Various Technics of Liquids and Solids Level Measurements

A wide variety of physical principles can be applied for measurements of liquids, solids and slurries levels such as: pressure, level-sight, radiation, sonic principles, electrical properties, etc. A series of questions must be answered in order to determine the kind of level sensor which should be utilized for an application,

- What is the material to measure: liquid or solid
- Can the sensor be placed in the chamber or it should be external
- Will you need contact or non-contact level measurement
- What's the acceptable degree of accuracy
- What are the application's temperature and pressure ranges
- Is the specific gravity of the liquid changing with time
- Is point level or continuous measurement required
- What level measurement range do you need
- Is the measured material electrically conductive
- Will the material coat or build up on surfaces
- Does turbulence, foam, or vapor occur at the surface of the liquid
- What kind of output do you need–analog, relay, digital display, etc.

Construction material(s) of the level sensor is also important and should not be affected or negatively affect the material in the tank. If a number of level detector designs may be used for a particular application, the user should research to find out what method has been traditionally accepted in that industry before purchasing the level instrument. Usually a method is preferred in an industry and the operators are familiar with that method, and it is advisable to stick to that if it still is a rational method.

Following a variety of measuring techniques and equipment are explained to assist engineers to select the correct technique of level measurement for their processes.

FLOATING SYSTEM

In this system, a float moves with the liquid surface. The result of this vertical movement of the float can be used to indicate the level to the observer, actuating a switch alongside or creating a quantitative analogue signal in its route based on the variation of the resistance placed inside the stem of the instrument as the magnetic float moves.

Magnetic floats should not be used for liquids containing iron particles or other strongly magnetic materials. Floats can be as stainless steel or other materials such as plastic, Teflon, etc.; suitable for liquids with specific gravity above the specific gravity of the float.

Magnetic Float Type Level Switches are available both as horizontal and vertical versions. The horizontal type is used on the sidewall of tanks and its operating principle is such that when the rising liquid level tilts the float upward, the magnet attached to the end of the body actuates the switch (Fig. 1).

The vertical type is usually installed on the top of the tank and the float is connected to a spring via its chain. Changes in spring tension cause vertical movement of the rod and the core, which in turn, results in magnet "A" moving away from the lead pipe; actuating the micro switch without mechanical connection (Fig. 2).

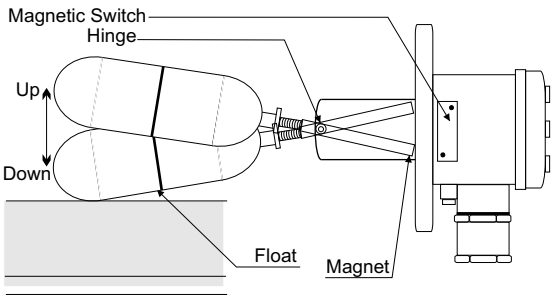

Fig. 1. Horizontal Magnetic Float Diagram

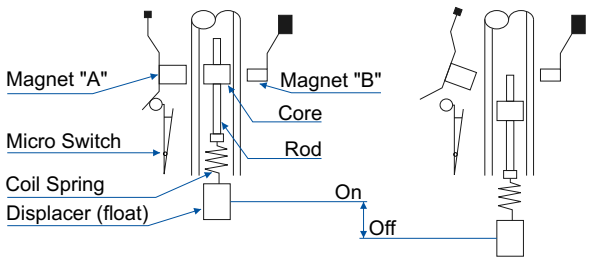

Fig. 2. Vertical Magnetic Float Diagram

If the instrument should be connected to the side of the tank, a variety of chambers may be used for side connection (LSF200 in Figure 3). Moreover, the instrument can be supplied with multiple floats and switches to control and notify the operator of the various levels of liquid in the tank (Fig. 3).

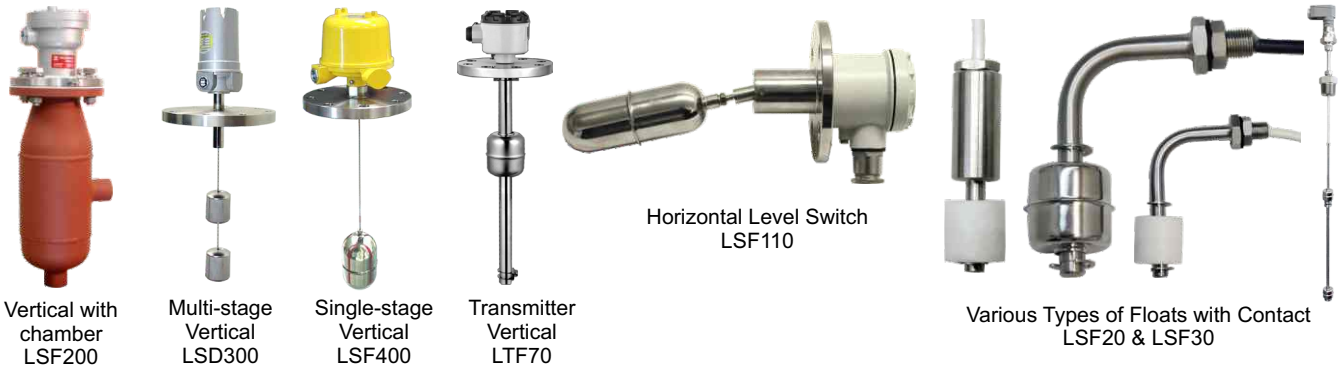

Fig. 3. Various Types of Magnetic Floats with Contact

When magnetic floats are applied in level indication, they use the principle of magnetic coupling to provide continuous level data without direct contact between the indicator and the fluid in the system. The float inside the hermetically sealed tube moves with the changing liquid level, and as it travels, the coloured wafers (flag display) which are magnetically coupled to the float rotate and their colour changes. The wafers should be visible at night without light. A ruler is mounted along the wafer column to indicate the quantitative value of the level in a distance unit or as a percentage of the total height (Fig. 4).

These floating systems may be equipped with a transmitter to act as an indicating level transmitter, or magnetic switches can be installed along the tube to form an indicating level switch.

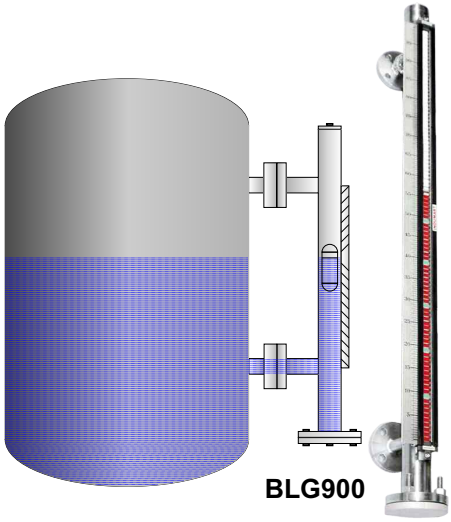

Fig. 4. Magnetic Float Level Indicator

The Magnetic Level Gauge (by-pass) is an improved alternative to sight gauges (glass tubes) used to visually monitor liquid levels in boilers, storage tanks, etc.

By using non-contact magnetic level gauges, the problems of glass breakage, leakage, bursting at high pressure and temperature, poor visibility due to scale build up and corrosion, and unsafe operation are eliminated.

Replacing the sight gauges with magnetic level gauges would result in improved safety, increased visibility (10 times), reduced maintenance, and lower long-term operating cost.

For an economical and practical solution for accurately displaying the level of liquids, the Float & Board Type Level Indicators may be considered. Wide choices of float and flange materials are available in the market to suit various filling materials and stainless steel bush-bearings assure smooth rotation of the pulley. The pulley must be housed in a dust-poof enclosure to protect the rope (Fig. 5).

Fig. 5. Float & Board Level Indicator

Dial Liquid Level indicators are used for level measurement of water, diesel oil, bunker-c, etc. Easy installation of these transmitters makes them the ideal choice for most level measurement and control applications. The operating principle is based on the buoyancy of float and spring force. When the float rises and falls, the gear mechanism connected to the float and the spring moves to display the level on the front scale and an analogue signal is produced. When the tank is being filled or drained, the float rises or falls until the total weight of the float and the wire becomes equal to the total force exerted by the liquid buoyancy and the spring. When the level rises, the spring is wound and the length of the wire is decreased, and when the level falls, the spring is stretched, and the length of the wire is increased. The front scale connected to the float and the wire via the gear mechanism displays the level on the dial. This system is also available with switching contacts and analogue (4...20 mA) output.

TLG500

Fig. 6

INSTALLATION TO THE TOP OF THE TANK

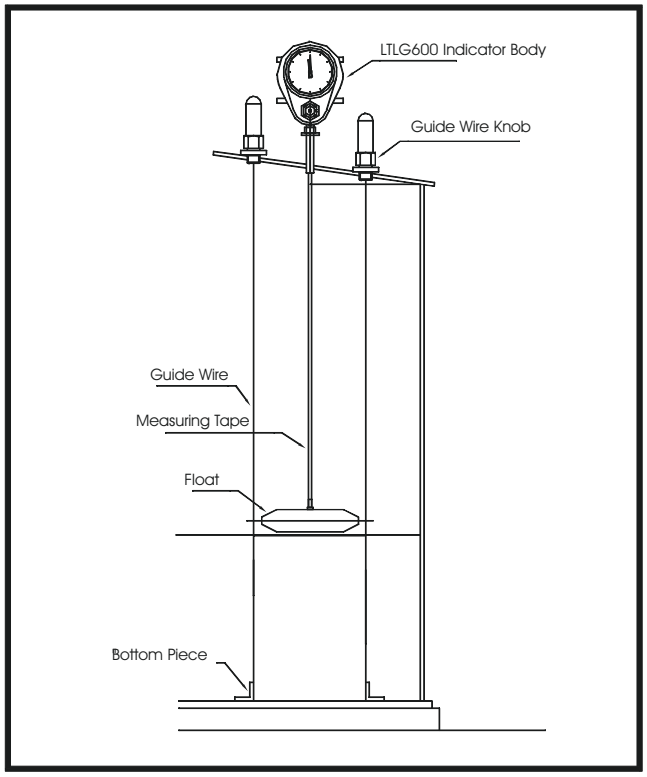

Fig. 7

INSTALLATION TO THE SIDE OF THE TANK

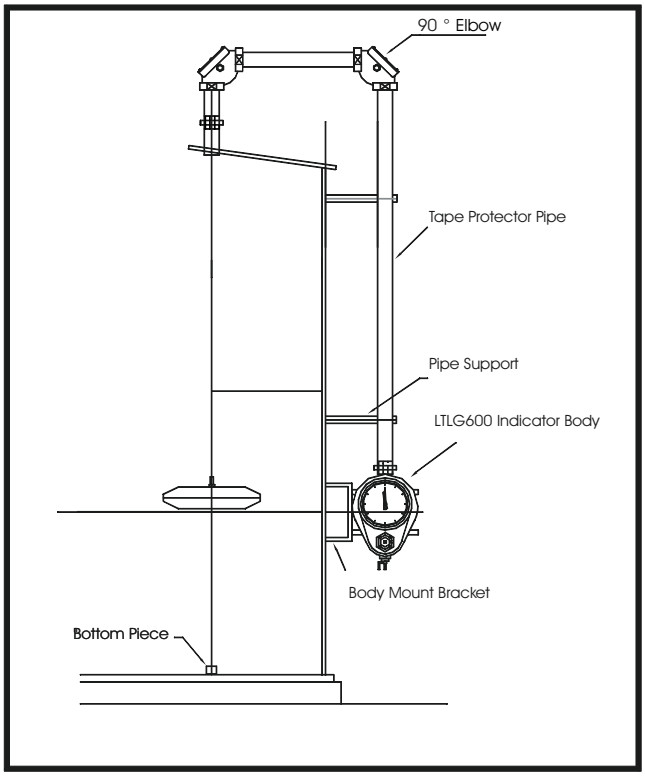

Fig. 8

This was the first part of a multiple section series. Please find the part 2 in the November 2009 issue of Indumart Newsletter. The remaining parts include pressure type, radiation type, Ultrasonic, capacitance probe and resistance tape level instruments.