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LIQUID LEVEL INDICATOR

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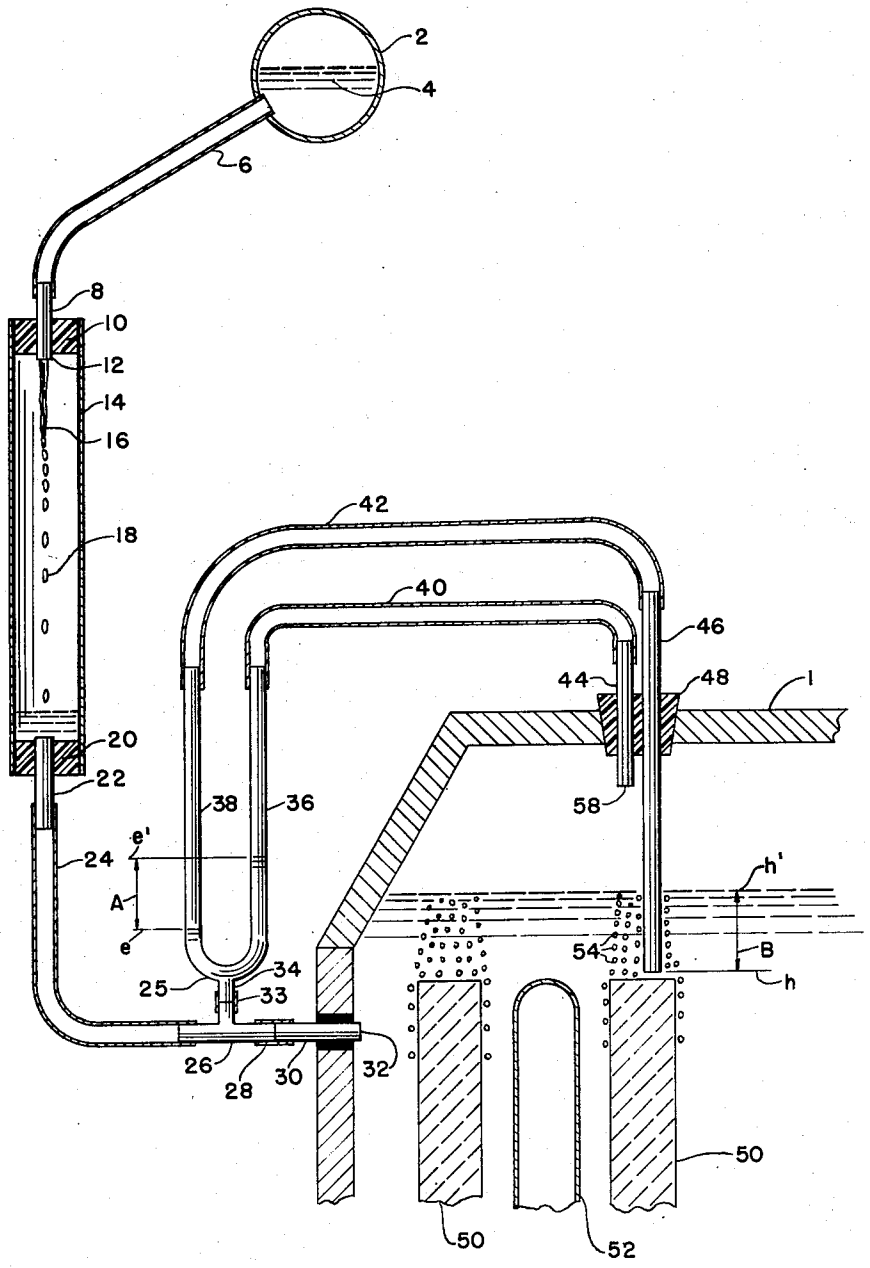

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LIQUID LEVEL INDICATOR

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This invention relates to a combination liquid feed-liquid level indicator device for reservoirs in hydrodynamic systems, and more particularly relates to a combination liquid feed-liquid level indicator device for electrolytic cells in which aqueous solutions are subjected to electrolysis to give at least one gaseous product.

The present invention is used in hydrodynamic systems which include a stream of liquid fed continuously or intermittently to a reservoir from which liquid and/or gases are continuously or intermittently withdrawn. Such systems include electrolytic cells, for example, cells in which water is subjected to electrolytic decomposition to oxygen and hydrogen, or in which a solution of an electrolyte, such as sodium chloride solution, is electrolytically decomposed to chlorine, hydrogen, and sodium hydroxide. The conventional construction of cells for the electrolysis of a sodium chloride brine includes regularly spaced anodes adjacent perforated cathodes supporting a liquid permeable diaphragm. A positive pressure of electrolyte solution is maintained on the anode side of the diaphragm by maintaining a higher level of electrolyte solution in the anode compartment than that in the cathode compartment, whereby the diaphragm is held in place and a liquid permeable-gas impermeable separator is maintained between the anode and cathode compartments of the cell.

It is essential to efficient and safe operation of such cells to preclude the intermixing of hydrogen and chlorine, since such intermixing requires subsequent separation to purify the gases, or may, if the proper proportions of the gases are present in the mixture, result in destructive explosions. However, when the liquid level in a cell is not maintained above the uppermost level of the cathode structure, intermixing of the gases evolved (chlorine and hydrogen) results, with attendant difficulties heretofore noted. It is for this reason that accurate determinations of the liquid level within the cells must be made at frequent intervals.

The liquid level indicators previously employed in conjunction with electrolytic cells have been for the most part of the simple U-tube manometer type, one leg of which extends into the anolyte solution within the cell and the other of which is open to the atmosphere. In some applications of the U-tube manometer, the U-tube is mounted atop the cell and one leg of the U-tube is opened to the atmosphere and the other extends vertically into the anolyte liquor

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to the point below the mean or normal liquid level therein and immediately above an anode, whereby chlorine gas evolved at the anode displaces anolyte solution for the extension of the manometer leg, and hydrostatic pressure exerted by the body of anolyte solution above the open end of the extension of the manometer leg is transferred through the gas in the leg to the indicating liquid in the U-tube.

The difficulty with such devices has been that the indicated level of the liquid within the cell was erroneous because of the added effect of the pressure of gas above the body of anolyte solution, the level of which is to be indicated, being transferred and exerted upon the indicating liquid in the manometer.

One of the objects of the present invention is to combine the functions of a liquid level indicator for an electrolytic cell with a simple feed device therefor.

Another object of the invention is to provide a liquid level indicator which gives an accurate, direct indication of the level of liquid in an electrolytic cell during the operation thereof.

A further object of the invention is to combine a liquid feed device and liquid level indicator for electrolytic cells, in which indicator the feed solution itself is the level indicating fluid.

Still another object of the invention is to provide an integrated combination of an accurate, direct reading liquid indicator with a solution feed device for use in electrolytic cells for the electrolysis of sodium chloride brine solution.

Another object of the invention is to provide a liquid level indicator for electrolytic cells which gives an accurate, direct indication of the level of the body of electrolyte solution within the cell either when the cell is operating on an electric circuit or when the circuit through the cell is broken.

These and other objects will be apparent to those skilled in the art from the discussion of the invention hereinafter and from the drawing, in which the single figure is a vertical section of the feed system and level indicator as applied to an electrolytic cell, the cell being shown in fragmentary section.

In the drawing, 1 is the cover of an electrolytic cell for the electrolysis of sodium chloride brine, to which cell brine solution 4 is fed from manifold header line 2 through take-off 6; take-off 6 leads to stream disintegrator 8, having means 12 for breaking up the continuity of the brine stream 16 and ultimately forming small discrete droplets 18; stream disintegrator 8 opens into

collector cage 14 through seal 10; collector cage 14 is in fluid connection with tube 22, supported by seal 20, which leads through conduits 24, 26, and 30 to the anolyte compartment of cell 1. Manometer 25 has tubular connector 34 at the lowermost portion thereof, to which one leg of conduit 26 is attached by means of liquid-tight seal 33; leg 36 of manometer 25 is continued and extended by means of tubes 40 and 44, entering cell 1 at 58 above the anolyte level. Leg 38 of manometer 25 is continued and extended by tubes 42 and 46 to level h immediately above an anode 50; continuations 44 and 46 of tubes 40 and 42 enter cell 1 through gas-tight seal 48.

The operation of the device of the present invention is as follows:

A sodium chloride brine solution 4 flows from manifold header 2 through take-off 6 and stream disintegrator 8 into collector cage 14; droplets 18 of the brine solution are collected at the base of cage 14 as a stream, which leaves cage 14 through tube 22; the stream passes through conduits 24, 26, and 30 into cell 1 at 32, supplementing the body of anolyte solution therein, which body of solution is maintained in cell 1 at a suitable level h' above the anodes and cathodes; an electric current passing from anode 50 through the anolyte solution causes the formation of bubbles 54 of chlorine gas, a small portion of which passes into the open end of tube 46 and displaces therefrom any anolyte solution which may have risen therein; tube 46 as shown enters the cell body vertically but may, if desired, enter at an angle from the vertical so long as the slope of tube 46 has an appreciable vertical component so that gas evolved at anode 50 may rise therein and displace any liquid anolyte which may for one reason or another have entered tube 46. A portion of the feed stream enters manometer 25 from conduit 26 through connector 34 and rises in leg 36 of manometer 25 to level e', and in leg 38, to level e.

The distance represented by A ($e'-e$) indicated by manometer 25 is equal to distance B ($h'-h$), the height of anolyte solution above the open end of tube 46, by virtue of the fact that the liquid in manometer 25 is of substantially the same specific gravity as that of the body of anolyte solution in cell 1, and moreover, by the fact that the indication given by the differential of the levels e and e' in manometer 25 equals the pressure of the hydrostatic head of solution above the open end of tube 46 (all liquid therein having been displaced by the gas evolved at anode 50), plus the pressure of the body of gas within the free space above the body of anolyte solution, minus that pressure, since it is also exerted through tubes 40 and 44 and leg 36 to the indicating liquid in manometer 25. The indication shown by manometer 25 is thereby compensated for pressure in the space above the anolyte in the cell. Therefore, only the effect of the hydrostatic pressure ($h'-h$) of the solution above the open end of tube 46 is obtained, whereby the height of the anolyte solution in cell 1 above h is obtained directly at manometer 25 as distance A.

When the manometer 25 is mounted in juxtaposition to the cell and the legs 36 and 38 thereof extend above and below the maximum and minimum liquid levels allowable in the anode compartment, the indication of the manometer is accurate whether the cell is operating "on circuit" or is "off circuit." When the cell is "off circuit," i. e. when no electric current flows from the anode to the cathode, anolyte solution gradually rises in tube 46 to the level prevailing in the anode compartment and the indicator liquid in legs 36 and 38 then assumes a common level corresponding to the actual level of the anolyte solution, since no gas is evolved from the surface of the anode to displace anolyte solution from tube 46, and since the anolyte compartment and manometer 25 are in fluid connection both as to the liquid and the gas phases therein.

Although the level indicator device is shown in the drawing in juxtaposition to an electrolytic cell, it may be situated more remotely from said cell so long as the legs 36 and 38 extend above and below the maximum and minimum levels attained by the anolyte in the cell during its operation. Preferably, however, the manometer 25 is not situated so remotely from the cell that temperature variations in the atmosphere can effect appreciable changes in the volume of gases in tubes 40 and 44 and in tubes 42 and 46, whereby erroneous deduction as to the liquid level in the cell could result. Also, the junction of conduit 26 and connector 34 may be positioned otherwise than as shown in the drawing. For example, connector 34 may be placed along either of the legs 36 and 38 of the manometer 25 above the lowermost portion thereof, so long as the entry of connector 34 into the legs is lower than the minimum liquid level therein. In addition, manometer 25 may be positioned laterally at an angle from the vertical in order to give an apparent exaggeration of the distance A and render the indication more exact and more easily perceptible at a visual angle different from the horizontal.

Where it is desired to transfer the information obtained at the manometer 25 to some place remote therefrom, translating devices, such as optical systems, electrical impulse systems, and the like, may be employed. However, the present device as shown has been found well-suited to commercial operations involving a large number of electrolytic cells within the same building, since an operator need only walk between rows of cells to make rapid and accurate observations of the level of liquid in the banks of such cells in a matter of minutes and thereby rapidly obtain a complete and accurate perspective of operating conditions obtaining throughout an entire bank of cells.

It is preferable in assembling the apparatus of the present invention that collector cage 14 be of transparent material, such as glass, synthetic transparent plastics, and the like, in order that direct observations of the disintegration of the feed stream may be had to insure isolation of the cell electrically. Likewise, legs 36 and 38 of manometer 25 are preferably of transparent materials, such as glass, transparent synthetic plastics, and the like. Also, in any variation of the device legs 36 and 38 of manometer 25 preferably extend above and below the maximum and minimum levels which the electrolyte solution in the cell attains during the course of the operation thereof, in order that an accurate visual determination of the liquid level in the cell may be made.

While there has been illustrated and described in detail an embodiment of the invention, the described invention is not intended to be understood as limiting the scope of the invention as it is realized that changes therewithin are possible and it is further intended that each element or instrumentality recited in any of the following claims is to be understood as referring to

all equivalent elements or instrumentalities for accomplishing substantially the same results in substantially the same or equivalent manner, it being intended to cover the invention broadly in whatever form its principle may be utilized.

What is claimed is:

1. An electrolyte level indicating device for an electrolytic cell including means to introduce a stream of electrolyte to the cell, and a manometer, the lower portion of which is in liquid connection with said means said manometer having a pair of pressure differential indicating legs, one of said legs terminating in said cell beneath the electrolyte level therein and above a gas-producing electrode, and the other of said legs terminating in said cell above the liquid level of said electrolyte.

2. A liquid level indicator for an electrolytic cell including a conduit mounted to feed a stream of electrolyte solution to said cell, and a U-tube manometer in liquid connection with said conduit in the lower portion of said manometer and having continuations of the arms thereof extending into said cell, one of said continuations extending into the body of solution in said cell to a region directly above the gas-evolving surface of a gas-evolving electrode and the other of said continuations extending into the free space of said cell above the liquid therein.

3. An electrolyte level indicating device for a chlorine-producing electrolytic cell including a U-tube manometer mounted in juxtaposition to said cell and extending above and below the normal liquid level to be maintained therein, continuations of the arms of said manometer extending into the interior of said cell, one of said continuations extending through the roof of said cell to below said liquid level and to a point immediately above an anode and the other of said continuations extending into the free space of the anode compartment of said cell, and a tubular member fluidly connecting the lowermost portion of said manometer and said conduit.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,808,023	Dienner	June 2, 1931
1,924,495	Gustine	Aug. 29, 1933
2,248,006	MacCallum	July 1, 1941
2,486,207	Richards	Oct. 25, 1949