Embodiments~~An object~~ of the invention ~~is to~~ provide an apparatus for determining at least one process variable of a medium as well as a method, with either of which, or both, apparatus and/or method, it is possible, moreover, to determine the process temperature in a simple manner.

According to a first aspect, there is provided an apparatus for determining fill level, density, viscosity, or pressure of a medium in a container or in a pipeline, comprising: an essentially tubular sensor housing, wherein one of the two ends of the sensor housing is embodied as a membrane; an oscillatable element placed on the outside of the membrane, which oscillatable element forms an oscillatable unit with the membrane; a driving/receiving unit; a nose, which is arranged as a contact piece between the driving/receiving unit and the membrane, and which contacts the membrane at the contact location; a clamping apparatus, which presses the driving/receiving unit toward the membrane; and a control/evaluation unit; wherein the driving/receiving unit excites the oscillatable unit to mechanical oscillations, and wherein the control/evaluation unit evaluates the amplitude, frequency, and/or phase of the oscillations of the oscillatable unit; and the nose and the membrane are embodied in such a manner that they form a thermocouple; wherein the nose and the membrane are necessary components of the apparatus for determining the process variable and which contact at a contact location, which is exposed to a process temperature T_p, wherein the nose comprises a first material and has a first connection line, which contacts the nose with a first end region; the membrane comprises a second material and has a second connection line, which contacts the membrane with

a first end region; a second end region of the first connection line and a second end region of the second connection line are led to a temperature determining unit, which is exposed to a reference temperature T_{ref}; the first material and the second material are selected and matched to one another in such a manner that at the contact location between the first material and the second material a thermovoltage U_{th} dependent on the difference between the process temperature T_p and the reference temperature T_{ref} arises; and the temperature determining unit measures the thermovoltage U_{th} and determines the process temperature T_p therefrom.

According to a second aspect, there is provided a method for determining a process temperature T_p with a measuring device for determining fill level, density, viscosity, or pressure in a container or a pipeline, which measuring device comprises an essentially tubular sensor housing, wherein one of two ends of the sensor housing is embodied as a membrane; an oscillatable element placed on the outside of the membrane, which oscillatable element forms with the membrane an oscillatable unit; a driving/receiving unit; a nose, which is arranged between the driving/receiving unit and the membrane as a contact piece, and contacts the membrane at the contact location; a clamping apparatus, which presses the driving/receiving unit toward the membrane; and a control/evaluation unit; wherein the driving/receiving unit excites the oscillatable unit to execute mechanical oscillations, and wherein the control/evaluation unit evaluates amplitude, frequency, and/or phase of the oscillations of the oscillatable unit, and a thermocouple is formed by the nose and the membrane; wherein the nose and the

membrane are necessary components of the measuring device for determining the process variable and which contact at a contact location, which is exposed to the process temperature T_p, wherein the nose is manufactured from a first material M1 and the membrane is manufactured from a second material; the nose is contacted with a first connection line and the membrane is contacted with a second connection line; the connection lines are led to a temperature determining unit, which is exposed to a reference temperature T_{ref}; the first material and the second material are selected and matched to one another in such a manner that a thermovoltage U_{th} forms between the nose of the first material and the membrane of the second material, which thermovoltage U_{th} is dependent on the difference between the process temperature T_p and the reference temperature T_{ref}; the thermovoltage U_{th} is measured in the temperature determining unit; and the process temperature T_p is determined from the thermovoltage U_{th}.

An embodiment of the apparatus of the invention discloses~~The object relative to apparatus is achieved by features including~~ that the first element comprises a first material and has a first connection line, which contacts the first element with a first end region, that the second element comprises a second material and has a second connection line, which contacts the second element with a first end region, that a second end region of the first connection line and a second end region of the second connection line are led to a temperature determining unit, which is exposed to a reference temperature T_{ref}, that the first material and the second material are selected and matched to one another in such a manner that at the contact location between the first material and the second

material a thermovoltage U_{th} dependent on the difference between the process temperature T_p and the reference temperature T_{ref} arises, and that the temperature determining unit measures the thermovoltage U_{th} and determines the process temperature T_p therefrom.

The required elements for temperature measurement are thus mainly components of the measuring device already present,

supplemented by connection wires or contact lines in order to enable the measuring of the thermovoltage. The materials of two suitable components of the measuring device are selected in such a manner that a thermovoltage between them results. This is proportional to the temperature difference between the process temperature and the reference temperature and dependent on the difference of the Seebeck coefficients of the materials. If the reference temperature and the process temperature are identical, the thermovoltage is zero. Thus, no temperature measuring element is introduced separately into the measuring device, but, a thermocouple is formed from components already present and necessary for the functioning of the measuring device.

In an~~a first~~ embodiment of the invention, the second material is stainless steel and the first material is essentially a nickel chromium compound.

In another~~a preferred~~ embodiment of the invention, the apparatus is a fill level measuring device for determining and/or monitoring a limit fill level of a medium in a container or a pipeline, including: an essentially tubular sensor housing, wherein one of the two ends of the sensor housing is embodied as a membrane; an oscillatable element placed on the outside of the membrane, which oscillatable element forms an oscillatable unit with the membrane; a driving/receiving unit; a nose, which is arranged as a contact piece between the driving/receiving unit and the membrane and contacts the membrane at the contact location; a

the sensor housing, which offers enough space, lying behind the clamping apparatus.

In another embodiment~~an additional further development~~ of the invention, the nose and the first connection line are manufactured from a first material, which has a first Seebeck coefficients a1, and the membrane and the second connection line are manufactured from a second material, which has a second Seebeck coefficients a2, wherein a1 is different from a2. The Seebeck coefficient is a material constant having the units, voltage over temperature. The thermovoltage, which can form between two materials, depends on the difference of these values, i.e. the larger the difference $|a1-a2|$, the larger the measurement effect.

Another embodiment~~A further development~~ of the invention provides that the temperature determining unit is arranged on the side of the clamping apparatus facing away from the driving/receiving unit. As a rule, the electronics of the measuring device are located here. Within the sensor housing, especially on the side facing away from the process, the temperatures arising generally lie within a limited range compared to the range, in which the process temperatures lie. The temperature determining unit is, thus, protected from very high process temperatures, which could negatively influence its functional ability.

In an embodiment, the temperature determining unit is integrated in the control/evaluation unit. For example, it is, in such case, a microcontroller having an integrated temperature sensor.

In an additional embodiment, the driving/receiving unit comprises piezoelectric elements and the first connection line is led through the clamping apparatus together with the contact lines of the piezoelectric elements. There are known embodiments, in which the contact lines of the piezoelectric elements are applied on a flexible circuit board. The connection line is, in this case, preferably embodied as an additional conductive trace on the same circuit board.

Furthermore, an embodiment of the invention relates to a method for determining the process temperature using a measuring device for determining a process variable different from temperature in a container or a pipeline, which measuring device includes at least one first element and a second element, which are necessary components of the measuring device for determining the process variable and which are in contact at a contact location exposed to the process temperature T_p.

An embodiment of the method of the invention discloses ~~The object, as regards the method, is achieved by features including~~ that the first element is manufactured from a first material M1 and the second element is manufactured from a second

material M2, the first element is contacted with a first connection line and the second element is contacted with a second connection line, the connection lines are led to a temperature determining unit, which is exposed to a reference temperature T_{ref}, the first material and the second material are selected and matched to one another in such a manner that a thermovoltage U_{th} forms between the first element of the first material and the second element of the second material, which thermovoltage U_{th} is dependent on the difference between the process temperature T_p and the reference temperature T_{ref}, the thermovoltage U_{th} is measured in the temperature determining unit, and the process temperature T_p is determined from the thermovoltage U_{th}.

In an embodiment of the method of the invention, the first material and the second material are selected in such a manner that their Seebeck coefficients differ from one another.

In another~~an especially advantageous~~ embodiment of the method for determining the temperature, a vibronic fill level measuring device is used, comprising: an essentially tubular sensor housing, wherein one of the two ends of the sensor housing is embodied as a membrane; an oscillatable element placed on the outside of the membrane, which oscillatable element forms an oscillatable unit with the membrane; a driving/receiving unit; a nose, which is arranged as a contact piece between the driving/receiving unit and the membrane and contacts the

membrane at the contact location; a clamping apparatus, which presses the driving/receiving unit toward the membrane; and a control/evaluation unit; wherein the driving/receiving unit excites the oscillatable unit to execute mechanical oscillations, and wherein the control/evaluation unit evaluates amplitude, frequency, and/or phase of the oscillations of the oscillatable unit; and a thermocouple is formed from the nose and the membrane.

Embodiments of the~~The~~ invention will now be explained in greater detail based on the appended drawing, the figures of which show as follows:

Fig. 1 a representation of a sectional illustration of a detail of a fill level measuring device;

Fig. 2 a schematic representation of the measuring principle.

As an example of an embodiment of the invention, a section through the process-side end region of the fill level measuring device 1 having an oscillatable unit is presented schematically in Fig. 1. The oscillatable unit is formed by the membrane 4 and an oscillatable element 3 formed as a oscillatory fork solidly connected to membrane 4. Membrane 4 is a part of the sensor housing 2 and closes the process-side end region. Oscillatable element 3, sensor housing 2 and membrane 4 are