dry nitrogen available for each alarm device; and localizes the supply of dry nitrogen in the immediate area of each tank or area being monitored.

Referring to the operation of the system disclosed in FIGS. **4** and **5** of the alarm devices **10** in tanks **56, 58, 60,** and **62** will sound horns or whistles **44** upon the occurrence of an overflow and/or leakage condition in any of said tanks and alarm devices **10** in the rakes **54A** and **54B** of barge **54** will sound alarm horn or whistles **44** if the water in the rakes rises above a predetermined level commensurate with a sinking condition of the ship. Therefore, the system of FIGS. **4** and **5** comprises a fail safe alarm which will warn the barge crew of any condition which might lead to an oil spill or dangerous condition on the ship.

Referring to FIG. **6** there is shown an embodiment of the present invention for automatically shutting down the pumping of oil or other fluid material from a loading dock to a barge **54**. Barge **54** maybe of the type illustrated in FIGS. **4** and **5** having at least four oil tanks, each of said tanks having an alarm device **10** disposed therein.

Each of the alarm devices **10** is connected to a common pressure switch **68** by suitable conduit means **64** connected to output manifold sections **30B** of each of the respective alarm devices **10**. Suitable check valves **66** may be provided in conduits **64** to restrict the flow of nitrogen to pressure switch **68** after the pressure builds up to a sufficient level to trigger switch **68**.

Pressure switch **68** may be any suitable commercially available type which generates an electrical output pulse or signal in response to a flueric or fluidic input signal. The output of pressure switch **68** is connected through electrical cable **70** to electrical connector **73** of the electrical system of the pumping means located on loading dock **53**. An electrical cable **72** extends between electrical connector **73** and a relay (not shown) which turns the power on and off to the pumping means. Said relay may be located for example in the main pumping room on the loading dock. An electrical cable **71** is also provided which extends from connector **73** to an electomagnetically actuated gate valve **74** located in the main supply line **78** of the oil pumping means. A manually operated gate valve **76** may also be provided in line **78**.

In operation an overflow or leakage condition in any of the tanks on barge **54** will release nitrogen under pressure through outlet manifold sections **30B** of alarm devices **10**. This nitrogen will simultaneously be supplied to horns or whistles **44** through outlet sections **30B** and to pressure switch **68** through conduits **64** by way of check valves **66**. This will cause pressure switch **68** to generate an output control signal through electrical cables **70, 71,** and **72** to the relay in the pump room and to electrically actuated gate valve **74**. This output control signal causes the relay in the pump room to open shutting down the pumps and closes electrically actuated gate valve **74**, which stops the flow of oil or fluid through conduit **78** to the tanks on oil barge **54**. Simultaneously with the shutting down of the pumping operation horns or whistles **44** are sounded warning the operator of the overflow or leakage conditions in the oil tanks being filled.

Referring to FIGS. **7** to **9** there is illustrated an alarm device for signaling either an overflow or leakage condition in a tank T having a dome portion **46** and a removable hatch **80**. The alarm device of FIGS. **7** to **9** is substantially identical to the alarm device of FIGS. **1** to **3** in some respects in that the valve means **26**, the manifold **30**, and the bell crank **36** have substantially the

same functions. However, float **24** is mounted for slidable movement on a vertically disposed rod **82** which also passed through a bore **84A** in a slidable disc **84** mounted below flow **24** and a bore **36C** in bell crank **36.** Float **24** rests on top of disc **84** and in the absence of the bouyant force of supporting fluid beneath disc **84,** the weight of float **24** will force disc **84** downwardly along rod **82.** The relative diameters of bore **36C** and rod **82** must of course be such that the vertical arm of bell crank **36** may be moved laterally a sufficient distance with respect to rod **82** to permit bell crank **36** to pivot about point **38** a sufficient amount to depress valve actuator **32.** Rod **82** may be attached to the walls of tank T by welding or any other suitable means.

The leakage condition-sensing means of the alarm device of FIGS. **7** to **9** includes disc **84,** a pulley or reel **88,** a cable **86** wound around reel **88,** and a lever **90** supported about a pivot point **94.** Pulley or reel **88** is pivotally mounted on lever **90** about pivot point **88B** and may be adjusted through hatch **80** by rotating reel **88** to wind or unwind a selected amount of cable **86** and thereby adjust the height of disc **84.** Reel **88** may be locked in any desired position by any suitable means. For example the periphery of reel **88** may contain a series of apertures **88A** which may be aligned with a locking pin **90A,** which passes through a suitable aperture in lever **90.** A second locking pin **92** may be provided for supporting lever **90,** reel **88,** and disc **84** just prior to a filling operation when tank T is empty. After the fluid in tank T reaches a predetermined minimum level which is sufficient to buoyantly support disc **84,** locking pin **92** maybe removed. Locking pin **92** may be supported on a bracket **91** extending from support **12** or any suitable wall of tank dome **46.** Locking pin **92** may be adjusted by reaching through the opening provided by hatch **80.**

Referring to the operation of the alarm device of FIGS. **7** to **9** an overflow condition is sensed in substantially the same manner as described with respect to the alarm device of FIGS. **1** to **3.** When the fluid level in tank T rises above a predetermined level **L2,** float **24** travels up rod **82** and presses against foot **36B** of bell crank **36.** This causes bell crank **36** to pivot about point **38** thereby depressing valve actuator **32,** which opens valve **28** and releases nitrogen gas through manifold outlet section **30B** to horn or whistle **44.** If on the other hand a leak occurs in tank T the fluid level in tank T will fall to a predetermined minimum level **L1,** the weight of float **24** will cause disc **84** to slide down rod **82** pulling on cable **86,** which will cause lever **90** to pivot about point **94** and depress valve actuator **32.** In a like manner to the overflow sensor this will initiate the release of nitrogen to horn or whistle **44** to sound an alarm indicating that tank T is leaking.

From the foregoing, it can now be readily seen that the present invention satisfies a long-felt need in the art to aid in precluding environmental pollution due to oil spills and the like.

It should be understood that the present invention may be modified as would occur to one of ordinary skill in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An audible alarm device for detecting and signalling the advent of a leakage condition in a fluid storage tank, comprising:

a source of dry nitrogen gas under pressure;

gas operated audible means external of said storage tank;

pneumatic valve means mounted internally of said storage tank including pneumatic pressure line interconnecting opposite sides of said valve means with said source and said audible means, respectively;

float means mounted internally of said storage tank, interconnected with said valve means, and responsive to predetermined fluid levels representing the advent of a leakage condition in said storage tank to actuate said valve means to transmit gas from said source through said pneumatic lines to sound said audible means, said float means in said tank being mounted for slidable movement on vertical rod means in response to varying fluid levels in said tank;

an operating plunger for said valve means;

lever means pivotally mounted at a first end thereof adjacent said valve mans and having reel means mounted on a second end thereof, said lever means being constrained to engage and depress said plunger when pivoted downwardly about said first end;

disc means mounted for vertical movement on said rod below said float and being adapted to engage said float in response to said second fluid level corresponding to a leakage condition; and

cable means connecting said disc means to said reel means on said second end of said lever means.

2. The invention of claim **1** wherein one end of said cable means is wound about said reel means and said reel means is pivotally and adjustably mounted on said lever means, whereby said cable means may be selectively wound or unwound from said disc means to adjust the position thereof on said rod means.

3. The invention of claim **2** wherein means are provided for locking said reel means in selected positions.

4. The invention of claim **1** wherein means are provided for locking said lever means in a fixed position.

* * * * *