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(54) **Kapacitív nyomásmérő cella a cellával szomszédos közeg nyomásának mérésére**

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CAPACITATIVE PRESSURE MEASUREMENT CELL FOR DETECTING THE PRESSURE OF A MEDIUM ADJACENT TO THE MEASUREMENT CELL

The invention relates to a capacitive pressure measurement cell for recording the pressure of a medium adjacent to the measurement cell according to the preamble of Patent Claim 1.

Such pressure measurement cells are known and are used in many fields of process engineering for process monitoring. In order to measure the pressure of a medium adjacent to the measurement cell the measurement cell has an elastic measurement membrane that is deflected in accordance with the pressure within the medium, wherein the deflection or reversible deformation of the membrane is electromechanically converted into a corresponding electrical measurement signal. As capacitive electromechanical converter, a measurement electrode arranged on the side of the measurement membrane facing away from the medium together with a counter electrode arranged opposite on a base body forms a measurement capacitor, of which the capacitance changes depending on the pressure-induced deflection of the measurement membrane. The measurement membrane together with the base body forms a measurement chamber that is pressure-tight with respect to the medium.

In the case of these capacitive pressure measurement cells there is the problem that, with a medium with rapidly changing temperatures, measurement errors occur as the pressure is measured, since the measurement membrane is in direct contact with the medium and is therefore influenced by temperature fluctuations thereof.

It is known that the temperature or slow temperature changes of the base body are determined by measuring the ambient temperature of said base body and that the measured pressure value is corrected in accordance with these measured temperature values. With a large temperature difference between the measurement membrane and the base body of the pressure measurement cell, in particular if the temperature of the medium changes quickly or suddenly, this correction method nevertheless leads to a faulty jump of the calculated measured pressure value, which only returns slowly to the correct measured value as the entire pressure measurement cell is warmed through slowly.

Furthermore, in order to determine a temperature-compensated measured pressure value, it is known to measure both the temperature of the base body of the pressure measurement cell and the temperature of the measurement membrane thereof and to compensate for the measured pressure value by means of these two measured temperature values.

For example, a capacitive pressure measurement cell is known from DE 40 11 901 A1, in which a resistance path made of a material with temperature-dependent resistance is arranged on the measurement membrane, wherein this resistance path is placed in a circular manner around the circular measurement electrode forming a capacitor plate of the measurement capacitor, such that the resistance path runs only in the edge region of the measurement membrane. It has been found, however, that the arrangement of the resistance path in the edge region cannot correctly record the temperature of the measurement membrane, since the edge region of the measurement membrane cools quickly on account of a temperature dissipation into the adjacent housing parts and leads to a measurement error.

Proceeding from this prior art the object of the present invention is to specify a pressure measurement cell of the type mentioned in the introduction, which allows a temperature measurement of the measurement membrane of a pressure measurement cell with greater measurement accuracy compared to the prior art.

This object is achieved by a pressure measurement cell having the features of Patent Claim 1.

Such a capacitive pressure measurement cell for recording the pressure of a medium adjacent to the pressure measurement cell, which has an elastic measurement membrane, whose first side is at least partially in contact with the medium, and whose second side, facing away from the medium, has a measurement electrode, as well as a resistor element made from a substance with temperature-dependent resistance, for measuring temperature, and which comprises a base body with counter electrode forming a measurement capacity together with the measurement electrode, said base body being positioned opposite the second side of the measurement membrane, is characterised in accordance with the invention by the fact that the resistor element is designed as a resistance layer between the second side of the measurement membrane and the measurement electrode.

The advantage of such a pressure measurement cell according to the invention lies in that practically the entire available area of the measurement membrane can be used for the resistance layer and the temperature conditions over the entire measurement membrane are thus recorded in the temperature measurement, leading to just low temperature errors.

Furthermore, it has been found with this pressure measurement cell according to the invention that a rapid or abrupt temperature change of the medium can be detected just as quickly and directly.

The production of such a resistance layer is possible with the same process as the production of the measurement electrode, wherein the two layers are separated from one another by means of an insulating layer. In order to produce the measurement electrode and the resistance layer, the same substance can be used, for example gold, or different substances can be used, for example gold for the measurement electrode and platinum/platinum compounds for the resistance layer.

It is particularly advantageous in accordance with one embodiment of the invention if the resistance layer and the measurement electrode are primarily designed as being congruent to each other. Both the measurement electrode and the resistance layer can thus both be produced with the same mask.

Furthermore, in accordance with one embodiment of the invention the resistance layer is structured, preferably structured in a meandering pattern. The insulating layer is then used at the same time as a planarisation layer of the structured resistance layer, such that the measurement electrode can be applied to the planar insulating layer.

Lastly, it is advantageous if the measurement membrane and/or the base body is/are made from a ceramic material.

The pressure measurement cell according to the invention can be used advantageously to construct pressure transducers.

The invention will be explained hereinafter on the basis of exemplary embodiments with reference to the accompanying figures.

In the figures:

Figure 1 shows a schematic sectional illustration of a pressure measurement cell as an exemplary embodiment according to the invention,

Figure 2 shows an enlarged detail from Figure 1,

Figure 3 shows a first exemplary embodiment of a structured resistance layer, and

Figure 4 shows a second exemplary embodiment of a structured resistance layer.

This capacitive measurement cell 1 comprises a measurement chamber 6 formed from a ceramic base body 3 and from a measurement membrane 2 also made of ceramic. In order to produce the pressure-tight measurement chamber 6, the measurement membrane 2 and the base body 3 are spaced apart at the edge via a spacer 3a made for example of glass, glass solder or a glass alloy, and are interconnected.

By means of its outer first side 2a, the measurement membrane 2 is in contact with a medium of which the pressure is to be measured by the measurement cell 1. The inner second side 2b of the measurement membrane 2 is covered by a resistance layer 4 made of a substance with temperature-dependent resistance. This resistance layer 4 is either formed over the entire area and in a circular manner or is structured, for example structured in a meandering pattern. Connection lines 4a, 4b are guided at the edge via the spacer 3a and the base body 3 to an electronics unit (not illustrated). The resistance layer 4 heats the measurement membrane 2 accordingly, with the result of a resistance value that changes in accordance with the temperature of the measurement membrane 2 and that is evaluated as a measured value in order to determine the temperature of the measurement membrane.

A measurement electrode 7 is arranged on the resistance layer 4 centrally with an insulating layer arranged between. In accordance with Figure 1 this measurement electrode 7 is formed with a diameter smaller than the diameter of the resistance layer 4, wherein both the measurement electrode 7 and the resistance layer 4 protrude as far as the region of the spacer 3a and the respective connection lines 4a, 4b or 7a thereof are guided in the glass solder layer. In the present exemplary embodiment the resistance layer 4 is formed with a larger base area than the area of the measurement electrode 7, i.e. the resistance layer 4 protrudes beyond the measurement electrode 7 in the radial direction. This has the advantage that the respective layer can be contacted directly without additional line guidance.

However, the layer of the measurement electrode 4 and the resistance layer 4 can also be produced congruent to each other.

If the resistance layer 4 is structured in a meandering pattern, the insulating layer is used at the same time as a planarisation layer of the resistance layer 4, such that the measurement electrode 7 can be applied to this planarised resistance layer 4. The connection lines 4a, 4b of the resistance layer 4 can be arranged for example on radially opposite sides and can be guided through the glass seam 7a.

In a further embodiment, which is not illustrated here in greater detail, the resistance layer 4 can also be formed with a base area that is selected to be smaller than the area of the measurement electrode 7 and is arranged at a distance from the peripheral glass seam 7a. In this case a temperature averaging can be achieved via a central region of the measurement membrane 2, wherein an influence of an installation arrangement that is thermally more inert due to its greater mass compared with the measurement membrane 2 is masked out.

This measurement electrode 7, together with a circular counter electrode 8 arranged on the opposite surface of the base body 3, forms a measurement capacitor, of which the measured capacitance is dependent on the deflection of the measurement membrane 2 caused by the media pressure. The counter electrode 8 is surrounded by an annular reference electrode 9, which together with the measurement electrode 7 forms a reference capacitor, of which the reference capacitance is practically constant due to the position of said reference capacitor on the outer edge of the measurement chamber 6, in which the measurement membrane demonstrates substantially no deflection. The measurement electrode 7, the counter electrode 8 and also the reference electrode 9 are each connected via connection lines 7a, 8a and 9a to an electronics unit (not illustrated) of the measurement cell 1.

Figure 2 shows an enlarged detail from Figure 1 in the region of the connection lines of the resistance layer 4.

Figure 2 shows particularly clearly a layered structure formed of measurement electrode 7, insulating layer 10, resistance layer 4 and measurement membrane, As shown in Figure 2, both the measurement electrode 7 and the resistance layer 4 are formed as far as the radially arranged glass seam, which also serves as a spacer 7a. In this way it is possible that both the measurement electrode 7 and the resistance layer 4 can be contacted by connection lines 7a, 4a, 4b running perpendicularly thereto in the glass seam.

It can also be seen clearly from Figure 2 that the insulating layer 10 protrudes beyond the measurement electrode 7 in the radial direction, such that the measurement electrode 7 is reliably insulated with respect to the resistance layer 4.

In Figure 2 it is also illustrated as a further possibility that the second connection line 4b for temperature measurement can be connected internally to the measurement electrode 7, such that the temperature measurement can take place between the electrodes 7a and 4a. There is thus no need to guide out the connection line 4b.

Figure 3 shows a first exemplary embodiment of a resistance layer 4 as can be used in the sensor from Figures 1 and 2, in plan view.

In the exemplary embodiment from Figure 3 the metallization for the resistance layer 4 is formed over the entire area and has a U-shaped recess for producing a sufficiently long current path and therefore a sufficiently large resistance, within which recess the second connection conductor 4b is arranged, protruding into said recess in a tongue-like manner.

Figure 4 shows a further exemplary embodiment of a resistance layer 4 in plan view, wherein the resistance layer 4 in this embodiment is formed in a meandering pattern on a circular base area. Due to the provision of a plurality of meanders or loops, a much longer current path and therefore also a much greater resistance to the temperature measurement can be produced compared with the exemplary embodiment from Figure 3. In the exemplary embodiment from Figure 4 the connection conductors 4a, 4b of the resistance layer are arranged on radially opposite sides of the resistance layer 4, but can also be guided directly side by side through the spacer 7a, for example by a conductive track running in the peripheral direction as illustrated in Figures 1 and 2.

In the case of this measurement cell 1 the pressure measurement signals generated by the measurement capacitor and afflicted by measurement errors are corrected or compensated for by means of the temperature values determined from the temperature-dependent measured resistance values of the resistance layer 4, in accordance with a predefined algorithm.

Reference signs

1	pressure measurement cell
2	measurement membrane
2a	first side of the measurement membrane 2
2b	second side of the measurement membrane 2
3	base body
3a	spacer
4	resistance layer
4a	first connection line of the resistance layer 4
4b	second connection line of the resistance layer 4
6	measurement chamber of the pressure measurement cell 1
7	measurement electrode
7a	connection line of the measurement electrode 7
8	counter electrode
8a	connection line of the counter electrode
9	reference electrode
9a	connection line of the reference electrode

KAPACITÍV NYOMÁSMÉRŐ CELLA A CELLÁVAL SZOMSZÉDOS KÖZEG NYOMÁSÁNAK MÉRÉSÉRE

Szabadalmi igénypontok

1. Kapacitív nyomásmérő cella (1) egy a nyomásmérő cellával (1) szomszédos közeg nyomásának mérésére, amelynek van

– rugalmas mérőmembránja (2), amely mérőmembrán első oldala (2a) legalább részben a közeggel érintkezik, továbbá amely mérőmembrán közeggel átellenes második oldala (2b) mérőelektróddal (7), valamint hőmérsékletméréshez hőmérsékletfüggő ellenállással rendelkező anyagból kialakított ellenálláselemmel rendelkezik, továbbá

– egy a mérőmembrán (2) második oldalával (2b) szemben elrendezett, a mérőelektróddal (7) mérőkapacitást képező ellenelektróddal (8) ellátott alapteste (3),

azzal jellemezve, hogy

az ellenálláselem a mérőmembrán (2) második oldala (2b) és a mérőelektród (7) közötti ellenállásrétegként (4) van kiképezve.

2. Az 1. igénypont szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy az ellenállásréteg (4) és a mérőelektród (7) egymással lényegében egybevágón vannak kialakítva.

3. Az 1. vagy a 2. igénypont szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy az ellenállásréteg (4) strukturált.

4. A 3. igénypont szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy az ellenállásréteg (4) kígyóvonalszerűen strukturált.

5. Az előző igénypontok bármelyike szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy a mérőmembrán (2) és/vagy az alaptest (3) kerámiaanyagból van/vannak előállítva.

6. Az előző igénypontok bármelyike szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy az ellenállásréteg (4) a mérőelektród (7) felületénél nagyobb alapfelülettel van kialakítva.

7. Az 1-5. igénypontok bármelyike szerinti nyomásmérő cella (1), **azzal jellemezve**, hogy az ellenállásréteg (4) a mérőelektród felületénél kisebb alapfelülettel van kialakítva, ahol az ellenállásréteg körülfutón kialakított üvegvarrattól sugárirányban távközzel elválasztva van kialakítva.

8. Nyomás-mérőátalakító, melynek egy az előző igénypontok bármelyike szerinti nyomásmérő cellája (1) van.

Fig. 1

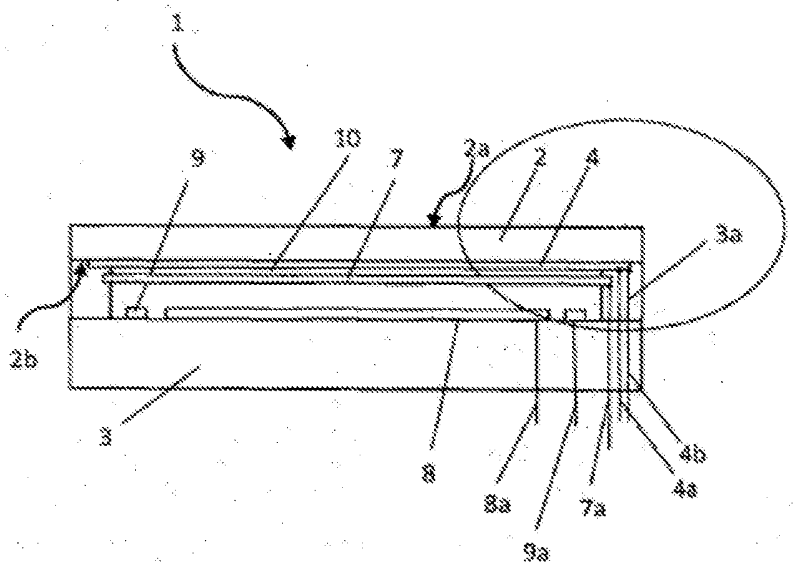

Fig. 2

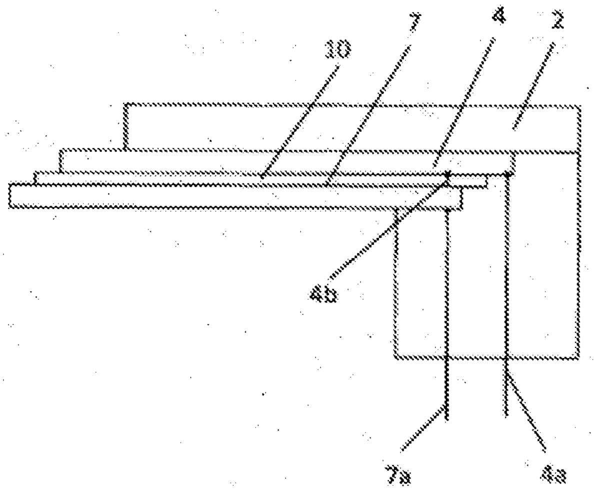

Fig. 3

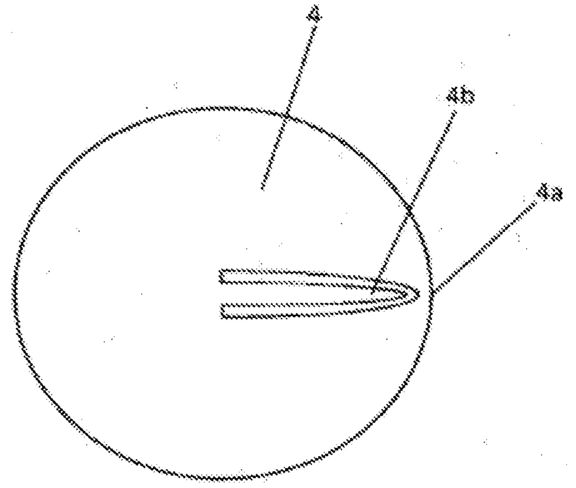

Fig. 4