The present invention relates to a switch device and more particularly to a switch device responsive to changes in the level of liquids or like flowable products. It is frequently necessary to control the operation of equipment in response to changes in the level of a liquid or other flowable product when the level must be determined in a location that is inaccessible, or in a corrosive atmosphere, or when other environmental problems exist. It is an object of the present invention to provide a switch device which is responsive to the changes in the level of the liquid or like product wherein the switch element is wholly protected from the environmental conditions.

More particularly it is an object of the invention to provide an easily manufactured, yet rugged and inexpensive, switch device for use in environments of the nature indicated above.

Still another object of the invention is to provide a switch device of the character indicated which may be quickly and easily installed.

These and other objects of the invention will become more apparent hereinafter.

In accordance with an illustrated embodiment, the switch device of the invention comprises a generally cylindrical housing of corrosion resisting, insulating material such as Fiberglas to one end of which housing is sealed a flexible, fluid impervious, conduit by means of which the housing may be suspended with the axis thereof extending substantially vertically. Mounted within the housing is a switch or a plurality of switches as may be required adapted to be actuated between open and closed positions upon tilting of the housing by a predetermined amount.

The switches are connected to electrical conductor means which extend outwardly from the housing through the conduit, the upper end of which is secured to the top wall of the enclosure in which the product whose level is to be utilized to actuate the switch is contained whereby the conduit and housing wholly protect the switch and conductors from any corrosive vapors within the ambient atmosphere.

For a more detailed description of the invention reference is made to the accompanying drawings wherein:

FIG. 1 is an enlarged side elevation of the device with parts taken away to show details of construction thereof;

FIG. 2 is a sectional view taken substantially along line 3-3 of FIG. 1;

FIG. 3 is a circuit diagram of a suitable switch arrangement for use with the device; and

FIG. 5 is a side elevation of the switch device showing the same in a tilted attitude caused by a rise in the level of a liquid within which it is suspended, and with parts broken away to show operation of the switches therein.

Referring now to the drawings, the illustrated switch device comprises a hollow, generally cylindrical housing preferably formed of Fiberglas or similar substantially rigid, inert, electrical insulating material. A flexible, fluid impervious conduit is sealed to one end of the housing coaxially thereof for suspending the housing from a top wall or bracket with the axis of the housing extending substantially vertically. The conduit is preferably formed of a chemically inert synthetic plastic such as a polyvinyl chloride or similar material. Any suitable means may be provided to connect the conduit to the housing. In the illustrated embodiment a coupling is sealed in the housing end wall and the conduit forced over the serrated stem of the coupling to form a fluid tight connection between the coupling and the conduit. The upper end of the conduit is likewise connected to a coupling having a stem over which the conduit extends and a threaded nipple extending upwardly from a flange. The nipple is adapted to thread itself into an opening provided in the wall or bracket, a nut being provided to lock the coupling in place.

Means are provided in the housing for mounting a switch or switches therein. In the illustrated embodiment, a pair of diametrically extending switch mounting brackets and comprises opposite complementary portions which extend from opposite housing side walls to meet substantially on the axis of the housing, each of such portions defining an acute angle "A" of between about 55 to 60 degrees with respect to the axis of the housing. The portions and are inclined upwardly with respect to the axis from the respective side walls of the housing. The bracket likewise comprises opposite complementary portions each of which is secured at one end to the side wall of the housing and which are inclined downwardly with respect to the housing to meet substantially on the axis of the housing. Portions and are likewise inclined at an angle of between about 55 to 60 degrees with respect to the housing axis. Mounted on each of these bracket portions is a tilt responsive switch, preferably a mercury switch, such as are indicated at . Clips are provided on each of the brackets to hold such switches in position. While such switches may be of the normally open or normally closed type, depending on the switching action desired, preferably they are of the type having a pair of contacts at each end of the housing of the switch whereby, when the device is suspended as shown in FIG. 1, the lower contacts of the switch will be closed and the upper contacts of each switch will be open. The value of this arrangement will be described in greater detail hereinafter.

Electrical conductor means are provided for connecting the switches to an apparatus to be controlled thereby. Such conductor means comprise leads and a cable or cord that extends outwardly of the housing through the conduit. To assure that no strain is placed on the leads or connections to the various switches, the cord is anchored against movement by means of a clip of greater diameter than the opening in the lower end of the coupling and which clip is fixedly secured to the cord. The clip is bonded in an epoxy or other suitable resin which extends into the neck of the coupling so as to provide a vapor tight seal between the cord and the coupling, thus to prevent entrance of any fluid into the housing in the event of rupture of the conduit.

The switch device of the invention is adaptable for use in numerous environments. For example, it may be utilized as an indicator switch to control the motors of pumps discharging into stock tanks of a paper mill or the like wherein the pulp liquids are highly acid. However, by reason of the complete enclosure of the switches herein the corrosive atmosphere have no effect thereon. The switch device may also be utilized in locations such as in a sump of a food product such as shell peas. In such an instance one device may be positioned at the bottom of the sump to start a pump to pump material into the sump when the liquid level reaches a predetermined low level, and another device could be provided...
at the top to stop the pump when the liquid level reaches a predetermined height.

Referring to FIG. 4 while various connecting arrangements are possible preferably the switches 60 are arranged with the lower contacts 80 thereof connected in series and which, of course, will be normally closed when the switch is suspended with its axis vertical. The upper contacts 82 of such switches which are normally open in the vertical position on the housing 10 are preferably connected in parallel.

FIG. 5 illustrates the operation of the switch of the instant invention when the surface of the liquid 84 above which it is suspended rises to a level which will cause the housing 10 to change its attitude as by tilting. As shown in the figure, the flexible conduit 12 permits the housing 10 to tilt, which action opens one or more of the lower contacts 80, and closes one or more of the upper contacts 82. Since the lower contacts 80 are connected in series, their associated circuit is, of course, broken. Since the upper contacts 82 are connected in parallel, closing any one of them closes their associated circuit, all of which are clearly shown in FIG. 4.

While various numbers of switches may be utilized, the presence of four switches in the arrangement shown causes the switch to open or close contacts within a relatively limited range of tilt of about five degrees whereby to operate a control or measurement of a liquid level may be maintained. While in some instances the lower contacts 80 may be utilized in other instances only the upper contacts 82 may be utilized for control, and in other instances both sets of contacts will be useful. An example of this is in operating alarms in two different locations wherein one alarm could be actuated through the closed switches, that is opening any one of the switches 80 would cause actuation of the alarm and the other alarm operated by closing any one of the normally open switches 82. As will be apparent to those skilled in the art, such an arrangement will reduce the amount of wiring that would otherwise be needed to operate both alarms.

Having illustrated and described the preferred embodiment of the invention it should be apparent to those skilled in the art that it permits of modification in arrangement and detail. I claim all such modifications as come within the scope of the appended claims.

I claim:

1. A fluid level detecting device, comprising:
   a hollow housing adapted to move with said fluid level;
   flexible support means attached to said housing and normally hanging vertically for supporting said housing in a normally vertical position with its axis inclined to the vertical when said fluid is below a predetermined level and for supporting said housing in an inclined position with its axis inclined to the vertical when said fluid exceeds said predetermined level and moves said housing;
   two pairs of mercury switches comprising elongated tubes;
   means in said housing for supporting said switches with the longitudinal axis of each switch inclined with respect to the housing axis by substantially the same acute angle, and with the lower ends of the switches circumferentially spaced substantially uniformly about the housing axis;
   said switches each containing a pair of switch contacts at the lower end thereof and a pool of mercury such that all of said pairs of contacts are closed by the mercury in the switches in said vertical position of said housing and at least one of said pairs of contacts is opened in any inclined position of said housing greater than a predetermined minimum angle; and
   means for connecting said two pairs of switch contacts in a series circuit such that when the fluid level rises and moves said housing from said vertical position to said inclined position said series circuit is opened, and when fluid level falls and moves from said inclined position to said vertical position such series circuit is closed, to produce electrical signals indicating the level of the fluid.

2. A fluid level detecting device in accordance with claim 1 in which the axis of each switch is inclined at an angle of between 55 and 60 degrees with respect to the housing axis.

3. A fluid level detecting device in accordance with claim 1 in which said switches each also contain another pair of switch contacts at the upper end thereof and the upper pairs of switch contacts are connected in parallel.

4. A fluid level detecting device in accordance with claim 1 in which the housing is fluid impervious and the flexible support means is a fluid impervious electrical conduit containing an electrical conductor having leads which are connected to said switches, said conduit being attached to said housing by one fluid tight seal and being secured to said conductor by another fluid tight seal extending between said conduit and said conductor.

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