

[54] **PRESSURE SWITCH WITH DIAPHRAGM FOR LIQUID BEARING SOLIDS**[75] Inventor: **Frank G. Weis**, Kansas City, Mo.[73] Assignee: **Ecodyne Corporation**, Chicago, Ill.[22] Filed: **June 13, 1973**[21] Appl. No.: **369,638**[52] U.S. Cl. **200/81.9 R**, 200/83 R, 251/315, 73/406[51] Int. Cl. **H01h 35/34**

[58] Field of Search 200/81.9 R, 83 R, DIG. 31; 73/262, 265, 266, 406, 269; 251/315; 340/240; 137/315, 613

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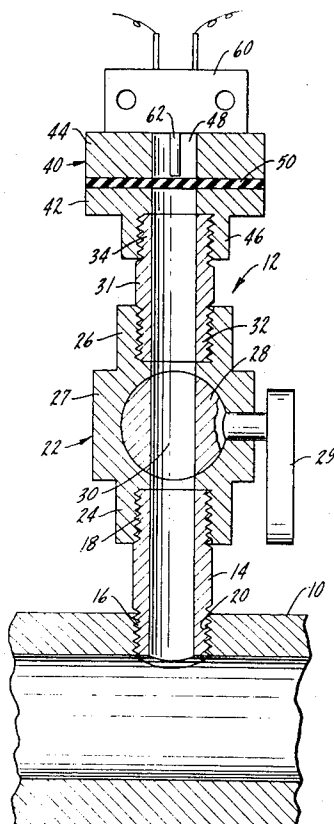
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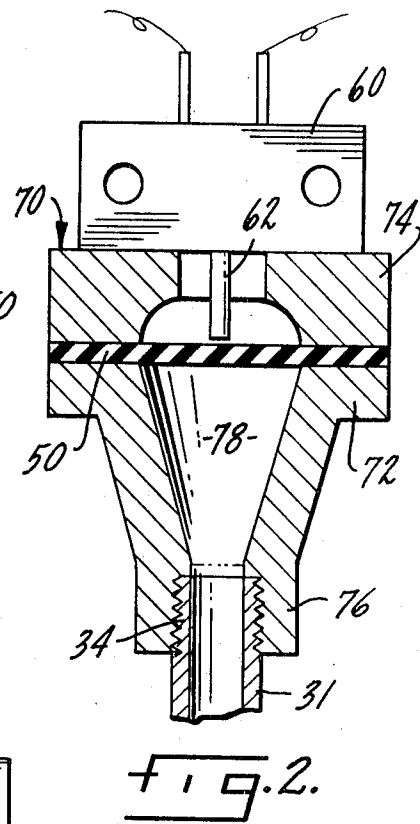
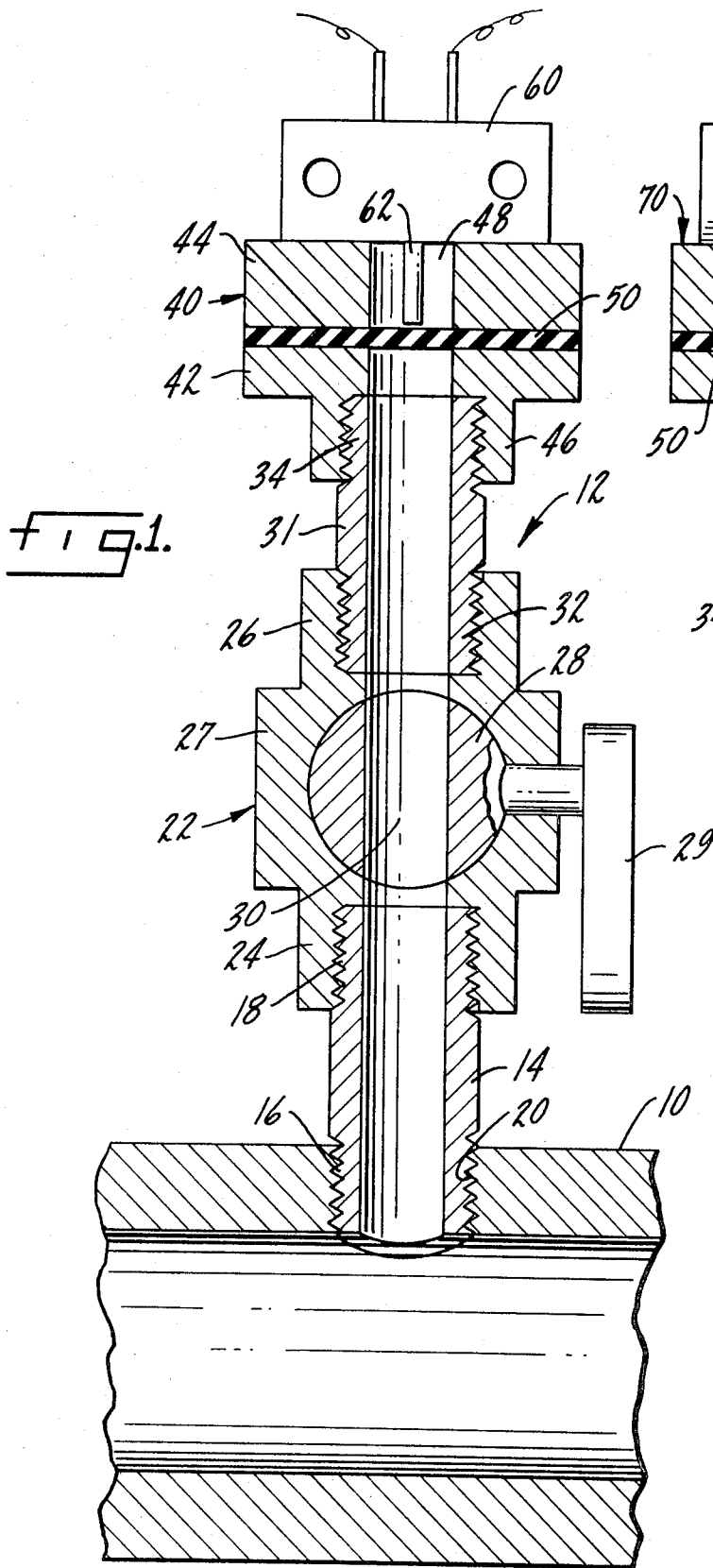
Primary Examiner—Robert K. Schaefer*Assistant Examiner*—Gerald P. Tolin*Attorney, Agent, or Firm*—Joel E. Siegel; Charles M. Kaplan[57] **ABSTRACT**

A pressure switch which has no flat surfaces or crev-

ices where solids may settle and accumulate to plug the switch. The switch includes a first vertical connecting nipple in fluid communication at its lower end with the liquid line and at its upper end with a full opening valve means. The valve means is preferably of the ball type having a passageway therethrough defined by vertical side walls. A second vertical connecting nipple is in fluid communication at its lower end with the outlet side of the valve means and at its upper end with a housing. The housing has an opening formed therein defined by vertical side walls. A diaphragm means is positioned within the housing in closing relationship to the opening so as to deflect under varying degrees of the pressure of the liquid within the opening. A switch means is positioned above the housing which is responsive to the deflection of the diaphragm means, the interior diameter of the first and second nipples, the passageway in the ball valve, and the opening in the housing are all in vertical alignment with one another and of substantially the same diameter so as to eliminate flat surfaces where solids may settle and collect.

An alternative embodiment is disclosed in which the portion of the housing below the diaphragm has side walls which converge towards the second connecting nipple at an angle greater than 60°.

6 Claims, 2 Drawing Figures



PRESSURE SWITCH WITH DIAPHRAGM FOR LIQUID BEARING SOLIDS

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a pressure switch for installation on a liquid bearing solids line and more particularly to a pressure switch for installation directly to a raw sewage line without the danger of the switch becoming clogged and inoperative.

It has been a long standing problem in the art to provide a pressure switch which can be installed directly on a raw sewage line or other liquid bearing solids line without the danger of the switch becoming clogged and inoperative. Clogging is caused by induced circulation inside the switch operating means or connecting pipe. The circulation deposits solids which settle and build up to plug up the operating mechanism. In the past, installation of a pressure switch or gage directly on such a line has resulted in clogging in a short period of time. Repeated attempts to solve this problem have resulted in failure. A first attempt to solve this problem uses a bladder of some known volume filled with liquid to isolate the switch from the sewage. A diaphragm of large size mounted directly on the pipe wall transfers the pressure through the bladder to the gage. A second attempt to solve this problem uses a rubber tube or sleeve positioned within the pipe. A liquid located between the outside of the tube and a metal jacket transfers the pressure to operate the switch. Both of these devices are expensive and present installation problems. They also require space and therefore can't be used in close quarters. A further problem is that if the liquid leaks out of the confining chamber, the diaphragm gradually expands until it completely fills the chamber. When this occurs, the correct pressure is no longer transmitted. A filling means must be incorporated to renew the liquid, which is a costly and large installation for a pressure switch.

The pressure switch of the present invention is particularly applicable for use on the suction line of a pump used to lift sewage or the like from a wet well. The switch accurately controls the operation of the pump dependent upon the liquid level within the wet well which in turn is proportional to the pressure within the suction line. It is essential in this environment that the pressure switch be designed to prevent the build up of solids which can cause the switch to become inoperative. It is therefore a primary object of the present invention to provide a pressure switch for direct installation on a liquid bearing solids line which prevents the switch from becoming inoperative due to clogging.

Another object is to provide such a pressure switch which does not use sealing the diaphragms to prevent clogging.

A further object of the present invention is to provide such a pressure switch which is inexpensive to manufacture and maintain and may be used in close quarters.

These and other objects are realized in accordance with the present invention by providing a pressure switch that has no flat surfaces or crevices where solids may settle and accumulate to plug the switch. In this regard, the switch includes a first vertical connecting nipple in fluid communication at its lower end with the liquid line and at its upper end with a full opening valve

means. The valve means is preferably of the ball type having a passageway therethrough defined by vertical side walls. A second vertical connecting nipple is in fluid communication at its lower end with the outlet side of the valve means and at its upper end with a housing. The housing has an opening formed therein defined by vertical side walls. A diaphragm means is positioned within the housing in closing relationship to the opening so as to deflect under varying degrees of the pressure of the liquid within the opening. A switch means is positioned above the housing which is responsive to the deflection of the diaphragm means. The interior diameter of the first and second nipples, the passageway in the ball valve, and the opening in the housing are all in vertical alignment with one another and of substantially the same diameter so as to eliminate flat surfaces where solids may settle and collect.

An alternative embodiment is disclosed which is identical in construction with the embodiment above except the opening in the housing below the diaphragm has side walls which converge towards the second connecting nipple at an angle greater than 60°. This permits a larger opening at the diaphragm without creating flat surfaces and still permitting solids to settle back into the pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and many of the attendant advantages of this 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, in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a vertical sectional view of a pressure switch constructed in accordance with the present invention; and

FIG. 2 is a vertical sectional view of the housing portion of an alternative embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1, a conduit through which a liquid bearing solids, such as raw sewage, flows is indicated at 10. A pressure switch 12, constructed in accordance with the present invention, is provided in communication with conduit 10 sensitive to the pressure within conduit 10. For example, conduit 10 may be the suction line of a pump used to pump raw sewage from the bottom of a wet well. Pressure switch 12 is operative to control the operation of the pump dependent upon the pressure within conduit 10 which in turn is proportional to the level of sewage in the wet well. In this and other similar environments it is essential that pressure switch 12 reliably operate without becoming clogged by the build up of settling solids.

Pressure switch 12 includes a connecting nipple 14 having threaded lower and upper ends 16 and 18 respectively. Lower end 16 is received within a threaded opening 20 in conduit 10 and is in fluid communication therewith. A full opening valve 22, such as a ball valve, or a plug valve is provided with a threaded lower boss 24 and a threaded upper boss 26 in vertical axial alignment with one another. Upper end 18 of nipple 14 is received within lower boss 24. Valve 22 includes a body 27 in which is defined a central cavity to receive a ball member 28. A passageway 30, formed through

ball 28, has substantially vertical side walls when in its open position in vertical axial alignment with bosses 24 and 26. The diameter of passageway 30 is substantially identical to the internal diameter of bosses 24 and 26 and nipple 14 to preclude the formation of flat surfaces and crevices where solids may settle. A connecting nipple 31, having threaded lower and upper ends 32 and 34 respectively, is positioned above valve 22 with lower end 32 being received within boss 26. The internal diameter of nipple 31 is substantially the same as the internal diameter of passageway 30.

A housing 40 is positioned above nipple 31. Housing 40 includes a lower section 42 and an upper section 44. Lower section 42 has a boss 46 formed integral therewith for receipt of upper end 34 of nipple 31. Passing through lower section 42 and upper section 44 is an opening 48 defined by substantially vertical side walls. Opening 48 is in vertical axial alignment with, and of substantially the same internal diameter as nipple 31. Sandwiched between lower section 42 and upper section 44 is a flexible diaphragm 50, made from rubber or the like, positioned in a closing relationship to opening 48. Diaphragm 50 is operative to flex or deflect in proportion to pressure of the liquid within the lower portion of opening 48. Upper section 44 is secured to lower section 42 with diaphragm 50 sandwiched therebetween in a suitable manner, such as by bolting (not shown).

Positioned above housing 40 is a switch means 60. Switch means 60 may be of any type well known in the art such as a conventional micro-switch. Switch 60 includes an actuating pin 62 which extends down into the upper portion of opening 48 to a position immediately above diaphragm 50. An increase in pressure in the lower portion of opening 48 beyond a predetermined value is effective to deflect diaphragm 50 to contact pin 62 and actuate switch 60. Referring to FIG. 2, an alternative construction of the housing is illustrated at 70.

Housing 70 includes a lower section 72 and an upper section 74. Lower section 72 has a boss 76 formed integral therewith for receipt of upper end 34 of nipple 31. Passing through lower section 72 and upper section 74 is an opening 78. The portion of opening 78 which passes through lower section 72 has side walls which converge towards end 34 of nipple 31 at an angle greater than sixty degrees. The specific shape of the portion of opening 78 which passes through upper section 74 is not as critical and as shown gradually necks down as it approaches the upper end of section 74. Sandwiched between lower section 72 and upper section 74 is a flexible diaphragm 50, made from rubber or the like, positioned in a closing relationship to opening 78. Diaphragm 50 is operative to flex or deflect in proportion to pressure of the liquid within the lower portion of opening 78. Upper section 74 is secured to lower section 72 with diaphragm 50 sandwiched therebetween in a suitable manner, such as by bolting. By converging the side walls of the portion of opening 78 which passes through lower section 72 a larger opening at the diaphragm results without creating flat surfaces and still permitting solids to settle back into the pipe.

In operation, liquid from conduit 10 rises through nipple 14, passageway 30 in valve 22, and nipple 31 into the portion of opening 48 which passes through the lower section 42 of housing 40. When the pressure of this liquid reaches a predetermined value, it causes diaphragm 50 to deflect upward a sufficient distance to

contact pin 62 and actuate switch 60. When the pressure drops below the predetermined value, the diaphragm returns to its original position and switch 60 is de-activated. The specific shape, dimensions, and space relationship of the elements which form the pressure switches as illustrated in FIGS. 1 and 2 effectively eliminate all flat surfaces and crevices and thereby prevent the build up of solids which can cause the switch to plug up and become inoperative. When it becomes necessary to replace or repair diaphragm 50 or switch 60 the valve 22 is placed in its closed position by rotating handle 29 which in turn rotates ball 28. This permits repair of these elements without shutting down the system in order to remove pressure from the switch.

Various modifications are contemplated and may obviously be resorted to by those skilled in the art without departing from the true spirit and scope of the invention, as hereinafter defined by the appended claims, as only preferred embodiments thereof have been disclosed.

What is claimed is:

1. A pressure switch for use in direct contact with a liquid bearing solids line; comprising:

- a. a substantially vertical connecting pipe having a lower end in fluid communication with said liquid bearing solids line so as to receive liquid under pressure therefrom;
- b. a control valve means in fluid communication with said connecting pipe for control of liquid flow therethrough, said control valve means having a passageway therethrough defined by substantially vertical side walls;
- c. a housing positioned above said control valve means having a substantially vertical opening therethrough defined by substantially vertical side walls;
- d. a diaphragm means, positioned within said housing in closing relationship to said opening, adapted to deflect under varying degrees of pressure of the liquid in said opening;
- e. switch means positioned above said housing responsive to the deflection of said diaphragm means; and
- f. said connecting pipe, said passageway and said opening are substantially in vertical alignment with one another and are of substantially the same diameter so as to eliminate flat surfaces where solids may settle.

2. The invention as defined in claim 1 wherein said side walls of said opening converge towards said connecting pipe at an angle greater than 60°.

3. A non-clogging pressure switch for direct attachment to raw sewage line, comprising:

- a. a first substantially vertical connecting nipple having a lower end in fluid communication with said raw sewage line so as to receive liquid under pressure therefrom;
- b. a full opening valve means having an inlet side in fluid communication with an upper end of said first connecting nipple for control of liquid flow therethrough, said valve means having a passageway therethrough defined by substantially vertical side walls;
- c. a second substantially vertical connecting nipple having a lower end in fluid communication with the outlet side of said valve means;

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- d. a housing secured to the upper end of said second connecting nipple having a substantially vertical opening therethrough defined by substantially vertical side walls;
- e. a diaphragm means, positioned within said housing in closing relationship to said opening, adapted to deflect under varying degrees of pressure of the liquid in said opening;
- f. switch means positioned above said housing responsive to the deflection of said diaphragm means; and
- g. said first and second connecting nipples, said passageway and said opening are substantially in vertical alignment with one another and are of substantially the same diameter so as to eliminate flat surfaces where solids may settle.

4. The invention as defined in claim 3 wherein said valve means includes a ball valve member with said passageway passing therethrough.

5. The invention as defined in claim 3 wherein said housing includes a lower section, secured to the upper end of said second connecting nipple, having a portion of said opening defined therein and an upper section, secured to said switch means, having a portion of said opening defined therein to receive a switch activating means, said diaphragm means being sandwiched between said lower and upper sections.

6. The invention as defined in claim 5 wherein said portion of said opening defined in said lower section has side walls which converge towards said second connecting nipple at an angle greater than 60°.

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