



US005613399A

United States Patent [19]

[11] Patent Number: 5,613,399

Hannan et al.

[45] Date of Patent: Mar. 25, 1997

[54] METHOD FOR LIQUID LEVEL DETECTION

FOREIGN PATENT DOCUMENTS

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103321	3/1984	European Pat. Off.	73/304 C
538182	4/1993	European Pat. Off.	73/304 C
2662249	11/1991	France	73/304 C
58-123431	7/1983	Japan	
381911	5/1973	U.S.S.R.	73/304 C
748138	7/1980	U.S.S.R.	
2066961A	7/1981	United Kingdom	
2074325A	10/1981	United Kingdom	73/304 C

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[21] Appl. No.: 422,859

[22] Filed: Apr. 17, 1995

Related U.S. Application Data

[62] Division of Ser. No. 143,834, Oct. 27, 1993, Pat. No. 5,406,843.

[51] Int. Cl.⁶ G01F 23/26

[52] U.S. Cl. 73/304 C; 364/509

[58] Field of Search 73/304 C, 292; 364/509

[56] References Cited

U.S. PATENT DOCUMENTS

2,519,668	8/1950	Konigsberg	
2,544,012	3/1951	Edelman	
2,621,517	12/1952	Sontheimer	
2,638,000	5/1953	Sontheimer	
2,648,058	8/1953	Breedlove	
2,651,940	9/1953	Kline	
2,751,531	6/1956	Barrett	
2,866,337	12/1958	Minneman et al.	
2,868,015	1/1959	Haropulos	
3,343,415	9/1967	Johnston	
3,391,547	7/1968	Kingston	
3,534,606	10/1970	Stamler et al.	
3,552,209	1/1971	Johnston	
3,620,080	11/1971	Ryder	
3,935,739	2/1976	Ells	73/304 C
4,086,528	4/1978	Walton	73/304 C
4,173,893	11/1979	Hedrick	73/304 C
4,235,106	11/1980	Maltby et al.	73/304 C
4,258,422	3/1981	Dougherty et al.	364/509
4,266,144	5/1981	Bristol	73/304 C
4,350,039	9/1982	van Dyke et al.	73/304 C

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[57] ABSTRACT

A digital liquid level sensing apparatus and method for detecting variations in the dielectric of a substance being sensed. The apparatus includes a capacitive element array which is disposed in a fluid to be measured and which includes a plurality of individual (i.e., segmented) input plates positioned along an axis of measurement of the fluid to be detected. The array also includes a common output plate having a length sufficient to span the entire accumulated length of the input plates. A controller sequentially applies DC excitation pulses to the input plates which cause a series of output currents to be coupled onto the output plate. The output currents are input to a current-to-voltage amplifier which generates a series of corresponding analog output voltages. The analog output voltages are then input to a peak voltage detector circuit to generate a series of peak voltage signals representative of the magnitudes of the analog output voltages. The controller converts each of the peak voltage signals into a corresponding digital value and stores each of the digital values in an on-board memory. The controller then sequentially compares each of the values against at least one predetermined reference value indicative of an output produced by an input plate disposed in air until a predetermined difference is detected between the reference value and any one of the stored digital values. This indicates a predetermined difference in the dielectric, thus indicating that a corresponding input plate is at least partially submerged in fluid.

(List continued on next page.)

3 Claims, 3 Drawing Sheets

