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3,201,685

CONDUCTIVITY PROBE

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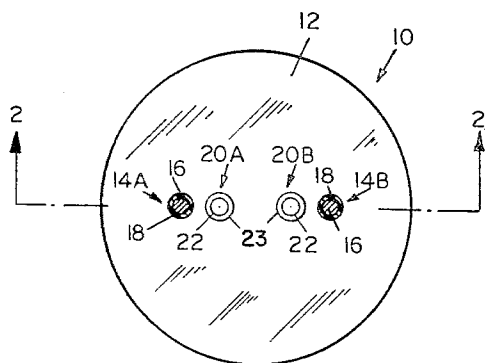


FIG. 1

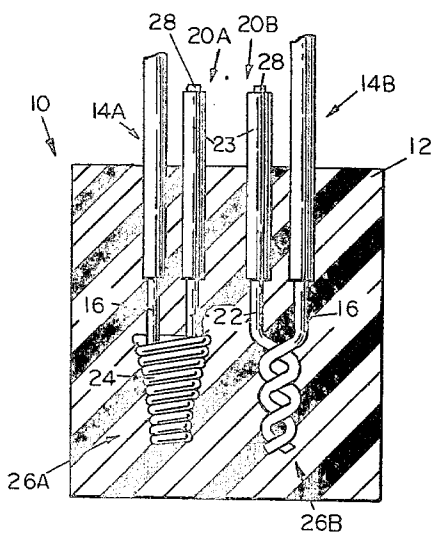


FIG. 2

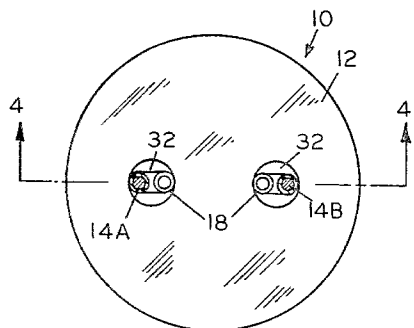


FIG. 3

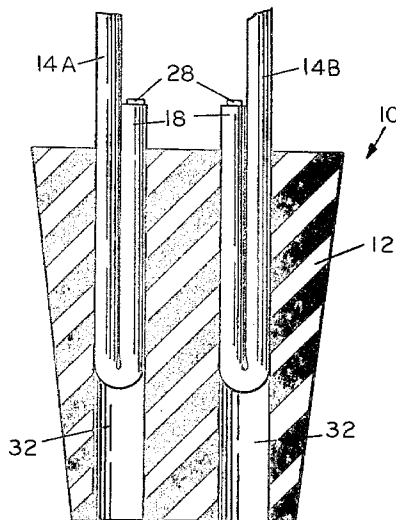


FIG. 4

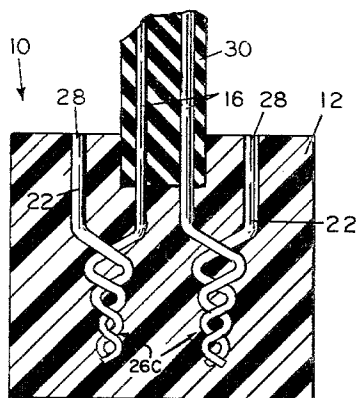


FIG. 5

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2 Claims. (Cl. 324—30)

This is a continuation in part application of Patent Number 3,134,070 issued May 19, 1964 for a "Unitary Control Device for Detecting the Minimum Levels of Concentration in A Multiplicity of Caustic Wash Solutions."

This invention relates to a conductivity probe. More particularly, the invention relates to a new and novel type of conductivity probe having improved characteristics of dependability and economy of construction.

Many industrial processes require thorough cleaning of containers, an example being bottles used to package food products. One of the most frequently used applications is that of the soft drink industry wherein bottles must be thoroughly cleaned before each reuse. The most commonly used method of cleaning bottles is by subjecting the used bottles to caustic wash solutions. The caustic solutions ordinarily vary in concentration from approximately two to five percent of caustic soda.

In order to provide efficiency of operation the concentration of the caustic solution must be carefully maintained. If the caustic concentration becomes too high there is danger of caustic carry over in the bottles which forms a type of contamination of the finished product. On the other hand, if the caustic wash solution becomes too low in concentration, effectiveness of the solution to accomplish thorough cleansing of the bottles is destroyed. Some states and municipalities have specific requirements relating to the level of concentration of caustic wash solutions which must be maintained for washing soft drink containers.

In order to accurately control the concentration of caustic wash solutions, the most effective method is by detecting the level of concentration by conductivity. This is accomplished by emersing a conductivity probe in the wash solution. Conductivity probes have been used for many years and ordinarily are constructed of metallic components supported at a spaced relationship with each other. The types of probes, however, which have been in use to the present time have serious limitations which have not adapted them for use to detect the concentration of caustic wash solutions as used in bottle washing machines.

The present types of probes are so constructed that debris, rubbish, scum and other matters, which enter or form in the caustic wash solutions as a multitude of bottles pass through the solution, frequently lodges between the metallic conductors. When this occurs, the effectiveness of the probe to measure the conductivity of the solution is drastically impaired and in many cases completely eliminated, as the conductivity measured is the resistance of the foreign matter extending across the probe points rather than the conductivity of the solution. Other types of probes have serious limitations in that the metallic elements are so positioned that the probes may easily lodge against the side of the container in which the solution is held or against other metallic elements in the container to provide a false conductivity reading. An equally important reason that the known types of probes are not readily adaptable for use in the soft drink industry is their expense. Most types of probes presently used are highly expensive and their expense retards the universal application of automatic control of caustic wash solutions.

It is therefore an object of this invention to provide a conductivity probe having characteristics such that a false

reading by the lodging of foreign matter between the metallic elements of the probe is substantially eliminated.

Another object of this invention is to provide an improved type of conductivity probe of a design such that the metallic electrodes cannot easily encounter the walls of the vessel in which the probe is placed, or other metallic components within the vessel, to provide false conductivity indications.

Another object of this invention is to provide a conductivity probe which will be exceedingly inexpensive to manufacture and assemble, a probe which utilizes readily available and inexpensive components, and a probe which does not easily lose its calibration after long use in a caustic wash solution or in other applications as a conductivity detector.

Another object of this invention is to provide a probe that is easily removed from the solution for inspection and cleaning.

These and other objects and a better understanding of the invention may be had by referring to the following description and claims taken in conjunction with the attached drawings, in which:

FIGURE 1 is a top view of one arrangement of a probe of this invention.

FIGURE 2 is a cross-sectional view taken along the line 2—2 of FIGURE 1 showing the internal construction of one arrangement of a probe according to this invention.

FIGURE 3 is a top view of a probe constructed according to another arrangement of this invention.

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 3 showing the internal arrangement of the probe of FIGURE 3.

FIGURE 5 is a cross-sectional view of an alternate embodiment of the probe of FIGURE 1 of this invention.

Referring now to the drawings and first to FIGURE 1, the top view of a probe, generally indicated by the numeral 10, is shown. The probe 10 is shown as being cylindrical, but any other external geometric configuration would be equally satisfactory. A body portion 12, which, according to the arrangement shown in FIGURE 1 and FIGURE 2, is formed of a moldable, non-conductive material inert to the solution in which the probe 10 is to be used. One frequently used process requiring probes as described in this invention is in caustic wash solutions as utilized to wash soft drink containers. A material highly successful for use in forming body portion 12 which is inert to caustic wash solutions is epoxy resin plastic. This material has the additional advantages of being inexpensive and easily and permanently molded.

Extending to probe 10 are a first and second detector conductor generally indicated by the numerals 14A and 14B. Detector conductors 14A and 14B extend from probe 10 to a circuit adaptable to utilize the conductivity as reflected by the probe 10 for making adjustments or indications. Detector conductors 14A and 14B are typically composed of an inner metallic conductor 16 covered by an insulating jacket 18. Detector conductors 14A and 14B may be a commonly used, readily available and inexpensive conductor such as thermoplastic wire, usually referred to in industry as TW type wire. Thus, metallic conductors 16 will ordinarily be of copper or aluminum and insulating jacket 18 will ordinarily be of thermoplastic. Thermoplastic is an ample insulation for detector conductors 14A and 14B when probe 10 is used in caustic wash solutions since the normal concentration utilized in bottle washing processes does not attack thermoplastic materials.

Extending upwardly out of the top of body portion 12 are conductivity conductors, generally indicated by the numerals 20A and 20B. Conductivity conductors 20A and 20B are likewise formed of an inner metallic portion

22 and an insulating jacket 23. The type of material of which metallic conductors 16 of the detector conductors 14A and 14B will ordinarily be formed, that is copper or aluminum, is readily attacked by a caustic solution and therefore is not acceptable as a type of metal to engage the solutions in which conductivity is being tested. Metallic portions 22 must of necessity be formed of a material not attacked by caustic soda solutions. This type of metallic material includes nickel, stainless steel, or even mild steel in case of the weaker types of caustic soda solutions used in bottle washing machines.

Conductivity conductors 20A and 20B will be short pieces of insulated conductors of a metal not attacked by caustic wash solutions. The arrangement whereby this is attained is best shown in FIGURE 2. A portion of the insulation around detector conductors 14A and 14B is removed exposing short lengths of metallic conductors 16. Metallic portions 22 are likewise exposed of conductivity conductors 20A and 20B and the ends are formed together to provide continuity between portions 22 and conductors 16. This may be accomplished as shown to the right of FIGURE 2 by merely twisting the conductors 16 and portions 22 together. To secure a more permanent and lower resistance contact, the twisted engagement may be soldered. Another arrangement which has proven highly satisfactory is shown at the left of FIGURE 2 and includes the use of a wire nut 24 of the type readily available on the market to secure conductors 16 and portions 22 together.

After conductors 16 and portions 22 have been joined securely together to provide continuity between the two, then the connections, generally indicated by the numerals 26A and 26B, are placed in a container which is filled with an epoxy resin. The resin solidifies, forming body 12. Body 12 serves to maintain the conductivity conductors 20A and 20B at the predetermined distance apart. Body 12 also serves to insulate connections 26 for each other and serves as a weight so that the probe 10 will remain beneath the surface of the liquid in which it is placed to detect conductivity.

Insulating jacket 23 extends above the upper surface of body 12 to within a short distance of the end of metallic portion 22 of conductivity conductors 20A and 20B. Left exposed is the tips 28 of the metallic portions 22 of conductivity conductors 20A and 20B. The resistance offered by the solution in which probe 10 is placed is measured between the tips 28 of the conductivity conductors 20A and 20B. The width between tips 28 is determinative of the total conductivity detected by the probe 10, however, the probe is designed such that the width between tips 28 cannot vary after the probe is placed into service. Electronic equipment to which detector conductors 14A and 14B connect will be designed such that calibration can be readily achieved of the probe 10 when first used to correct for any variations in the distance between tips 28.

FIGURE 5 discloses an alternate embodiment of the probe 10 of FIGURES 1 and 2. In this embodiment a duplex conductor 30 having two metallic conductors 16 therein extends within the body 12 of the probe 10. Non-reactive metallic portions 22 are affixed at connections 26C to metallic conductors 16 and extend to at least the upper surface of the body portion 12 where the tip ends 28 measure the conductivity of the liquid contacted.

The embodiment of FIGURE 2 provides an arrangement whereby the tips 28 which engage the liquid being tested are shielded by detector conductors 14A and 14B from engaging the sides of any vessel in which the probe 10 may be placed. In like manner, the arrangement of FIGURE 5 is such as to substantially preclude any possibility of the tips 28 contacting any metallic components of the container or other equipment. Duplex conductor 30 positioned between tips 28 serves to shield the tips 28 from being contacted by a foreign substance, such as pa-

per, scum, straws, or any other element which may find itself in the caustic wash solution which would provide a false conductivity reading.

Some of the advantages of the probe disclosed in FIGURES 1, 2 and 5 may not be readily apparent. The construction as described permits the use of rather inexpensive and flexible metal conductors 14A and 14B, or, as in FIGURE 5, a duplex conductor 30 leading from the probe 10 to electronic control devices. At the same time this construction requires only short, therefore inexpensive, portions of the more expensive and less flexible types of conductivity conductors 20A and 20B, such as Monel, mild steel, or stainless steel, which are not attacked by caustic soda solutions. The provision of a probe 10 having exposed metal conductors 20A and 20B which will not corrode in the presence of caustic solutions means frequent cleansing of the probe is eliminated and that less frequent recalibration of the control mechanism is required. The probe 10 is very inexpensive to manufacture and assemble, also it is exceedingly sturdy.

An alternate embodiment of the invention is shown in FIGURE 3 and FIGURE 4. FIGURE 3 is a top view showing a body portion 12 having two holes 32 formed therein. As can be seen in FIGURE 4, each of the holes 32 receives a bent doubled detector conductor 14A and 14B. Tips 28 are exposed by removal of a small portion of the insulating jacket 18.

The configuration of the probe 10 of FIGURE 3 and FIGURE 4 does not require the change of conductors from one type, such as copper, to another type, such as Monel, stainless steel or mild steel. This means, however, that the probe of FIGURES 3 and 4 to be effective will be required to utilize entire lengths of this type of conductor. This has certain disadvantages in that most of the types of conductors which are not attacked by caustic wash solutions are less flexible and are more expensive than copper conductors. Body 12 may be formed of a readily available rubber cork having two holes 32 formed therein, or non-conductive material as is shown in FIGURE 2 and FIGURE 5. Positioning the tips 28 between conductors 14A and 14B attains the advantages enumerated for the embodiment of FIGURE 2 by the substantial lessening of any chance of a false conductivity reading occurring in the probe.

This invention provides a probe which is many times less expensive than other types of probes on the market and which combines advantages substantially eliminating the possibility of error in conductivity detection. This invention also provides a probe that is easily removed from the caustic solution for inspection and cleaning.

Although this invention has been specifically described as a probe utilized in caustic wash solutions, this is by way of example only of a specific application of the invention and it can be seen that the novel probe of this invention may be utilized in many other applications.

Although this invention has been described with a certain degree of particularity, it is manifested that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure.

I claim:

1. A conductivity probe for use in detecting the conductivity of a chemical solution, comprising, a body of inert insulating material; a first and a second metallic conductivity conductor supported within said body, said conductivity conductors composed of a metal chemically inert to said solution, said first and second metallic conductivity conductors each having an end portion extending beyond the exterior surface of said body in spaced relationship with each other adaptable for contacting said solution; and first and second insulated detector conductors each having one end extending within said body in juxtaposed relationship to said metallic conductivity conductors, said detector conductors having a metal core covered with an insulating cover, and said metal core of

5

said first detector conductor electrically contacting said first metallic conductivity conductor within said body and said metal core of said second detector conductor electrically contacting said second metallic conductivity conductor within said body, said insulated detector conductors and said conductivity conductors extending from the same surface of said body and substantially in the same plane.

2. A conductivity probe for use in detecting the conductivity of a chemical solution, comprising, a body of resilient inert material, said body having first and second holes formed therein parallel to each other and in a spaced relationship to each other; a first insulated conductor having an exposed end, said conductor sharply bent near said exposed end thereof to form a double portion whereby a short portion of said conductor extends back contiguous to the length of said conductor, said doubled portion of said first conductor inserted into

6

and resiliently retained in said first hole; and a second insulated conductor having an exposed end and said second insulated conductor in like manner sharply bent near said exposed end thereof to form a doubled portion whereby a short portion of said conductor extends back contiguous to the length of said conductor, said doubled portion of said second conductor inserted into and resiliently retained in said second hole of said body whereby said exposed ends of said first and second conductors are supported adjacent each other.

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