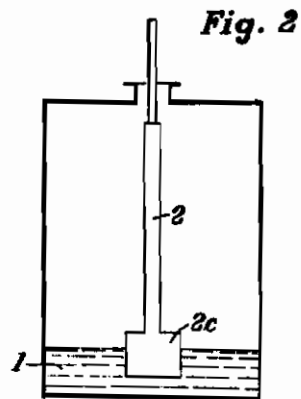
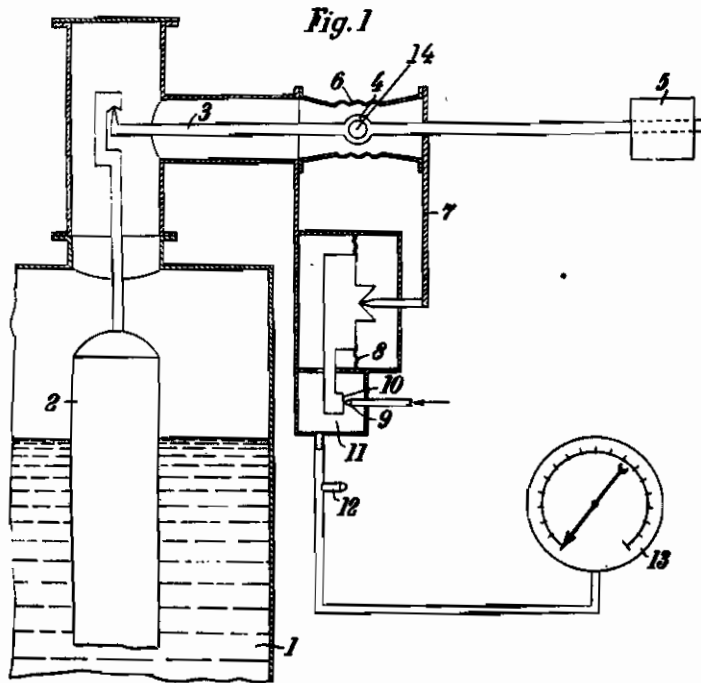


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REMOTE INDICATING APPARATUS FOR MEASURING THE DEPTH OF LIQUIDS IN TANKS

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This invention relates to a remote indicating apparatus for measuring the depth of liquids in tanks.

The measuring apparatuses for liquids hitherto known show one or several of the following defects: Incorrect registration or complete failure, if slight leaks occur in the conduit pipes, furthermore dependence of the registration on the temperature of the conduit pipe, sensitivity against rough treatment, small efficiency, which causes small adjusting power of the indicating or recording apparatus. If electricity is used as an auxiliary power, delicate, fine, mechanical parts have to be employed and special protective measures have to be taken when working with explosive substances. Mercury, furthermore, is used as contact liquid for many remote indicating apparatuses working by electricity which, however, in many cases is to be avoided from a purely chemical view point.

It is an object of this invention to construct an indicating apparatus for measuring the depth of liquids in tanks etc.

Another object is the construction of an apparatus being adaptable without danger to highly inflammable liquids.

These and other objects will be apparent from the following description.

A remote indicating apparatus for measuring liquids not showing any of the above mentioned disadvantages will be described hereinafter. It is destined to measure the depth of liquids in tanks, which are intended for work or storage, the depth of which is difficult to determine by other measuring apparatuses, especially when the tanks are submerged or kept under high pressure. By the present invention it is also possible to construct an apparatus being adaptable without danger to inflammable liquids, because it avoids electric current and the like.

The apparatus works according to the compensation principle by using compressed air which does not come into contact with the liquid with which it may form an explosive gas-mixture.

The apparatus uses the known principle to measure the buoyancy of a body submerged partly in the liquid, for instance when measuring the capacity of the depth of liquids, or completely when measuring the density. The buoyant body may be adjusted to the form of the tank in order to obtain an even graduation of the indicating apparatus. According to the present invention this buoyancy is measured by means of that pressure of the compressed air automatically regulating itself, which is necessary to hold

the buoyant body always at the same height. As the measuring apparatus performs small movements only around the zero-position, it is possible to transmit these movements towards outside by an elastic membrane-packing free from friction. This membrane can be made, contrary to membranes for a deflection method, of flabby, non-stiff material.

To use such a membrane makes it possible to rigidly connect with each other those parts of the transmitting system being arranged outside and inside.

The apparatus is exemplified in the accompanying drawings. Figure 1 shows for instance the most important part of the apparatus.

In the drawing the tank for the liquids is always marked with 1 and the buoyant body with 2. This buoyant body is hung up in the tank in such a way, that it begins shortly above the bottom of the tank and reaches up to the highest possible point of the liquid. This buoyant body 2 hangs on a double-armed lever 3 which through the bellows membrane 9 is gas-tight guided towards the outside. A useful construction of how to arrange the lever, is as follows: there is rigidly connected with the lever 3 a fork not shown in the drawing, which grips around the membrane having on each side a spindle bearing, which is rotatively mounted in a bearing rigidly connected with the tank in such a way, that the supposed rotative axle 14 penetrates through the middle of the membrane. Number 4 marks a ball bearing. The power of the tank-pressure effective on the membrane in a horizontal direction is also taken up by this arrangement.

The lever 3 carries on its right end a movable counterbalance, to compensate the weight of the buoyant body when the tank is empty.

If the buoyant body 2 is raised in the tank by the raising liquid, the counter balance 5 sinks down which by means of flange 7 presses against a membrane installed in a pressure box 11, which on the other hand by means of the adjoined piece 10 releases the opening of the nozzle 9 for compressed air. By this nozzle 9 so much compressed air enters into the chamber 11, that membrane 8 and with it the lever 7 and the double-armed lever 3 is brought back into the original position by lowering the buoyant body 2. The pressure of the compressed air behind the membrane, formed by compensation in the chamber 11, is therefore a measurement for the depth of the liquid in the tank 1. The air- or gas-pressure existing there is measured for instance with an ordinary manometer 13, which may be re-

placed by an automatic registration device or by an alarm equipment. If the contents of the tank decrease, the pressure of the compressed air in the chamber 11 must be adjustable. A blow-off-nozzle 12 is therefore provided, which preferably is built in an adjustable manner. By adjusting this nozzle leakages in the pipes may be compensated and are in this way not dangerous any more.

As the membrane registers automatically always the right pressure within the remote measuring apparatus, changes of temperature are without influence on the resulting measurement. Likewise a change of the length of the conduit pipes is always possible. Also further indicating, registering or regulating devices may be put up without further readjustment.

Membrane 6 forms an important part in making the outside parts of the apparatus tight against the inside parts of the tank, since the apparatus works according to a compensation method, thereby registering small movements around the zero-position. This membrane can be constructed so strongly, that the apparatus may be used without difficulties also for tanks of considerable pressure (at the present about 25 atm.) with still high accuracy and excellent adjusting power.

Another important part, moreover, is the buoyant body 2. The weight of this body is somewhat higher than the quantity of water displaced by it and is not unnecessarily of bigger dimensions. In order to avoid unnecessary lowering of the

double-lever 3, the body may consist of massive material, in most cases, however, a hollow piece of sufficient wall thickness may be sufficient, which, when measuring chemically aggressive liquids, is to be provided, if necessary with a protective coating.

The special form of the buoyant body 2 may also be comprised within this patent application. The form of said body (see cross sectional view of Fig. 2) may be chosen in such a way, that it is especially sensitive for a certain measuring range. This finds a most useful application for reaction vessels in chemical factories. Also the overflowing of storage tanks may be indicated in a striking manner and in time, by an increased scale movement being caused by a special form of the buoyant body.

Figure 2 shows diagrammatically a cross sectional view of a buoyant body. This simple form of the buoyant body is employed in a reaction vessel, wherein an exact measurement of the chemicals to be added is made possible by the reinforcement 2c.

The new apparatus is of wide use. It may be employed for instance to measure specific weights of liquids, if the buoyant body is completely submerged. Furthermore it may serve as regulator for regulating the depth, the contents or the density of the liquids. In connection with a regulating device controlled by compressed air it may be used directly as regulating device of the aforesaid kind.

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